SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA, 682013

Curriculum and Syllabi

Under the discipline

ZOOLOGY

For Undergraduate (Honours) Degree Programmes

Introduced from 2024-25 admissions onwards

Prepared by

Board of Studies in Zoology

Sacred Heart College (Autonomous), Thevara, Kochi.

BOARD OF STUDIES IN ZOOLOGY
SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI, KERALA

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1. INTRODUCTION

The National Education Policy (NEP) 2020 envisages the revision of the Choice Based Credit System (CBCS) for instilling innovation and flexibility. It emphasizes on promoting interdisciplinary studies, introducing new subjects, and providing flexibility in courses and fresh opportunities for students. It also envisages setting up of facilitative norms for issues, such as credit transfer, equivalence etc., and a criterion-based grading system that assesses student achievement based on the learning goals for each programme.

The NEP document suggests several transformative initiatives in higher education. These include:

- Introduction of holistic and multidisciplinary undergraduate education that would help develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, ethical and moral - in an integrated manner; soft skills, such as complex problem solving, critical thinking, creative thinking, communication skills; and rigorous specialization in a chosen field (s) of learning.
- Adoption of flexible curricular structures in order to enable creative combinations of disciplinary areas for study in multidisciplinary contexts in addition to rigorous specialization in a subject
- Undergraduate degree programmes of either 3 or 4-year duration.
- The students are getting a chance to determine his/her own semester-wise academic load and will be allowed to learn at his/her pace, to the extent possible.
- Increase in the number of choices of courses available to students and the students are getting an opportunity to choose the courses of their interest from all disciplines.
- Multidisciplinary and holistic education with emphasizes on research, skill development and higher order thinking,
- Promotion of innovation and employability of the student.
- Flexibility for the students to move from one institution to another as per their choice.
- Flexibility to switch to alternative modes of learning (offline, ODL, and online learning, and hybrid modes of learning).

Outcome Based Education (OBE)

Undergraduate courses in Zoology follow the Outcome-based Education (OBE) framework. OBE is a system where all the parts and aspects of education are focused on the outcomes of the course. The students take up courses with a certain goal of developing skills or gaining knowledge and they have to complete the goal by end of the course. Outcome-based education affirms teachers as facilitators, rather than lecturers. In this model, teachers guide the students and encourage them to develop their knowledge and skills. The undergraduate courses at the Department of Zoology, Sacred Heart College (Autonomous), Thevara provides a learning approach in which students develop analytical ability and critical thinking and research acumen over different situations.

Programme Outcomes:

The Undergraduate Programme Outcomes (POs) are as follows:

PO 1: Critical thinking and Analytical reasoning

- Critical thinking guides the assessment and judgment of information, while analytical reasoning involves specific methods for analysis and conclusion drawing. It includes the ability to assess evidence, identify assumptions, formulate coherent arguments, understand complex relationships, and evaluate practices and theories critically. Additionally, critical sensibility involves self-awareness and reflection on personal and societal experiences.

PO 2: Scientific reasoning and Problem solving

- Capacity to interpret and draw conclusions from data, critically evaluate ideas and evidence with an open-minded perspective; ability to apply learned competencies to solve unfamiliar problems and apply knowledge to real-life situations, avoiding mere replication of curriculum content.

PO 3: Effective communication and leadership skill

- Proficiency in expressing thoughts verbally and non-verbally, utilizing appropriate communication media. Confidently sharing ideas, active listening, analytical reading and writing and presenting complex information clearly to diverse groups. Effective teamwork and leadership skills, including setting direction, inspiring vision, building and motivating teams, and guiding them efficiently towards common goals.

PO 4: Social consciousness and responsible citizenship

- Social consciousness involves an empathetic and informed perspective, extending beyond personal concerns to embrace a responsibility for the collective good in nation-building. It includes reflecting on the impact of research on conventional practices and a clear understanding of societal needs for inclusive and sustainable development. Responsible citizens contribute positively through civic engagement, environmental stewardship, and a commitment to social justice, abiding by laws and working for the advancement of society.

PO 5: Equity, Inclusiveness and Sustainability

- Promoting equity, inclusiveness, sustainability, and diversity appreciation. Developing ethical and moral reasoning with values of unity, secularism, and national integration for dignified citizenship. Understanding and appreciating diversity, managing differences, and using an inclusive approach. Emphasizing creating environments where diverse individuals feel valued, addressing present needs without compromising future generations' ability to meet their own needs, considering environmental, economic, and social factors.

PO 6: Moral and Ethical Reasoning

- Possessing the capacity to embody moral and ethical values in personal conduct, articulating positions and arguments on ethical matters from diverse perspectives, and consistently applying ethical practices in all endeavours. Proficient in recognizing and addressing ethical issues pertinent to one's work, steadfastly steering clear of any unethical behaviour.

PO 7: Networking and Collaboration

- Cultivating networking skills in education entails establishing meaningful professional connections and relationships among educators, administrators, and stakeholders. It also involves fostering cooperative efforts among individuals, institutions, and research organizations within the educational realm. These practices are indispensable for nurturing a supportive, innovative, and dynamic learning environment.

PO 8: Lifelong Learning

- Cultivating the ability to continually acquire knowledge and skills, including the art of "learning how to learn," becomes paramount for lifelong learning. This self-paced and self-directed approach serves personal development, aligns with economic, social, and cultural objectives, and facilitates adaptation to evolving workplace demands through skill development and reskilling. It equips individuals with competencies and insights, allowing them to adeptly respond to society's changing landscape and enhance their overall quality of life. Lifelong learning extends beyond formal education, embracing diverse informal and non-traditional learning experiences.

2. REGULATIONS FOR UNDERGRADUATE (HONOURS) DEGREE PROGRAMMES

PREAMBLE

Sacred Heart College (Autonomous), Thevara, Kochi is a grant-in-aid private college affiliated to Mahatma Gandhi University, Kottayam, Kerala. The College was established in 1944 as a higher educational institute for men on the basis of the minority rights. It started admitting girls in 1975 and currently serves all sections of the society without any discrimination of caste or creed.

The College was granted Autonomous Status by the University Grants Commission (UGC) in 2014.

Vision and Mission of the Institution

The vision of the College aims at the formation of holistic individuals who would champion the cause of justice, love, truth and peace. To this effect, Sacred Heart College envisions the **"Fashioning of an enlightened society founded on a relentless pursuit of excellence, a secular outlook on life, a thirst for moral values as well as an unflinching faith in God."** It seeks the creation of a world, guided by divine wisdom, governed by moral principles, inclusive by secular outlook and united by the principle of equity.

The Mission of the Institution is to provide an environment that

- **facilitates the holistic development of the individual**
- **enables the students to play a vital role in the nation-building process and contribute to the progress of humanity**
- **disseminates knowledge even beyond the academia**
- **instils in the students a feel for the frontier disciplines, and**
- **cultivates a concern for the environment**

by setting lofty standards in the ever-evolving teacher-learner interface.

Framing of the Regulations

As part of the implementation of the National Education Policy 2020 (NEP 2020), the University Grants Commission (UGC) has issued the Curriculum and Credit Framework for Undergraduate Programmes 2023 (CCFUP) which would provide a flexible choice-based credit system, multidisciplinary approach, multiple entry and exit options, and establish three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).

The Kerala Higher Education Reforms Commission has recommended a comprehensive reform in the undergraduate curriculum for the 2023-24 academic year, adopting 4-year undergraduate programs to bring Kerala's undergraduate education at par with well acclaimed universities across the globe.

The Kerala State Curriculum Committee for Higher Education has been constituted, and have proposed a model Kerala State Higher Education Curriculum Framework (KSHECF) for Undergraduate Education.

Further, an Academic Committee and various sub committees were constituted for the implementation of the Regulations. The Academic Committee submitted the draft regulations on

15-03-2024, namely**: THE SACRED HEART COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SHC-UGP (Honours)}** under the New Curriculum and Credit Framework, 2024.

REGULATIONS

Short Title and Commencement

i. These Regulations may be called THE SACRED HEART COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SHC-UGP (Honours)} under the New Curriculum and Credit Framework 2024.
ii. These Regulations will come into effect from the academic year 2024-2025 and will have prospective effect.

Scope and Application

iii. These Regulations shall apply to all Undergraduate programmes under various Faculties conducted by THE SACRED HEART COLLEGE (AUTONOMOUS) for the admissions commencing in the academic year 2024-2025.
iv. Every programme conducted under the SHC-UGP shall be monitored by an SHC-UGP Academic Committee comprising members nominated by the Principal.

Definitions

Unless used in a context otherwise specified,

i. College means THE SACRED HEART COLLEGE (Autonomous), a grant-in-aid private college affiliated to Mahatma Gandhi University, Kottayam, Kerala.
ii. 'University' means the MAHATMA GANDHI University which is the affiliating University of Sacred Heart College (Autonomous).
iii. FYUGP means Four Year Undergraduate Programme.
iv. Academic Year: Two consecutive (one odd and one even) semesters followed by a vacation in one academic year.
v. Academic Coordinator/Nodal Officer: Academic Coordinator/Nodal Officer is a faculty nominated by the college council to co-ordinate the effective conduct of the FYUGP including Continuous Comprehensive Assessment (CCA) undertaken by various departments within the college. She/ he/ they shall be the convenor for the College level Academic Committee.
vi. Academic Week: A unit of five working days in which the distribution of work is organized, with at least five contact hours of one-hour duration on each day.
vii. Academic Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. It is defined both in terms of student efforts and teacher's efforts. A course which includes one hour of lecture or tutorial or minimum 2 hours of lab work/ practical work/ field work per week is given one credit hour. Accordingly, one credit is equivalent to one hour of lecture or tutorial or two hours of lab work/ practical work/ field work/ Practical and learner engagement in terms of course related activities (such as seminars preparation, submitting assignments, group discussion, recognized club-related activities etc.) per week. Generally, a one credit course in a semester should be designed for 15 hours Lecture/ tutorials or 30 hours of practical/ field work/ Practical and 30 hours learner engagement.

viii. Academic Bank of Credits (ABC): An academic service mechanism as a digital/ virtual entity established and managed by Government of India to facilitate the learner to become its academic account holder and facilitating seamless learner mobility, between or within degree-granting Higher Education Institutions (HEIs) through a formal system of credit recognition, credit accumulation, credit transfers and credit redemption to promote distributed and flexible process of teaching and learning. This will facilitate the learner to choose their own learning path to attain a Degree/ Diploma/ Certificate, working on the principle of multiple entry and exit, keeping to the doctrine of anytime, anywhere, and any level of learning.

ix. Credit Accumulation: The facility created by ABC in the Academic Credit Bank Account (ABA) opened by the learner across the country in order to transfer and consolidate the credits earned by them by undergoing courses in any of the eligible HEIs.

x. Credit Recognition: The credits earned through eligible/ partnering HEIs and transferred directly to the ABC by the HEIs concerned.

xi. Credit Redemption: The process of commuting the accrued credits in the ABC of the learner for the purpose of fulfilling the credits requirements for the award of various degrees. Total credits necessary to fulfil the criteria to get a degree shall be debited and deleted from the account concerned upon collecting a degree by the learner.

xii. Credit Transfer: The mechanism by which the eligible HEIs registered with ABC are able to receive or provide prescribed credits to individual's registered with ABA in adherence to the UGC credit norms for the course(s) registered by the learner in any HEIs within India.

xiii. Credit Cap: Maximum number of credits that a student can take per semester, which is restricted to 30.

xiv. Continuous Comprehensive Assessment (CCA): The mechanism of evaluating the learner by the course faculty at the institutional level.

xv. End Semester Evaluation (ESE): The mechanism of evaluating the learner at the end of each semester.

xvi. Audit Course: a course that the learner can register without earning credits, and is not mandatory for completing the SHC-UGP. The student has the option not to take part in the CCA and ESE of the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is eligible for a pass in that course, without any credit (zero-credit).

xvii. Courses: refer to the papers which are taught and evaluated within a programme, which include lectures, tutorials, laboratory work, studio activity, field work, project work, vocational training, viva, seminars, term papers, presentations, assignments, self-study, group discussion, internship, etc., or a combination of some of these elements.

xviii. Choice Based Credit System (CBCS) means the system wherein students have the option to select courses from the prescribed list of courses.

xix. College-level Academic Committee: Is a committee constituted for the FYUGP at the college level comprising the Principal as the Chairperson, the Academic Co-ordinator/ Nodal Officer as its convenor.

xx. Academic Co-ordinator/ Nodal Officer: A senior faculty member nominated by the college council.

xxi. Course Faculty: A faculty member nominated by the Head of the Department shall be in charge of offering a particular course in a particular semester of FYUGP.

xxii. Department means any teaching department in a college offering a course of study approved by the College as per the regulations of the college and it includes a

Department, Centre, or School of Teaching and Research conducted directly by the College.

xxiii. Board of Studies (BoS) means the academic body duly constituted to frame the syllabus of each department.

xxiv. Senior Faculty Advisor (SFA) is a faculty nominated by a Department Council to co-ordinate all the necessary work related to FYUGP undertaken in that department, including the continuous comprehensive assessment.

xxv. Department Council means the body of all teachers of a department in a college.

xxvi. Faculty Adviser (FA) means a teacher from the parent department nominated by the Department Council to advise students in academic matters.

xxvii. Graduate Attributes means the qualities and characteristics to be obtained by the graduates of a programme of study at the College, which include the learning outcomes related to the disciplinary areas in the chosen field of learning and generic learning outcomes. The College will specify graduate attributes for its programmes.

xxviii. Programme means the entire duration of the educational process including the evaluation leading to the award of a degree.

xxix. Programme Pathway: Combination of courses that can be chosen by a student that give options to pursue interesting and unconventional combinations of courses drawn from different disciplinary areas, like the sciences and the social sciences/ humanities. The pathways could be in terms of major- minor options with different complementary/ allied disciplines.

xxx. Regulatory Body means University Grants Commission (UGC), All India Council for Technical Education (AICTE), National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA) etc.

xxxi. Signature Courses: Signature courses are the specialized Discipline Specific Elective courses or skill-based courses designed and offered by the regular/ ad hoc/ visiting/ emeritus/ adjunct faculty member of a particular college with the prior recommendation of the BoS and the approval of Academic Council of the College.

xxxii. Letter Grade or simply 'Grade' in a course is a letter symbol (O, A+, A, B+, B, C, P, F, and Ab). Grade shall mean the prescribed alphabetical grade awarded to a student based on their performance in various examinations. The Letter grade that corresponds to a range of CGPA.

xxxiii. Grade Point: Each letter grade is assigned a 'Grade point' (G) which is an integer indicating the numerical equivalent of the broad level of performance of a student in each course. Grade Point means point given to a letter grade on 10-point scale.

xxxiv. Semester Grade Point Average (SGPA) is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a semester by the total number of credits in that semester. SGPA shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxxv. Credit Point (P) of a course is the value obtained by multiplying the grade point (G) by the credit (C) of the course: $P = G \times C$

xxxvi. Cumulative Grade Point Average (CGPA) is the value obtained by dividing the sum of credit points in all the semesters earned by the student for the entire programme by the total number of credits in the entire programme and shall be rounded off to two decimal places.

xxxvii. Grade Card means the printed record of students' performance, awarded to them.

xxxviii. Words and expressions used and not defined in this regulation, but defined in the Mahatma Gandhi University Act and Statutes, being the Act and Statues of Sacred

Heart College (Autonomous)'s affiliating University shall have the meaning assigned to them in the Act and Statutes.

Features and Objectives of SHC-UGP

The features and objectives of the SHC-UGP shall be:

v. The features, meaning, and purpose of FYUGP shall be as stipulated by the UGC and as adapted by the Kerala State Higher Education Curriculum Framework (KSHECF) for undergraduate education.

vi. The practice of lateral entry of students to various semesters exists, but an exit with a Degree shall be awarded only upon successful completion of 133 credits as per the conditions stipulated in this regulation.

vii. FYUGP shall have three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).

viii. Students who choose to exit after 3 years shall be awarded UG Degree in their respective Discipline/ Disciplines after the successful completion of the required minimum Courses with 133 credits.

ix. A 4-year UG Degree (Honours) in the Discipline/ Disciplines shall be awarded to those who complete the FYUGP with a specific number of Courses with 177 credits including 8 credits from a graduate project/ dissertation in their major discipline.

x. Students who acquire minimum 75% in their graduation (upto 6th semester) are eligible for Honours with Research Programme. However if necessary, College may conduct screening test for the honours with research programme in accordance with College Regulations from time to time.

xi. 4-year UG Degree (Honours with Research): Students who aspire to pursue research as a career may opt for 4-year UG Degree Honours with Research stream under FYUGP with a specific number of Courses with 177 credits including 12 credits from a research project in their major discipline.

xii. The recognized research departments or departments with at least two faculty members having PhD shall offer the Honours with Research programme. Minimum 2 students (mentees) should be allotted to a faculty member (Mentor).

xiii. Students who have chosen the honours with research stream shall do their entire fourth year under the mentorship of a mentor.

xiv. The mentor shall prescribe suitable advanced level/capstone level courses for a minimum of 20 credits to be taken within the institutions along with the courses on research methodology, research ethics, and research topic-specific courses for a minimum of 12 credits which may be obtained either within the institution or from other recognized institutions, including online and blended modes.

xv. Students who have opted for the honours with research should successfully complete a research project under the guidance of the mentor and should submit a research report for evaluation. They need to defend successfully the research project to obtain 12 credits under a faculty member of the College. The research shall be in the Major/ allied discipline.

xvi. The research outcomes of their project work may be published in peer-reviewed journals or presented at conferences or seminars or patented.

xvii. The proposed FYUGP curriculum comprises Three Broad Parts: a) Foundation Components, b) Discipline Specific Pathway components (Major/ Minor), and c) Discipline Specific Capstone Components.

xviii. The Foundation component of the FYUGP shall consist of a Set of General Foundation Courses and a Set of Discipline Specific Foundation Courses.

xix. General Foundation Courses shall be grouped into 4 major baskets as Ability Enhancement Courses (AEC), Skill Enhancement Courses (SEC), Value Addition Courses (VAC), and Multi-Disciplinary Courses (MDC).

xx. Ability Enhancement Courses shall be designed specifically to achieve competency in English, other languages as per the student's choice with special emphasis on language and communication skills.

xxi. English or other language courses shall be designed to enable the students to acquire and demonstrate the core linguistic skills, including critical reading, academic and expository writing skills as well as the cultural and intellectual heritage of the language chosen. Separate courses will be designed for Science, Humanities and Commerce streams.

xxii. Multi-Disciplinary Courses (MDC) shall be so designed as to enable the students to broaden their intellectual experience by understanding the conceptual foundations of Science, Social Sciences, Humanities, and Liberal Arts. Students shall not be eligible to take the MDC in the same discipline that they have studied during their +2. Third semester MDC can be Kerala specific content.

xxiii. Skill Enhancement Courses (SEC) shall be designed to enhance 21st century workplace skills such as creativity, critical thinking, communication, and collaboration.

xxiv. Discipline Specific Courses shall include Discipline Specific Pathway Courses, both Major and Minor streams, enabling students to gain basic knowledge in the chosen discipline.

xxv. Discipline Specific Foundation Courses shall focus on foundational theories, concepts, perspectives, principles, methods, and critical thinking essential for taking up advanced/ Capstone Courses. Practical courses shall be included in discipline specific foundation courses.

xxvi. The curriculum of the SEC should be designed in a manner that at the end of year-1, year-2, year-3, and year-4 students are able to meet the level descriptors for levels 5, 6, 7, and 8 of the UGC Guidelines on National Skills Qualifications Framework (NSQF). The detailed descriptors of the NSQF levels is provided as **Appendix I** below.

xxvii. Value Addition Courses (VAC) shall be so designed as to empower the students with personality development, perspective building, and self-awareness.

xxviii. Discipline Specific Pathway Components (Major/ Minor) shall provide the students with an opportunity to pursue in-depth study of a particular subject or discipline and develop competency in that chosen area, which includes Discipline Specific Core (DSC) courses and Discipline Specific Elective (DSE) courses as Major and Minor courses.

xxix. Major components consist of three types: Discipline Specific Core or the Discipline Specific Elective Courses, and the research /laboratory/ fieldwork.

xxx. Minor Courses can be selected from any discipline that may supplement or complement the Major Courses.

xxxi. Students who complete a sufficient number of Courses in a discipline or an interdisciplinary area of study other than their chosen Major shall qualify for a Minor in that discipline or in a chosen interdisciplinary area of study.

xxxii. Major Components shall be the main focus of study. By selecting a Major, the student shall be provided with an opportunity to pursue an in-depth study of a particular discipline.

xxxiii. Each Board of Studies (BoS) shall identify specific Courses or baskets of Courses towards Minor Course credits. Students shall have the option to choose Courses from

disciplinary/ interdisciplinary minors and skill-based courses related to a chosen programme.

xxxiv. Students can opt for a change of Major at the end of the second semester to any Minor discipline studied among the foundation level courses. Students also can opt for a change of Major at the end of the second semester to any MDC.

xxxv. Students should opt their 5th and 6th semester VAC and SEC from their Major disciplines only.

xxxvi. Course cum Credits Certificate: After the successful completion of a semester as proof for re-entry to another institution this certificate is essential. This will help the learner for preserving the credits in the Academic Bank of Credits.

xxxvii. The Advanced Level/ Capstone Level Courses shall be designed in such a manner as to enable students to demonstrate their cumulative knowledge in their main field of study, which shall include advanced thematic specialization or internships or community engagement or services, vocational or professional training, or other kinds of work experience.

xxxviii. Advanced/ Capstone level Major Specialization shall include Courses focused on a specific area of study attached to a specific Major, which could be an Elective Course. They shall include research methodology as well.

xxxix. The student has the option to register for and attend a course without taking part in the CCA and ESE of that course. Such a course is called the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is/are eligible for a pass in that course, without any credit (zero-credit). The Audit Course will be recorded in the final grade card of the student.

xl. All students shall undergo Summer Internship or Apprenticeship in a Firm, Industry or Organization; or Training in labs with faculty and researchers or other Higher Education Institutions (HEIs) or Research Institutions. The College will adhere to the guidelines on internship published by the University.

xli. Students will be provided the opportunities for internships with local industries, business organizations, agriculture, health and allied sectors, Local Government institutions (such as panchayats, municipalities), State Planning Board, State Councils/ Boards, Research Institutions, Research Labs, Library, elected representatives to the parliament/ state assembly/ panchayat, media organizations, artists, crafts persons etc. These opportunities will enable the students to actively engage with the practical aspects of their learning and to improve their employability.

xlii. The College will provide opportunities for field-based learning/minor projects enabling them to understand the different socio-economic and development-related issues in rural and urban settings. The College will provide the students with opportunities for Community engagement and services, exposing them to socio-economic issues to facilitate theoretical learning in real-life contexts.

xliii. Additional Credits will be awarded for those who actively participating in Social Activities, which may include participation in National Service Scheme (NSS), Sports and Games, Arts, participation in College union related activities (for respective elected/ nominated members), National Cadet Corps (NCC), adult education/ literacy initiatives, mentoring school students, and engaging in similar social service organizations that deemed appropriate to the College.

xliv. Grace marks shall be awarded to a student for meritorious achievements in co-curricular activities (in Sports/ Arts/ NSS/ NCC etc.). Such a benefit is applicable in the same academic year spreading over two semesters, in which the said meritorious

achievements are earned. The Academic Council will decide from time to time the eligibility and other rules of awarding the grace marks.

xlv. Options will be made available for students to earn credit by completing quality-assured remote learning modes, including Online programmes offered on the Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) or other Online Educational Platforms approved by the competent body/university from time to time.

xlvi. Students shall be entitled to gain credits from courses offered by other recognized institutions directly as well as through distance learning.

xlvii. For the effective operation of the FYUGP, a system of flexible academic transaction timings shall be implemented for the students and teachers.

Eligibility for Admission and Reservation of Seats

i. The eligibility for admissions and reservation of seats for various FYUG Degree Programmes shall be in accordance with the norms/ rules made by the Government/ University from time to time.

ii. No student shall be eligible for admission to FYUG Degree Programmes in any of the disciplines unless he/she/they has successfully completed the examination conducted by a Board/University at the +2 level of schooling or its equivalent.

iii. Students shall be admitted and enrolled in the respective programmes solely based on the availability of the academic and physical facilities within the institution. The College shall provide all students with a brochure detailing the Courses offered by the various departments under the various Programmes and the number of seats sanctioned by the University for each Programme.

iv. During the time of admission each student may be provided with a unique higher education student ID which may be linked with the Aadhar number of the student so that this ID can be transferred if required to other higher education institutions as well.

v. The students at the end of second semester may be permitted to change their major programme of study to any course/ institution/ university across the state. Based on the availability of seats and other facilities, the students may be permitted to opt any discipline which he/she/they had studied during the first two semesters as Discipline Specific Foundation courses/ Multidisciplinary Foundation courses. If ranking is required it will be in the order of the highest-grade points secured in the discipline to which the switching of Major is sought.

vi. Students shall be allowed to change their major programmes, if required, to a maximum of 10% of the sanctioned strength of that particular programmes depending upon the academic and infrastructural facilities available in the Institution.

vii. Depending upon the availability of academic and infrastructural facilities, the College may also admit a certain number of students who are registered for particular programmes in each semester by transfer method, if required, from other Institutions subject to conditions as may be issued by the University.

viii. A student who has already successfully completed a First-Degree Programme and is desirous of and academically capable of pursuing another First-Degree Programme may also be admitted with the prior approval of the University as per the conditions regarding programme requirements specified by the University.

ix. A Student can also be admitted for an additional major/ second major/ additional minor and on completion of the required credits he/she/they can be awarded a second major/ additional major/ minor. He/she/they may be exempted from minor pathway and general foundation course requirement.

x. The College can also enroll students in certain courses as per their choice depending upon the availability of infrastructure and other academic facilities from other recognized HEIs who are already registered for a particular programme there either through regular/ online/ distance mode irrespective of the nature of programme (Govt./ Aided/ Self- finance/ Autonomous). On successful completion of the course the credits may be transferred through the Academic Bank of Credit.

Academic Monitoring and Student Support

The academic monitoring and student support shall be in the following manner, namely

i. The College shall appoint a Senior Faculty member as Academic Co-ordinator/ Nodal officer for the smooth conduct of FYUGP.
ii. Advisory System: There shall be one Senior Faculty Advisor (SFA) for each department and one Faculty Advisor (FA) for 20 to 30 students of the class to provide advice in all relevant matters. The Head of the Department, in consultation with the SFA, shall assign FA for each student.
iii. The documents regarding all academic activities of students in a class shall be kept under the custody of the FA/ SFA.
iv. All requests/ applications from a student or parent to higher offices are to be forwarded/ recommended by FA/ SFA.
v. Students shall first approach their FA/ SFA for all kinds of advice, clarifications, and permissions on academic matters.
vi. It is the official responsibility of the institution to provide the required guidance, clarifications, and advice to the students and parents strictly based on the prevailing academic regulations.
vii. The SFA shall arrange separate or combined meetings with FA, faculty members, parents, and students as and when required and discuss the academic progress of students.
viii. The FA/ SFA shall also offer guidance and help to solve the issues on academic and non-academic matters, including personal issues of the students.
ix. Regular advisory meetings shall be convened immediately after the commencement of the semester and immediately after announcing the marks of the Continuous Comprehensive Assessment (CCA).
x. The CCA related results shall be displayed on the department notice board/ other official digital platforms of the college at least for two working days.
    a. Any concern raised by the students regarding CCA shall be looked into in the combined meetings of advisors, HOD, course faculty, and the students concerned.
    b. If the concerns are not resolved at the advisor's level, the same can be referred to the properly constituted college-level grievance redressal committees as per the existing UGC/ University/ Government norms.
    c. The Principal/ HOD shall ensure the proper redressal of the concerns raised by the students regarding CCA.
    d. If the students raise further concerns about the issue, the principal shall refer the issue to the appropriate authorities with proper documents and minutes of all the committees.
xi. The FA/ SFA shall be the custodian of the minutes and action taken reports of the advisory meetings. The SFA shall get the minutes and action taken reports of advisory meetings approved by the Head of Department and the Principal.

xii. The Principal shall inform/forward all regulations, guidelines, communications, announcements, etc. regarding student academic and other matters to the HODs/ SFA for information and timely action.

xiii. It shall be the official responsibility of the Principal to extend the required administrative and financial support to the HODs, SFAs and FAs to arrange necessary orientation programmes for students regarding student counselling, the prevailing norms, regulations, guidelines and procedures on all academic and other related matters.

xiv. An integrated educational planning and administration software will be made available by the College to manage the academic information of all students including student admissions and registration, managing students' personal and academic information, course registrations, attendance management, all process related to assessments including regular & online examinations, grading, publishing of results, supplementary examinations, LMS, stakeholders' feedback, etc.

xv. Faculty, staff, students, and parents shall be allowed to access this software system over a highly secure authenticated mechanism from within the campus.

Course Registration

i. Each department shall publish well in advance the relevant details of courses offered, such as the name, academic level, expected outcomes, time slot, and course faculty members.

ii. Students shall be allowed to visit and interact with respective faculty members during the first week of each semester, to gather more information about the courses and the availability of seats.

iii. Based on consultations and advice from the faculty adviser, each student shall complete course registration within one week from the commencement of each semester.

iv. The number of credits that a student can take in a semester is governed by the provisions in these Regulations, subject to a minimum of 16 and a maximum of 30 Credits.

v. A student can opt out of a Course or Courses registered, subject to the minimum Credit/ Course requirement, if he/she/they feels that he/she/they has registered for more Courses than he/she/they can handle, within 30 days from the commencement of the semester.

vi. The college shall publish a list of the students registered for each course including audit course, if any, along with the chosen Programmes, repeat/ reappearance courses, if any.

vii. The higher education institutions shall admit candidates not only for programmes, but also for courses.

Re-admission and Scheme Migration

i. Students who opt out before the completion of the third year shall be provided with a 'Course cum Credits Certificate' after the successful completion of a semester as proof for re-entry to another institution.

ii. Students who have successfully completed a particular programme pathway may be permitted to take an additional minor or second major.

iii. Those students who are opting for a second major are eligible for getting certain credit transfer/ credit exemption from their previous minor programs of study, subject to the prior recommendation of the BoS that, those credits are relevant for the present major programme of study.

Duration of Programme, Credits, Requirements and Options

i. Students will be offered the opportunity to take breaks during the programme and resume after the break, but the total duration for completing the FYUG programme shall not exceed 7 years.
ii. Students who wish to complete the undergraduate programmes faster may do so by completing different courses equivalent to the required number of credits and fulfilling all other requirements in N-1 semesters, where N is the number of semesters in the FYUGP.
iii. Provided further that the students may complete the undergraduate programme in slower pace, they may pursue the three years or six semester programme in 4 to 5 years (8 to 10 semesters), and four years, or eight semester programme in 5 to 6 years (10 to 12 semesters) without obtaining readmission.
iv. For students who crossed 6 semesters at a slower space, the requirement of 16 credits per semester from the institutions where they enrolled may be relaxed.

Credit Structure

The proposed number of credits per course and the credit distribution of them for the FYUG Programmes are given below:

i. An academic year shall consist of 200 working days; one semester consists of 90 working days; and an academic year consists of two semesters.
ii. Ten working days in a semester shall be used for extracurricular activities. One semester consists of 18 weeks with 5 working days per week. In each semester, 15 days (3 weeks) should be kept aside for End Semester Evaluation (ESE) and CCA.
iii. The maximum number of available weeks for curriculum transactions should be fixed at 15 in each semester. A minimum of 5 teaching or tutorial hours could be made available for a day in a 5-day week.
iv. A course that includes one hour of lecture/ tutorial or two hours of lab work/ practical work/ field work/ Practical per week is given one credit hour.
v. One credit in a semester should be designed for 15 hours of lectures/ tutorials or 30 hours of lab work/ practical work/ field work/ Practical and 30 hours of learner engagement in terms of course-related activities such as seminar preparation, submitting assignments, etc.
vi. A one-credit seminar or internship or studio activities or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).
vii. A course can have a combination of lecture credits, tutorial credits, and Practical credits.
viii. Minimum credit for one Course should be 2 (Two), and the maximum credit should be 4 (Four).
ix. All Discipline Specific Major/ Minor Courses shall be of 4 (Four) credits.
x. For all Discipline Specific Major/ Minor Courses, there may be practical/ Practical of two or four hours per week.
xi. All Courses under the Multi-Disciplinary, Ability Enhancement, Value Addition and Skill Enhancement categories are of 3 credits.
xii. Summer Internship, Apprenticeship, Community outreach activities, etc. may require sixty hours (or as appropriate) of engagement for acquiring one credit.
xiii. A student shall be able to opt for a certain number of extra credits over and above the requirements for the award of a degree.
xiv. Maximum number of credits that a student can earn per semester shall be restricted to 30. Hence, a student shall have the option of acquiring credits to a maximum of 180 credits for a 6-semester UG programmes and 240 credits for a 4-year (8-semester) programmes.

xv. Each faculty member shall offer a maximum of 16 credits per semester. However those who are offering both practical and theory courses shall offer a maximum of 12-16 credits per semester.

xvi. For a four-credit theory course, 60 hours of lecture/ tutorial class shall be assured as a mandatory requirement for the completion of that course.

Course Structure of the SHC-UGP Programme

The SHC-UGP consists of the following categories of courses and the minimum credit requirements for pathway option-one shall be as follows;

Sl. No.	Categorization of Courses for all Programme	Minimum Number of Credit Required	
1.	Major	68	88
2.	Minor	24	24+12*
3.	Multi-Disciplinary Courses (MDC)	9	9
4.	Skill Enhancement Courses (SEC)	9	9
5.	Ability Enhancement Courses (AEC)	12	12
6.	Value Addition Courses (VAC)	9	9
7.	Summer Internship, field based learning etc.	2	2
8.	Research Project / Dissertation		12/8**

* The students can acquire advanced/ capstone level courses with 12 credits from their DSC/ DSE/ Minor courses depending up on their pathway choice. The Minor courses can be of level 300 or above.

** The students pursuing the 4-year honours with research have to complete a project with 12 credits and for the 4-year honours degree students have to complete a project with 8 credits and DSC/ DSE capstone/ advanced level course in the 8th semester.

i. 20% syllabus of each course will be prepared by the teacher as 'Teacher Specific Content' and will be evaluated under CCA.

ii. In case of MDC, SEC, VAC courses coming under 3rd & 4th semester, college should make necessary arrangements to give adequate preference to courses designed by language departments. MDC in the 3rd semester can be Kerala Specific Content.

Academic Levels of Pathway Courses

Semester	Difficulty level	Nature of Course
1 & 2	100-199	Foundation-level or introductory courses
3 & 4	200-299	Intermediate level courses
5 & 6	300-399	Higher level courses
7 & 8	400-499	Advanced/Capstone level courses

Signature Courses

i. With a prior recommendation of BoS and the approval of academic council, each faculty member can design and offer at least one signature course in every semester, which may be offered as DSE /SEC/ VAC.
ii. The College will publish a list of signature courses in DSE/ SEC/ VAC offered by the faculty members with a prior recommendation of BoS and the approval of academic council.
iii. The College may empanel distinguished individuals who have excelled in their field of specialization like science and technology, industry, commerce, social research, media, literature, fine arts, civil services etc. as adjunct faculty as per the UGC guidelines with the approval of the College. With a prior recommendation of BoS and the approval of academic council, the adjunct faculty can offer SEC/VAC as signature course.
iv. Ad hoc/ Guest faculty/ Visiting faculty/ Visiting Scholars can also offer DSE/ SEC/ VAC as signature courses with a prior recommendation of BoS and the approval of academic council.
v. The faculty concerned may design the particular course and it should be forwarded to the concerned BoS after the approval of the Academic Committees formed as part of this regulations.
vi. The examinations and evaluation of the signature courses designed by the faculty shall be conducted by the faculty themselves and an external expert faculty chosen by the college from a panel of experts submitted by the faculty and recommend by the BoS concerned.

Programme Pathways and Curriculum Structure

Students who have joined for any programme under these regulations shall have the option to choose the following pathways for their UG degree and Honours programme.

i. **Degree with single Major**: A student pursuing the FYUG programme in a specific discipline shall be awarded a Major degree if he secures at least 50% of the total credits in the specific discipline required for the award of the Degree in that Discipline. Example: Physics Major/ Economics Major/ Commerce Major
ii. **Degree Major with Minor**: If a student pursuing the FYUG Programme is awarded a Major Degree in a particular discipline, he/she/they are eligible to be awarded a Minor in another discipline of his choice, if he earns a minimum of 32 credits (approximately 25% of credit required for the three-year programme) from 8 pathway courses in that discipline. Example: Physics Major with Chemistry Minor/ Chemistry Major with English Minor/ Commerce Major with Economics Minor/ English Major with Functional English Minor/ Hindi Major with Malayalam Minor etc.
iii. **Major with Multiple Disciplines** of Study: This pathway is recommended for students who wish to develop core competencies in multiple disciplines of study. In this case, the credits for the minor pathway shall be distributed among the constituent disciplines/ subjects. If a student pursuing FYUG Degree Programme is awarded a major Degree in a particular discipline, he/she/they are eligible to get mentioned his core competencies in other disciplines of his choice if he has earned 12 credits from the pathway courses of that discipline. Example: Physics Major with Minors in Chemistry and Mathematics, Economics Major with Minors in History and English, Commerce Major with Minors in Economics and Statistics.
iv. **Interdisciplinary Major**: For these programme pathways, the credits for the major and minor pathways shall be distributed among the constituent disciplines/subjects to attain core

competence in the interdisciplinary programme. Example: Econometrics Major, Global Studies Major, Biostatistics Major.

v. **Multi-Disciplinary Major**: For multidisciplinary major pathways, the credits for the major and minor pathways will be distributed among the broad disciplines such as Life Sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc. Example: Life Science, Data Science, Nano Science.

vi. **Degree with Double Major**: A student who secures a minimum of 50% credits from the first major will be awarded a second major in another discipline if he could secure 40% of credit from that discipline for the 3-year/ 4-year UG degree to be awarded a double major degree. Example: Physics and Chemistry Major, Economics and History Major, Economics and History Major, Commerce and Management Major.

Pathway Option 1 - Degree Major or Major with Multiple Disciplines of Study

Course Components	No. of Courses								
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Re**
DSC A (4 Credit /Course)	1(P)	1(P)	3 (2P)	3 (2P)		5	4	17	7 Out o opte
DSC B & C (4 Credit /Course)	2(P)	2(P)	1(P) (B or C)	1(P) (C or B)				6	
Multidisciplinary Courses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recor that the offered to Indi Knowl System areas.
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4	
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1**	1**	3	*Reco that th may b by the Depart ** Fro
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1**	3	*Reco that or offer E Depar one Lar Dep ** Fro
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours									
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total C**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit op availa**

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Pathway Option 2 - Major with Minor

Course Components	No. of Courses								
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Rema**
DSC A (4 Credit /Course)	1(P)	1(P)	3 (2P)	3 (2P)		4	3	15	7 Out of 1 be opte DSE
DSC B (4 Credit /Course)	2(P)	2(P)	1(P)	1(P)		1	1	8	1 Out of be opted as
Multidisciplinary Courses (MDC)/ (3 Credit /Course)	1(P)	1(P)	1*					3	*Recom d that th course o be relate Indian Knowled Systems allied ar
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (Englis h) 1 (OL)	1 (Englis h) 1 (OL)						4	
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1**	1**	3	*Recomm that the may be by the E Depart ** From onl
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1**	3	*Recom d that on be offer the En Depart and on Oth Langu Depart ** From only
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours									
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total C**

									13
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit op availa**

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Pathway Option 3 - Double Major

Course Components	**No. of Courses**								
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Rema**
DSC A (4 Credit /Course)	1(P)	1 (P)	2(2P)	2(1P)		4	3	13	7 Out of 13 be opted DSE
DSC B (4 Credit /Course)	2(P)	2(P)	2(1P)	2(2P)		1	1	10	2 Out of 1 be opted as
Multidisciplinary Courses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recomme that the co offered be related to I Knowledge Systems or allied areas
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English) 1 (OL)	1 (English) 1 (OL)						4	
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1	1	3	*Recomm that the c may be of by the En Departm
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1	3	*Recomm d that one be offere the Eng Departme one by C Langua Departm
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours									
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**	

Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Cr**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit o ava**

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Note: In all the above 3 tables "(P)" means courses with practical

Guidelines for Acquiring Credit from Other Institutions/Online/Distance Mode

i. A student shall register to a minimum of 16 credit per semester from the college/ department where he/she/they officially admitted for a particular programme. However, students enrolled for a particular programme in one institution can simultaneously enroll for additional credits from other HEIs within the University or outside University subject to a maximum of 30 credits per semester including the 16 institutional credits.
ii. The College shall publish a list of courses that are open for admission for students from other institutions well in advance before the commencement of each semester.
iii. Each BoS shall prepare and publish a list of online courses at different levels before the commencement of each semester offered in various online educational platforms recognized by the Academic Council of the college, which can be opted by the students for acquiring additional credits.
iv. BoS shall prepare and publish a list of allied/ relevant pathway courses before the commencement of each semester offered by other Board of Studies that can be considered as pathway course for major/ minor for their disciplines at different levels.
v. At the end of each semester the college will include the credit acquired by the student through online courses in their semester grade card subject to a maximum of 30 credits.

Attendance

i. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if he has completed 75% of the prescribed classroom activities in physical, online, or blended modes, including any makeup activities as specified by the course faculty of that particular course.
ii. A student is eligible for attendance as per the existing university and government orders which includes participation in a meeting, or events organized by the college or the university, a regularly scheduled curricular or extracurricular activity prescribed by the college or the university. Due to unavoidable or other legitimate circumstances such as illness, injury, family emergency, care-related responsibilities, bad or severe weather conditions, academic or career-related interviews students are eligible for authorized absence. Apart from this, all other eligible leaves such as maternity leave, and menstrual leave shall also be treated as authorized absences.
iii. The condonation facility can be availed as per the university norms.

Workload

i. The workload of a faculty who offers only lecture courses during an academic year shall be 32 credits.
ii. The workload of a faculty offering both practical courses and theory courses may be between 24-32 credits per academic year.
iii. An academic year shall consist of two semesters.
iv. To protect the existing language workload, college should make necessary arrangements to give adequate preference to those courses designed by language departments coming under MDC, SEC and VAC of 3rd & 4th semester. It is recommended that the MDC offered in the third semester shall be based on Indian Knowledge Systems or Nation-specific topics and may be offered by the Other Languages department or any other department as may be seen fit. Additionally, the SEC in the fourth semester may be offered by the English Department and of the VACs in the third and fourth semesters, one may be offered by the Other Languages

Department and the other may be offered by the English Department. These recommendations may be modified as per the recommendations of the SHC-UGP Academic Monitoring Committee.

v. Programme wise workload calculation will be as per the FYUGP workload ordinance 2024.
vi. The teachers given the administrative responsibilities in the department and college level may give a relaxation in their work load as specified in the UGC regulations 2018.

Credit Transfer and Credit Accumulation

i. The college will establish a digital storage (DIGILOCKER) of academic credits for the credit accumulation and transfer in line with ABC.

ii. The validity of credits earned shall be for a maximum period of seven (7) years or as specified in the university/ UGC regulations.The students shall be required to earn at least 50% of the credits from the College.

iii. Students shall be required to earn the required number of credits as per any of the pathway structure specified in this regulation for the award of the degree.

Outcome Based Approach

The curriculum will be designed based on Outcome Based Education (OBE) practices. The Graduate Attributes (GA) and Programme Outcomes (PO) will be defined and specified in the syllabus of each programme.

Assessment and Evaluation

i. The assessment shall be a combination of Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).

ii. 30% weightage shall be given for CCA. The remaining 70% weight shall be for the ESE.

iii. Teacher Specific Content will be evaluated under CCA.

iv. CCA will have two subcomponents Formative Assessment (FA) and Summative Assessment (SA). Each of these components will have equal weightage and to be conducted by the course faculty/ course coordinator offering the course.

v. FA refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, module or course. FA is to encourage students to build on their strengths rather than fixate or dwell on their deficits. FA can help to clarify and calibrate learning expectations for both students. FA will help students become more aware of their learning needs, strengths, and interests so they can take greater responsibility over their own educational growth. FA will be prerogative of the course faculty/ course coordinator based on specific requirement of the student.

vi. Suggestive methods of FA are as follows: (anyone or in combinations as decided by the course faculty/ course coordinator)

a. Practical assignment
b. Observation of practical skills
c. Viva voce

d. Quiz
e. Interview
f. Oral presentations
g. Computerized adaptive testing
h. In-class discussions
i. Group tutorial work
j. Reflection writing assignments
k. Home assignments
l. Self and peer Assessments
m. Any other method as may be required for specific course/ student by the course faculty/ course coordinator.

vii. Summative Assessments (SA) are used to evaluate student learning, skill acquisition, and academic achievement at the conclusion of a defined instructional period- typically at the end of a project, unit, module, course or semester. SA may be a class tests, assignments, or project, used to determine whether students have learned what they were expected to learn. It will be based on evidence, collected using single or multiple ways of assessment. The systematically collected evidences should be kept in record by course faculty/ course coordinator and the marks should be displayed on the college notice board/ other official digital platforms of the college before the end semester examinations.

viii. The method of SA will be as follows: (any one as decided by the course faculty/ course coordinator)
a. Written test
b. Open book test
c. Laboratory report
d. Problem based assignments
e. Individual project report
f. Case study report
g. Team project report
h. Literature survey
i. Standardized test
j. Any other pedagogic approach specifically designed for a particular course by the course faculty/ course coordinator.

viii. A student may repeat SA only if for any compulsive reason due to which the student could not attend the assessment.

ix. The prerogative of arranging a CCA lies with the course faculty/ course coordinator with the approval of SHC-UGP Academic Committee based on justified reasons.

x. The course faculty/ course coordinator shall be responsible for evaluating all the components of CCA. However, the college may involve any other person (External or Internal) for evaluation of any or all the components as decided by the Principal/Controller of Examinations from time to time in case any grievances are raised.

xi. Written tests shall be precisely designed using a variety of tools and processes (e.g., constructed responses, open-ended items, multiple-choice), and the students should be informed about the evaluation modalities before the commencement of the course.

xii. The course faculty may provide options for students to improve their performance through continuous assessment mechanism.
xiii. There shall be theory and practical examinations at the end of each semester.
xiv. Regarding evaluation, one credit may be evaluated for 25 marks in a semester; thus, a 4-credit course will be evaluated for 100 marks; 3-credit courses for 75 marks and 2-credit courses for 50 marks.
xv. All examinations will be conducted by the College and will be evaluated at the College itself.
xvi. Individual Learning Plans (ILPs) and/ or specific assessment arrangements may be put in place for differently abled students. Suitable evaluation strategies including technology assisted examinations/ alternate examination strategies will be designed and implemented for differently abled students.

Practical Examination

i. The end semester practical examination will be conducted and evaluated by the institution.
ii. There shall be a CCA for practical courses conducted by the course faculty/ course coordinator.
iii. The scheme of evaluation of practical courses will be as given below:

Components for the Evaluation of Practical Courses	Weightage
CCA of practical/Practical.	30%
ESE of practical/Practical.	70%

iv. Those who have completed the CCA alone will be permitted to appear for the ESE.
v. For grievance redressal purpose, the university shall have the right to call for all the records of CCA.
vi. Duration of Examination: Questions shall be set as per the defined Outcome .The duration of the examinations shall be as follows.

Mode	Time (in Hours)
Written Examination	2
Multiple Choice	1.5
Open Book	2
Any Other Mode	2

Evaluation of Project/Dissertation

The evaluation of project work shall be CCA with 30% and ESE 70%. The scheme of evaluation of the Project is given below:

Project type	Maximum Marks	CCA	ESE
Research Project of Honours with Research (12 credits)	200	60	140

Project of Honours (8 credits)	100	30	70

Evaluation of Internship

The evaluation of internship shall be done by a committee constituted by the Department Council. The scheme of CCA and ESE is given below:

Components of Evaluation of Internship	**Weightage**	**Marks for Internship 2 Credits/ 50 Marks**
CCA	30%	15
ESE	70%	35

The department council may decide any mode for the completion of the Internship. If in case evaluation is not specified in any of the selected internship programme, institution can adopt a proper evaluation method as per the weightage specified in the table above.

Letter Grades and Grade Points

Mark system is followed for evaluating each question. For each course in the semester, letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given below,

i. The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.

ii. Based on the marks obtained, the weighted grade point will be mentioned in the student's grade cards.

Letter Grade	**Grade Point**	**Percentage of Marks (Both Internal & External Marks put together)**	**Class**
O (Outstanding)	10	95% and above	First Class with Distinction
A+ (Excellent)	9	85% and above but below 95%	
A (Very good)	8	75% and above but below 85%	
B+ (Good)	7	65% and above but below 75%	First Class
B (Above average)	6	55% and above but below 65%	
C (Average)	5	45% and above but below 55%	Second Class
P (Pass)	4	35% and above below 45% Aggregate (external and internal put together) with a minimum of 30% in external	Third Class

F (Fail)	0	Below an aggregate of 35%or below 30% in external evaluation	Fail
Ab (Absent)	0		Fail

iii. When students take audit courses, they may be given pass (P) or fail (F) grade without any credits.

Computation of SGPA and CGPA

The following method is recommended to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

iv. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in the semester, i.e.

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Si is the SGPA in the i^{th} semester, Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

$$\boldsymbol{SGPA} = \frac{Sum\ of\ the\ credit\ points\ of\ all\ courses\ in\ a\ semester}{Total\ Credits\ in\ that\ Semester}$$

Illustration – Computation of SGPA

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	DSC A	4	A	8	4 x 8 = 32
I	DSC B	4	B+	7	4 x 7 = 28
I	DSC C	4	B	6	4 x 6 = 24
I	MDC	3	B	6	3 x 6 = 18
I	AEC 1	3	O	10	3 x 10 = 30
I	AEC 2	3	C	5	3 x 5 = 15
	Total	**21**			**147**
	SGPA				**147/21 = 7**

The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme, i.e.

$$\boldsymbol{CGPA} = \frac{Sum\ of\ the\ credit\ points\ of\ all\ courses\ in\ six\ or\ eight\ semesters}{Total\ Credits\ in\ Six\ (133)\ or\ Eight\ (177)\ semesters}$$

v. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Implementation and Monitoring of SHC-UGP

i. The implementation and monitoring of SHC-UGP will be carried out by duly appointed bodies/committees of the college such as the Academic Council, the various Boards of Studies and the Academic Monitoring Committee.

ii. Academic Council

Among its other functions, the Academic Council of the College shall:

i. Scrutinize and approve all the proposals submitted by the Board of Studies of each Department with regard to the SHC-UGP details such as, academic pathways, allowed syllabi enrichment/ updating, details of elective courses, Online courses, blended teaching, courses offering to the students of other HEIs, panel of examiners, summative and formative evaluation tools proposed by the course faculty concerned, new courses and syllabus proposed by the faculty members as signature courses etc.
ii. The Academic Council can differ on any proposal and it shall have the right to return the matter for reconsideration to the Board of Studies concerned or reject it, after giving sufficient reasons to do so.
iii. Undertake the scrutiny of all documents related to Teacher Specific Content.
iv. Recommend to the College Governing Council for starting innovative programmes using the flexibility and holistic nature of the SHC-UGP curriculum frame work.

iii. Board of Studies

Among its other functions, the Board of Studies of each Department shall:

i. Prepare teacher specific content of syllabi for various courses keeping in view the objectives of the SHC-UGP and submit the same for the approval of the Academic Council.
ii. Scrutinize the signature course content and its evaluation techniques.
iii. Suggest methodologies for innovative teaching and evaluation techniques.
iv. Suggest panel of examiners to the Office of the Controller of Examinations.
v. Coordinate research, teaching, extension and other academic activities in the department.

iv. SHC-UGP Academic Monitoring Committee

The SHC-UGP Academic Monitoring Committee shall be constituted under the Chairmanship of the Principal, with the Academic Coordinator as the Convenor, shall be entrusted to oversee the implementation and monitoring of the SHC-UG programme.

i. The Academic Monitoring Committee will collect and whet the proposals submitted by the Board of Studies of each Department with regard to the SHC-UGP and duly forward them to the Academic Council.

ii. It will oversee and coordinate the activities undertaken for the successful implementation of SHC-UGP in the College and will function as an advisory body in such matters.

Power to Remove Difficulties

If any difficulty arises in giving effect to the provisions of these Regulations, the Principal may by order make such provisions which appears to him/her to be necessary or expedient for removing the difficulty. Every order made under this rule shall be subject to ratification by the appropriate authorities.

Modifications to the Regulations

Notwithstanding anything contained in these Regulations, any amendments or modifications issued or notified by the University Grants Commission or the State Government or the Mahatma Gandhi University from time to time, shall be incorporated into these Regulations by the appropriate regulatory bodies of the College and shall constitute an integral part thereof.

3. SYLLABUS INDEX

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
DISCIPLINE SPECIFIC COURSES (DSC)						
I	24UZOODSC101	Introduction to Zoology	100-199	4	3	2
II	24UZOODSC102	Foundations of living system	100-199	4	3	2
III	24UZOODSC201	Protistan Diversity and Animal Diversity Non-Chordata- I	200-299	4	3	2
	24UZOODSC202	Animal Diversity Non-Chordata- II	200-299	4	3	2
	24UZOODSC203	Ethology	200-299	4	4	0
IV	24UZOODSC205	Animal Diversity Chordata- I	200-299	4	3	2
	24UZOODSC206	Biological Chemistry	200-299	4	3	2
	24UZOODSC207	Applied Zoology	200-299	4	4	0
V	24UZOODSC301	Animal Diversity Chordata -II	300-399	4	3	2
	24UZOODSC302	Cell Biology and Molecular Biology	300-399	4	4	0
	24UZOODSC303	Fundamentals of Genetics	300-399	4	4	0
	24UZOODSC304	Biotechnology - Principles and Practices	300-399	4	4	0
	24UZOODSC305	Wildlife Management	300-399	4	4	0
VI	24UZOODSC306	Microbiology and Basic Immunology	300-399	4	4	0
	24UZOODSC307	Physiology and Endocrinology	300-399	4	3	2
	24UZOODSC308	Reproductive Biology and Teratology	300-399	4	3	2
	24UZOODSC309	Zoogeography and Evolutionary Biology	300-399	4	3	2

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
VII	24UZOODSC401	Biophysics, Instrumentation, and Diagnostic Imaging Techniques	400-499	4	4	0
	24UZOODSC402	Biostatistics and Research Methodology	400-499	4	4	0
	24UZOODSC403	Advanced Genetics	400-499	4	4	0
	24UZOODSC404	Economic Entomology	400-499	4	3	2
	24UZOODSC405	Aquafarming	400-499	4	4	0
	24UZOODSC406	Solid Waste Management	400-499	4	4	0
VIII	24UZOODSC407	Advanced Immunology	400-499	4	3	2
	24UZOODSC408	Animal Systematics	400-499	4	3	2
DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE)						
VIII	24UZOODSE401	Developmental Biology	300-399	4	4	0
	24UZOODSE402	Fishing and Fish Processing Technologies	300-399	4	4	0
	24UZOODSE403	Biological Specimen Preparation Techniques.	300-399	4	4	0
DISCIPLINE SPECIFIC COURSES (DSC) - *Minor Pathway*						
I	24UZOODSC101	Introduction to Zoology	100-199	4	3	2
II	24UZOODSC102	Foundations of living system	100-199	4	3	2
III/IV	24UZOODSC204	Applied Zoology	200-299	4	3	2
	24UZOODSC208	Functional Zoology	200-299	4	3	2
MULTIDISCIPLINARY COURSES (MDC)						
I	24UZOOMDC101	Ornamental Fish Farming & Aquarium Keeping	100-199	3	2	2
II	24UZOOMDC102	Reproductive Health and Sex Education	100-199	3	2	2

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
III	24UZOOMDC201	Human Diseases and Their Management	200299	3	0	0
SKILL ENHANCEMENT COURSES (SEC)						
V	24UZOOSEC301	Aquarium Fabrication and Setting	300-399	3	2	2
VI	24UZOOSEC302	Responsible Tourism	300-399	3	3	0
VALUE ADDITION COURSES (VAC)						
VI	24UZOOVAC301	Fundamentals of Parasitology	300-399	3	3	0
DISCIPLINE SPECIFIC COURSES (DSC) – Physiology *Minor for Psychology*						
I	24UZOODSC111	Introduction to Physiological Psychology	100-199	4	3	2
II	24UZOODSC112	Physiological Psychology - II	100-199	4	3	2
III	24UZOODSC211	Behavioural Genetics & Psychoneuroimmunology	200-299	4	3	2

PROPOSED PROGRAMME STRUCTURE FOR B.Sc. (HONS.) ZOOLOGY

(*with Zoology as Major and Minors B and C*)

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
I	24UZOODSC101	Introduction to Zoology	100-199	4	3	2
	-	DSC – Minor (B)	100-199	4	3	2
	-	DSC – Minor (C)	100-199	4	3	2
	-	AEC - English	100-199	3	3	0

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
	-	AEC – Other Languages	100-199	3	3	0
	-	MDC	100-199	3	2	2
				21	**17**	**8**
II	24UZOODSC102	Value-Added Products of Animals	100-199	4	3	2
	-	DSC – Minor (B)	100-199	4	3	2
	-	DSC – Minor (C)	100-199	4	3	2
	-	AEC - English	100-199	3	3	0
	-	AEC – Other Languages	100-199	3	3	0
	-	MDC	100-199	3	2	2
				21	**17**	**8**
III	24UZOODSC201	Protistan Diversity and Animal Diversity Non-Chordata- I	200-299	4	3	2
	24UZOODSC202	Animal Diversity Non-Chordata-II	200-299	4	3	2
	24UZOODSC203	Ethology	200-299	4	4	0
	-	DSC – Minor (B) / (C)	200-299	4	3	2
	-	MDC	200-299	3	3	0
	-	VAC	200-299	3	3	0
				22	**19**	**6**
IV	24UZOODSC205	Animal Diversity Chordata- I	200-299	4	3	2
	24UZOODSC206	Biological Chemistry	200-299	4	3	2
	24UZOODSC207	Applied Zoology	200-299	4	4	0
	-	DSC – Minor (C) / (B)	200-299	4	3	2
	-	SEC	200-299	3	3	0
	-	VAC	200-299	3	3	0
				22	**19**	**6**
Summer Internship				**2**	**-**	**60**
V	24UZOODSC301	Animal Diversity Chordata -II	300-399	4	3	2

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
	24UZOODSC302	Cell Biology and Molecular Biology	300-399	4	4	0
	24UZOODSC303	Fundamentals of Genetics	300-399	4	4	0
	24UZOODSC304	Biotechnology - Principles and Practices	300-399	4	4	0
	24UZOODSC305	Wildlife Management	300-399	4	4	0
	24UZOOSEC301	Aquarium Fabrication and Setting	300-399	3	2	2
				23	**21**	**4**
VI	24UZOODSC306	Microbiology and Basic Immunology	300-399	4	4	0
	24UZOODSC307	Physiology and Endocrinology	300-399	4	3	2
	24UZOODSC308	Reproductive Biology and Teratology	300-399	4	3	2
	24UZOODSC309	Zoogeography and Evolutionary Biology	300-399	4	3	2
	24UZOOSEC302	Responsible Tourism	300-399	3	3	0
	24UZOOVAC301	Fundamentals of Parasitology	300-399	3	3	0
				22	**19**	**6**
Exit at 3rd Year with 133 Credits – BSc Degree						
VII*	24UZOODSC401	Biophysics, Instrumentation, and Diagnostic Imaging Techniques	400-499	4	4	0
	24UZOODSC402	Biostatistics and Research Methodology	400-499	4	4	0
	24UZOODSC403	Advanced Genetics	400-499	4	4	0
	24UZOODSC404	Economic Entomology	400-499	4	3	2
	24UZOODSC405	Aquafarming	400-499	4	4	0
	24UZOODSC406	Solid Waste Management	400-499	4	4	0

SEM	Course Code	Course Title	Course Level	Credit	Hours per Week	
					Theory	*Practical*
** 3 Courses in Sem 7 can be taken from minor pathway at 300-399 level (for single minor pathway)*				**24**	**23**	**2**
VIII	24UZOODSC407	Advanced Immunology	400-499	4	3	2
	24UZOODSC408	Animal Systematics	400-499	4	3	2
	24UZOODSE401	Developmental Biology	400-499	4	4	0
	24UZOODSE402	Fishing and Fish Processing Technologies	400-499	4	4	0
	24UZOODSE403	Biological Specimen Preparation Techniques.	400-499	4	4	0
	-	12 Credit Project or 8 Credit Project + DSE	-	12	-	-
				20	-	-
Completion of the Programme at 4th Year with 177 Credits – BSc Honours Degree						

4. SYLLABUS FOR DISCIPLINE SPECIFIC COURSES (DSC) IN ZOOLOGY

DSC - COURSE 01:

Discipline	ZOOLOGY
Semester	I
Type of Course	DSC
Course Code	24UZOODSC101
Course Title	Introduction to Zoology
Course Level	100-199
Course Summary	The course includes several marvellous facts about the animal world which can foster sense of interest¸ connection, empathy and caring towards the animals. They feel responsible and enthusiastic to learn more about the animal world.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify the wonders of the animal world and the facts behind the phenomena	U	2
2	Explain Coloration, Mimicry & Parental care.	U	2
3	Discover the research avenues & career opportunities in Zoology	U	2
4	Predict the Entrepreneurial Possibilities in the field of Zoology	E	1, 2
5	Prepare detailed reports of field visits to environmentally important places research institutions and career orientation centers	A	2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Wonders of Animal world**		**(15 Hours)**	
	1.1	Incredible Animal Architects Introduction to Animal Societies		1
	1.2	Honeybees – Skilled Engineers of Nature Comb building in Honey bees		
	1.3	Architectural secret of Termite hills		
	1.4	Weaver Bird-Wonderful Architect		
	1.5	Glowing Wonders Bioluminescence – Mechanism Noctiluca – Sparkle of the sea Firefly- Stars on earth Octopus – Wild Glowing Wonder Angler fish – the glowing monster		
	1.6	Story of Pearl, Types of Pearl, Pearl Formation, Process of Picking best Pearl		
2	**Coloration , Mimicry & parental care**		**(15 Hours)**	
	2.1	Coloration & Mimicry Fakers of Nature- Secret behind Coloration & Mimicry Beautiful Butterflies, Colorful Earthworms, Painted Starfish Blue beauty Frog , Lovely Chameleon , Handsome Peacock Magnificent Owl Butterfly Leaf insect – The Walking leaves		2
	2.2	Parental care Animal Parenting – Facts & examples Who will take care? Father or Mother. Mother – Velvet Spider -		

		Epitome of sacrifice Father – Water bug - Model father Pregnant Father – Sea Horse Father Brooder – Male Darwin frog. Sophisticated parents – Python parenting Supermom – Humming Bird Aggressive Mother – Otter		
3	**Major Research Areas & Careers in Zoology**			**15 hours**
	3.1	Exciting avenues for research Bioinformatics, Molecular biology, Biostatistics, Wildlife Biology, Toxicology & Pharmacology, Forensic biology, Physiology, Genetics, Microbiology, Immunology, Developmental Biology, Ethology, Biotechnology, Environmental Biology, Animal Systematics, Marine biology, Fisheries, Cell biology, Entomology, Biochemistry, Parasitology, brief description only		4
	3.2	Attractive career opportunities General- All general UPSC jobs especially IFS (Indian Forest Service), Kerala PSC (all general degree based jobs), jobs in Kerala Forest and wildlife department (Range Forest Officer and Beat Forest officer), Scientists, Research assistants, Lab technicians, Animal house keepers in reputed research centers like ZSI, CSIR, ICAR, RGCB, KFRI, NCBS, TIFR, SACON, BARC, ICZN etc. Jobs in NGOs like WWF, ATREE, Wildlife SOS, Wildlife Trust of India, Center for Wildlife Studies, Nature Conservation Foundations etc. Specific- Entomologist in Vector control board and in research institutes like KFRI; Teaching; Biologist and Curator in Museum and Zoological Parks; Fisheries officer in Fisheries department, Junior scientific assistant in pollution control board, District Malaria Officer, forensic assistant in police department and health department; ecologist, conservation biologist and nature education officers in various wildlife sanctuaries and protected areas; jobs in Pharmaceutical companies. Embryologist, Cytological specimen preparation, Cytogeneticist in diagnostic labs and hospitals. Medical coding		4
	3.3	Lucrative Entrepreneurial Possibilities Products, byproducts & value added products of: Apiculture, Sericulture, Dairy Farming, Poultry Farming, Pets and their management, Aqua culture (Edible and ornamental) and Vermiculture		
	Practical		**(30 hours)**	

4	4.1	Identification of any 10 specimens coming under the following categories 1. Animal architects, 2. Glowing animals, 3. Animal mimicry 4 Animal coloration 5. Parental care.		5
	4.2	Search wonders of animal world and make short videos/reports/photos: 1. Animal architects, 2. Glowing animals, 3. Animal mimicry, 4 Animal coloration, 5. Parental care.		
	4.3	1. Field visit - Nature camp, butterfly garden, museum, pearl culture farm. (any 2) 2. Visit to any 2 research institutes 3. Visit and interact with any two entrepreneurs from different fields and submit the report 4. Career Orientation class by experts		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 05 marks** • Lab involvement and practical skills • Record/Any other method as may be required for specific course / student by the course faculty
	B. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments • Record

REFERENCES:

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2. Barnes R. D. (1982) Invertebrates Zoology 6th edn. Toppan International Co
3. Barrington, E. J. W. (1969) Invertebrate Structure and functions. English Language Book Society.
4. Bhaskaran. K. K. and Biju Kumar. A. (2003). Chordate Zoology. Manjusha Publications. Calicut.
5. Borradile, L.A. (1955) The Invertebrata.2nd endn. Cambridge University Press.3
6. Burney D. (2001) Animal; Kayla Morey.
7. Carter, G. S. A. (1946) General Zoology of Invertebrates 2nd endn. (Wick and Jackson Ltd., London).
8. Colbert, E.H. (1955) Evolution of the Vertebrates. John Wiley and Sons Inc. N.York.
9. Ekambaranatha Iyer M. and Anantakrishnan T. N. (1990); Manual of Zoology. Vol. II .S. Viswanathan and Co.
10. Frank W. L. (2014). Animal Wonder World; M. Evans & Company.

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12. Halstead, L.B. (1969). The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U. S. A.
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14. Hobart M. Smith. Evolution of Chordate structure, Holt, Rinehart and Winston. Inc. N. York.
15. Jordan E. L. and P. S. Verma. (2002). Chordate Zoology, S. Chand and Co. N.Delhi.
16. Kapoor, V.C. (1991) Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
17. Kotpal, R.L. (1982) Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
18. Meera J.A. (2020). Chordate Zoology of Kerala¸Zoological Sociey of Kerala.
19. Moore, R. C. Lalicker, C. G. and Fisher, A. G. (1952) Invertebrate Fossils, Mc
20. Graw Hill Book Co., New York.
21. Waterman, AJ. (1971) Chordate Structure and Function. Macmillan Co. London.
22. Young, J.Z. (1950) Life of Vertebrates. Clarendon Press Oxford.

SUGGESTED READING

1. Jolie, M. (1968) Chordate Morphology. East West Press.
2. Parragon Publishing India. (2023) Fascinating facts Animals.Parragon Publishing India.
3. William S. Beck. Karel, F.. Liem and George Gaylord Simpson. (2000). Life: An introduction to biology. Harper Collins Publishers, New York.
4. Young J.Z. (2006). The life of Vertebrates. Oxford University.

DSC- COURSE 02

Discipline/Programme	**BSc (Honours) ZOOLOGY**					
Semester	**2**					
Type of Course	**DSCA**					
Course Code	**24UZOODSCZOO103**					
Course Title	**Foundations of living system**					
Course Level	**100**					
Course Summary	This course explores basic understanding of cell biology focus on animal cells, types of cells and tissues. Students can delve into the diversity of animal cells and their structure and functions, additionally students will learn about the organisation and functions of animal tissues- epithelial, muscular, nervous and connective tissue.					
Lecture,Tutorial, Practical	**45/30**					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any	Should have basic knowledge in sceince					

	CO No.	Expected Course Outcome	Learning Domains*	PO No
	1	Recall cell as the basic unit of life	K	1, 3
	2	Compare and contrast various types of cells	An	1, 3
	3	Analyse the structural organisation of cells	An	1, 3
	4	Develop the skill to distinguish between various types of cells in animal body	S	1, 4
	5	Analyse the various biomolecules in the cell	An	1, 3
		Imagine the organisation of various cells and the Location of Biomolecules like nucleic acids	C	1, 3, 4

(K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	The Cell		**(15 Hours)**	
	1.1	Cell as the machinery Life Prokaryotic and eukaryotic cells	1, 2, 3, 4	15
	1.2	Difference between plant and animal cells		
	1.3	Basic structure of animal cell		
	1.4	Plasma membrane, Protoplasm, Cytoplasm		
	1.5	Cell inclusions- nucleus, mitochondria, ER, Golgi apparatus, lysosomes and ribosomes (Brief account of the structure and function)		
	1.7	Hierarchial organisation of Animal complexity		
	1.6	Levels of organization in Organismal Complexity		
	1.7	Extracellular components of the metazoan body		
	1.8	Complexity and body size		
2	**Types of Animal cells and Tissues**		**(15 Hours)**	
	2.1	Why Study Animal Cells? (Applications in Health, Biotechnology, and Research)	1, 2, 4	15
	2.2	Epithelial Cells Types of Epithelial Cells (Squamous, Cuboidal, Columnar) Structure and Function (Protection, Absorption, Secretion) Specialized Epithelia (Ciliated Cells in Respiratory Tract)		
	2.3	Connective Tissue Cells Fibroblasts: Structure and Role in Matrix Production Adipocytes: Fat Storage and Endocrine Functions Chondrocytes and Osteocytes: Cartilage and Bone Formation Mast Cells and Macrophages: Immune Response		
	2.4	Muscle cells and Specialized Supporting Cells Types of Muscle Cells (Skeletal, Cardiac, Smooth) Structural Differences and Functions Specialized Muscle Cells (Pacemaker Cells in Heart)		

		Applications in Sports Science and Medicine Specialized Supporting Cells: Bone Cells (Osteocytes, Osteoblasts): Role in Structure and Growth Cartilage Cells (Chondrocytes): Cushioning and Support		
	2.5	Nervous Cells: Cells of communication Neurons: Role in Communication Supporting Cells: Glial Cells and Their Functions Understanding Nerve Damage and Regeneration		
	2.6	Blood Cells – Circulatory Heroes Red Blood Cells (RBCs): Types of RBC White Blood Cells (WBCs): Role in Defense Platelets: Role in Dengue		
	2.7	Immune Cells – Defenders of the Body Overview of Immune Cells (Macrophages, T Cells, B Cells) Role in Fighting Infections and Diseases Modern Relevance: Vaccines, Immunotherapy, and Allergies		
	2.8	Reproductive Cells Gametes: Sperm Cells and Oocytes (Structure and Function) Processes of Fertilization and Zygote Formation Supporting Cells (Sertoli and Granulosa Cells)		
	2.9	Stem Cells and Differentiation Types of Stem Cells (Embryonic, Adult, Induced Pluripotent) Role in Development and Tissue Repair Cellular Differentiation into Specialized Cells		
3	**Biomolecules in the cell (15 Hours)**			
	3.1	**Introduction to Biomolecules** Definition and significance of biomolecules.		
	3.2	***I****ntroduction to Vitamins and Minerals, Classification of Vitamins and Minerals ,Functions and Deficiency Disorders of Vitamins and Minerals*		
	3.2	**Proteins**:Structure of amino acids and peptide bonds.Levels of protein structure: Primary, secondary, tertiary, and quaternary.Functions of proteins.Examples of biologically important proteins e.g., haemoglobin		

	3.3	**Carbohydrates**:Classification: Monosaccharides, disaccharides, oligosaccharides, and polysaccharides.		
	3.4	**Lipids**:Types of lipids: Fats, phospholipids, steroids, and waxes.		
	3.5	**Enzymes:**Definition and Nature of Enzymes Classification of Enzymes (Six Major Classes)		
	3.6	**Nucleic Acids**: Structure and function of DNA and RNA.Central Dogma of Molecular Biology.		
4	**Practical (30 hours)**			
	4.1	Adequately use light microscopes to observe cells at a magnification up to 100X (oil immersion) The Steps in the tissue preparation for light microscopy		30 hours
	4.2	Identification and recognition of Blood cells using light microscope Microscopic observation of tissues- Muscle tissue-skeletal muscle and smooth muscle, skeletal tissue, epithelial tissue, adipose tissue, nervous tissue Cell organelles identification- Mitochondria, Golgi bodies, ER, Nucleus, Lysosomes, Ribosomes Structure of DNA, RNA and proteins (Models /Images	1, 2, 3, 4	
	4.3	Estimation of Haematocrit value		
	4.4	Preparation of whole mounts- Mounting of cheek epithelium, Observe sperm and egg		
	4.5	Comparison of cheek epithelium, plant epithelia, fungus, protista and bacterial cell		
5	**Teacher specific course components**			

<table>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT

A. Continuous Comprehensive Assessment (CCA)
Theory: 25 marks
• Involvement and responses in class room transactions - 5 marks
• Home Assignments/preparedness - 5 marks
• Oral presentation/Viva/Quiz/Open book test/written test - 5 marks)
• Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks
• Any other method as may be required for specific course / student by the course faculty – 5 marks
Practical: 7. 5 marks
• Lab involvement and practical skills - 5 Marks
• Record/Any other method as may be required for specific course / student by the course faculty - 2.5 marks</td></tr>
<tr><td>B. End Semester examination (ESE)

Theory: 50 marks
• Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks
Practical: 17.5 marks
• Practical based assessments: 15 marks
• Record: 2.5 marks</td></tr>
</table>

Recommended Reading

1. Becker, W. M., Kleinsmith, L. J., Hardin. J. & Bertoni, G. P. (2009). The World of the Cell (7th ed.). Pearson Benjamin Cummings Publishing, San Francisco.

2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith & Watson James (2008). Molecular Biology of the Cell (5th ed.). Garland publishing Inc. New York and London.

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4. Janet Iwasa, Wallace Marshal ., (2021) CARP_S Cell and molecular Biology, 9th edition: Wiley Online publication Asia Edition

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DSC - COURSE 03

Discipline	ZOOLOGY
Semester	III
Type of Course	DSC
Course Code	24UZOODSC201
Course Title	Protistan Diversity and Animal Diversity Non-Chordata- I
Course Level	200-299
Course Summary	This course aims to provide a thorough understanding of various animal phyla, including Kingdom Protista, Phylum Orthonectida, Phylum Placozoa, Phylum Coelenterata, Phylum Ctenophora, Phylum Platyhelminthes, Phylum Aschelminthes and Phylum Annelida. The course structure focuses on the key features, classification, and special characteristics of representative examples within each phylum. Additionally, it explores topics such as economic importance, unique features, and adaptations. The course places a strong emphasis on practical knowledge in the area of invertebrate zoology, with a particular focus on developing students' hands-on skills, observational abilities, and collaborative work.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Classify the Kingdom Protista, Phylum - Orthonectida, Placozoa, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes and Annelida.	U	1
2	Compare salient features of different phyla from Orthonectida to Annelida.	U	1
3	Describe the canal systems in Sponges¸ Parasitic Protists¸ Life cycle of *Plasmodium*¸ Coral and coral reefs and its conservation¸ Polymorphism in Coelenterates¸ Pathogenic nematodes in man.	U	1
4	Distinguish different parasitic/pathogenic Protists¸ Patyhelminthes, Nematodes and Annelids	U	2
	Practical		
1	Identification of specimens from Protista¸ Porifera¸ Cnidaria¸Platyhelminthes¸ Nematoda & Annelida	**U**	**1**

2	Apply culture techniques of protists and prepare temporary whole mounts of specimens	**A**	**1, 2**

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Kingdom Protista**		**15**	
	1.1	Kingdoms of classification: Two-kingdom, Three Kingdom, Five kingdom and Eight kingdom classifications, Levels of animal organization. (Mention only)	1	1
	1.2	**Animal -like protists** 1. Phylum Rhizopoda Eg.: *Amoeba* 2. Phylum Actinopoda Eg.: *Actinophrys* 3. Phylum Foraminifera Eg.: *Elphidium* 4. Phylum Ciliophora Eg.: *Balantidium* 5. Phylum Opalinata Eg.: *Opalina* 6. Phylum Kinetoplasta Eg.: *Trypanosoma* 7. Phylum Metamonada Eg.: *Giardia* 8. Phylum Choanoflagellata Eg.: *Proterospongia* 9. Phylum Parabasalia Eg.: *Trychonympha* 10. Phylum Sporozoa Eg.: *Toxoplasma* **Plant -like protists** 11. Phylum Euglenophyta Eg. : *Euglena* 12. Phylum Cryptophyta Eg. : *Cryptomonas* 13. Phylum Bacillariophyta Eg.: Diatoms 14. Phylum Chlorophyta Eg.: *Volvox* 15. Phylum Rhodophyta Eg. : Red Algae 16. Phylum Dinoflagellata Eg. :*Noctiluca* **Fungus -like protists** 17. Phylum Mycetozoa Eg.: Slime moulds 18. Phylum Microsporidia Eg.: *Nosema* (Brief description only)	7	1
	1.3	**Type: - *Paramecium* –** Morphology (Mention - cyclosis, respiration, osmoregulation and excretion), asexual reproduction (Binary fission) and sexual reproduction (Conjugation). **General topics**: 1. Parasitic Protists (*Entamoeba* and *Leishmania*) 2. Lifecycle of *Plasmodium*	7	1

2	**Kingdom Animalia: Classification, Phylum Porifera and Cnidaria**		**15**	
	2.1	Basis of classification Germ layers: diploblastic, and triploblastic Symmetry – Asymmetry, Spherical, Radial, Biradial and Bilateral Coelom – Acoelomates, Pseudocoelomates and Eucoelomates -Schizocoelom, Enterocoelom, Protostomia and Deuterostomia Metamerism Outline classification of Kingdom Animalia Three branches – Mesozoa, Parazoa and Eumetazoa Mesozoa: Phylum Orthonectida - Eg. Rhopalura Parazoa: Phylum Placozoa – Eg. Trycoplax adherens	5	1
	2.2	Phylum Porifera – Classification up to classes. Salient features of phylum and classes. Class I – Calcarea Eg. Sycon Class II – Hexactinellida Eg. Euplectella Class III – Demospongia Eg. Cliona General topic: 1. Canal system in Sponges.	4	1, 2
	2.3	Eumetazoa Phylum Cnidaria Classification up to classes. Salient features of phylum and classes. Class I- Hydrozoa Eg. Obelia (Mention metagenesis) Class II- Scyphozoa Eg. Rhizostoma Class III- Anthozoa Eg. Metridium General topics: 1. Coral and coral reefs and its conservation. 2. Polymorphism in Coelenterates	5	1, 3
	2.4	Phylum Ctenophora - Salient features Eg. Pleurobrachia	1	1
3	**Phylum Platyhelminthes, Nematoda and Annelida**		**15**	
	3.1	Phylum Platyhelminthes – Classification up to classes. Salient features of phylum and classes. Class I- Turbellaria Eg. Planaria Class II- Trematoda Eg. Fasciola hepatica Class III- Cestoda Eg. Taenia solium General topics: 1. Life history of Fasciola hepatica. 2. Platyhelminth parasites of Man and Dog (Schistosoma, Taenia solium, Echinococcus)	5	1, 4
	3.2	Phylum Nematoda - Classification up to classes. Salient features of phylum and classes.	5	1, 5

		Class- Phasmidia Eg. Enterobius, Ascaris Class -Aphasmidia Eg. Trichinella General topics: Pathogenic nematodes in man. (Wuchereria bancrofti, Ancylostoma duodenale, Enterobius vermicularis, Ascaris lumbricoides)		
	3.3	Classification up to classes. Salient features of phylum and classes. Class I- Archiannelida Eg. Polygordius Class II -Polychaeta Eg. Chaetopterus Class III- Oligochaeta Eg. Megascolex. Class IV- Hirudinea Eg. Hirudinaria General topic: 1. Ecological and parasitic Adaptations with reference to the above examples.	5	1
4		**Practicals**	**30**	
	1	1. General identification and classification (Phylum, Class, Genus and Species) a) Protista (any 6) b) Porifera- 1 c) Cnidaria - 3 d) Platyhelminthes- 2 e) Nematoda – 1 f) Annelida – 2	10	1
	2	2. Identification of any four economically important parasitic protists (Slides/ photographs may be used)	2	1
	3	3. Identification of Protistans from pond water (any 2).	4	2
	4	4. Mounting of earthworm setae.	2	3
	5	5. Study of sections (Any Two) a. T.S. of Hydra b. T.S. of Ascaris c. T.S. of Fasciola d. T.S. of Earthworm	4	1
	6	6. Identification of larval stages. (Any two, Slides or photographs may be used) (miracidium, sporocyst, redia, cercaria, metacercaria)	4	1
		ACTIVITY 1. Poster making as a group project on parasitic protists infesting humans and presentation by a group representative	4	4
5		Teacher Specific Module		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial, ICT enabled learning, Group activity, Assignment, Seminar
Assessment Types	**MODE OF ASSESSMENT THEORY** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test, Papers, Seminar **Practical Total = 15 Marks** Lab performance, record, other assignments
	B. End Semester Examination **Theory Total = 50 Marks;** **Practical Total = 20 Marks,** **Record, Examination** Spotter identifications: 1. Identification & classification 2. Identification of economically important parasitic protist 3. Identification, sketch and labeling of section (any one) 4. Identify and write notes on larval stage 5. Mounting of setae.

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2. Dhami P. S. and Dhami J. K., (1979). Invertebrate Zoology. R. Chand and Co. Delhi.

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5. Kotpal, R. L., (2017). Modern Text book of Zoology-Invertebrata, (Animal Diversity- I). Rastogi Publications, New Delhi.

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3. Cavalier-Smith, T. (2017). Kingdom Chromista and its eight phyla: a new ynthesis emphasising periplastid protein targeting, cytoskeletal and periplastid evolution, and ancient divergences. Protoplasma 255. 297-357. https://doi.org/10.1007/s00709-017-1147-3
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DSC - COURSE 04

Discipline	**ZOOLOGY**
Semester	**III**
Type of Course	DSC
Course Code	24UZOODSC202
Course Title	**ANIMAL DIVERSITY - NON CHORDATA- II**
Course Level	200
Course Summary	This course aims to provide a thorough understanding of various animal phyla, including Phylum Onychophora, Phylum Arthropoda, Phylum Mollusca, Phylum Echinodermata, Hemichordata, and Minor Phyla.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Differentiate salient features of Phylum Onychophora, Arthropoda, Mollusca, Echinodermata, Hemichordata, and Minor Phyla.	An	1,2
2	Describe different systems of Prawn, pearl culture, edible molluscs, the economic importance of insects, water vascular systems, and larval forms of Echinodermata.	U, S	1,2
3.	Dissect the prawn and cockroach nervous systems and mount the prawn appendages, mouth parts of thec ockroach, plant bug, and mosquito.	A, S	1,2
4.	Sketch invertebrates scientifically.	A, S	1,2
5	Classify species belonging to the minor phyla and phylum Arthropoda, Mollusca, and Echinodermata.	An, S	1,2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

	Practical		
1	Identification of specimens from Protista¸ Porifera¸ Cnidaria¸Platyhelminthes¸ Nematoda & Annelida	**U**	**1**

2	Apply culture techniques of protists and prepare temporary whole mounts of specimens	**A**	**1, 2**

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Phylum Onychophora and Phylum Arthropoda**		**15**	
	1..1	**Phylum Onychophora** Salient features of the phylum Eg. *Peripatus* (Mention its affinities).	1	1, 5
	1.2	**Phylum Arthropoda** Classification up to classes. Salient features of phylum and classes. (Brief mention only) **1. Sub Phylum - Trilobitomorpha** Class -Trilobita (mention the salient features). Eg. *Triarthrus* **2. Subphylum –Chelicerata** Class 1 Merostomata (Xiphosura) (Eg. *Limulus*- Living fossil) Class 2.Arachnida (Eg., *Palamnaeus*- Scorpion) Class 3 Pycnogonida (Eg. *Pycnogonum* – Sea spider) **3. Subphylum- Crustacea** Class 1 Branchiopoda Eg. *Daphnia* Class 2 Ostracoda Eg. *Cypris* -seed shrimp Class 3 Copepoda Eg. *Cyclops* Class 4 Remipedia Eg. *Speleonectes* (eyeless crustacean seen in caves) Class 5.Branchiura Eg.,*Argulus* (common fish louse) Class 6 Cirripedia Eg. *Sacculina* Class 7 Malacostraca Eg. *Squilla* (spot tail mantis shrimp) **4. Subphylum- Uniramia** Class 1 Chilopoda Eg. *Scolopendra* – (Centipede) Class 2 Symphyla Eg. *Scutigerella* – (garden centipedes or pseudocentipedes) Class 3 Diplopoda Eg. *Spirostreptus*- (Millipede) Class 4 Pauropoda Eg. *Pauropus* Class 5 Hexapoda (Insecta) Eg. *Bombyx mori* – (silk moth)	14	
2	**Type study & General topic**		**15**	

		Type: Prawn – *Fenneropenaeus* sp. **General Topic:** Economic importance of insects		2
3	**Phylum Mollusca and Echinodermata**		**15**	
	3.1	**Phylum Mollusca** Classification up to classes. Salient features of phylum and classes. (Brief mention only) Class I- Aplacophora Eg. *Neomenia* Class II- Monoplacophora Eg. *Neopilina* Class III Amphineura Eg. *Chiton* Class IV Gastropoda Eg. *Aplysia* Class V Scaphopoda Eg. *Dentalium* Class VI Pelecypoda (Bivalvia) Eg. *Pinctada* Class VII Cephalopoda Eg. *Sepia* **General Topics** 1. Pearl culture Edible molluscs	7	1, 2
	3.2	**Phylum Echinodermata** Classification up to classes. Salient features of phylum and classes. Class I- Asteroidea Eg. *Astropecten* Class II- Ophiuroidea Eg. *Ophiothrix* Class III- Echinoidea Eg. *Echinus* Class IV- Holothuroidea Eg. *Holothuria* Class V – Crinoidea Eg.*Antedon* **General Topics** Water vascular system in Echinodermata	6	
	3.3	**Phylum Hemichordata** Salient features and affinities Eg. Balanoglossus	1	1, 5
	3.4	**Minor Phyla** Salient features of 1. Phylum Chaetognatha Eg. *Sagitta* Phylum Sipunculida Eg. *Sipunculus*	1	
4	**Practicals**		**30**	
	1	**Scientific Drawing:** Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.	5	4
	2	General identification and classification (Phylum, Class, Genus and Species) a). Arthropoda - 6 b). Mollusca - 4 c). Echinodermata – 3 d) Minor Phyla – 2	2	5

	3	**Dissections** 1. Prawn - Nervous system 2. Cockroach - Nervous system	8	3
	4	**Mounting:-** 1. Prawn appendages. 2. Mouth parts - Cockroach/ Plant bug/ Mosquito. (Any Two)	6	3
	5	**Taxonomic identification with key** Identification of insects up to the level of order (Any Three).	3	5
	6	**Larval identification** (Any Two). (Nauplius, Zoea, metazoea, Mysis)	1	2
	7	**Group activity on identification and classification of any five arthropods from college campus. (Group of 3 to 5)** Geotagged photo submission in the form of print out	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Tutorial, ICT enabled learning, Individual/Group activity, Assignment, Seminar
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar **Practical Total = 05 Marks** Lab performance, record, Submission of group activity reports
	B. End Semester Examination **Theory Total = 50 Marks;** **Practical Total = 20 Marks,** Dissection -, Mounting/scientific drawing, Spotter identification/taxonomic identification

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2. Barrington, E.J.W., (1967). Invertebrate Structure and function. ELBS and Nelson, London.
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DSC - COURSE 05

Discipline	**ZOOLOGY**
Semester	**III**
Type of Course	DSC
Course Code	24UZOODSC203
Course Title	**ETHOLOGY**
Course Level	200
Course Summary	This course is designed to unravel the intricate connections between animal behavior and cognitive processes and the fascinating dynamics of how organisms learn, evolve, and exhibit behavioral plasticity in response to their environment.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the basics and advances in ethology.	U	1, 2, 4
2	Describe the role of neural plasticity in learning, memory and behavior.	U	1, 2, 3, 8
3	Analyze the different patterns & mechanisms of animal behavior.	An	1, 2, 3, 8
4	Distinguish the nature and characteristics of social behaviour.	U	1, 2
5	Interpret different animal communications.	A	1, 2, 6, 8

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Introduction to Ethology**		**3**	
	1.1	Historical background and Scope of ethology, Branches of Ethology, Significance of ethology during animal conservation., animal welfare and human society, Ethogram. Contributions of Pavlov, Frisch and Lorenz		1

2	**Learning, Memory and Neural mechanisms**		**17**	
	2.1	**Neurobiology and Neuroplasticity** Structure of brain-overview. Describe briefly Hypothalamus, Hippocampus and Amygdala; Learning centers in brain- Broca's areas, Wernicke's area and angular gyrus; Motor areas. Physiological changes during learning. Neural Mechanisms of Behavior	6	2
	2.2	**Motivation & Learning** Innate and learned behavior, motivation- learning model- Lorenz's Psycho-Hydraulic Model of Motivation Types of learning: Habituation, Sensitization, Associative learning – Classical Conditioning, Operant Conditioning, Taste Aversion, Cognitive learning- Latent learning, Trial and error learning, Insight learning, Imitation, learning set learning, Imprinting, Instinct	9	2
	2.3	**Memory** Short term & long term memory., Consolidation of memory. Role of sleep in memory consolidation.	2	2
3	**Patterns & Mechanisms of Animal Behaviour**		**22**	
	3.1	**Reproductive behavior & Parental care** Reproductive strategies, Types of Mating systems, Sexual selection, Courtship behavior in invertebrates (Scorpion) & vertebrates (Stickle back fish), Parental care & investment. Influence of hormones on sexual behavior, maternal behavior and parental behavior.	7	1,3
	3.2	**Complex behavior** Orientation, Navigation, Migration (birds), Homing instinct, Hibernation, Aestivation, Biological rhythms – Circadian, Circannual, lunar periodicity, tidal rhythm, Biological clock, Physiological concepts of wakefulness and sleep. Physiological basis for emotionality and stress	9	1, 3
	3.3	**Defensive behavior and biomimicry** Camouflage, Cryptic coloration, Disruptive coloration, Aposematic coloration, Mimicry – Batesian, Mullerian and Aggressive Mimicry, Biomimicry.	6	1, 3
4	**Social Behavior**		**18**	
	4.1	Socio – biology (brief account), Cost and benefits of group living, Group selection, Kin selection, Altruism, Reciprocal altruism, Alarm call	4	4

	4.2	**Social organization** Territoriality- territory marking in animals, Aggressive behavior, Foraging behavior, Aggregation – schooling in fish. Social organization in insects (ants, honeybees), Mammals (Primates) Activity –Behavioral study/ behavioral conditioning of any one organism based on observation	6	4
	4.3	**Animal Communication** Components of Communication, Types of Communication – Visual, Auditory, Olfactory, Tactile, Chemical – Pheromones, Types of pheromones, Pheromonal communication in ants and mammals. Bee Dance in honeybees.	8	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** ICT Enabled Learning, Experiential learning, Tutorial, Lecturing,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) Theory Total = 30marks** Quiz, Test Papers, Seminar, Activity Report (on behavioral study)
	B. End Semester Examination **Theory Total = 70 marks, Duration 2 hrs** Short Essays 8 out of 18 x 4 = 32 Marks; Short questions - 14 out of 16 x 2 = 28 Marks Fill in the blanks - 10x1 =10 Marks

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DSC - COURSE 06

Discipline	**ZOOLOGY**
Semester	IV
Type of Course	DSC
Course Code	**24UZOODSC205**
Course Title	**ANIMAL DIVERSITY - CHORDATA I**
Course Level	200-299
Course Summary	The course gives an overall idea of the classification of chordates and highlights the differences between different classes of chordates up to Class Reptilia. It also sheds light on the evolutionary significance of certain animals, the connecting links between two groups. It also helps in the identification of poisonous and non-poisonous snakes. The course enables skill development in understanding the diversity, systematic position, and economic importance of chordates.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Classify Chordata up to class and Class amphibia and Reptilia up to order.	An	2
2	Examine the general characters of protochordates, agnatha, pisces, amphibia, and reptilia.	U	2
3	Describe fish migration, scales, parental care, and accessory respiratory organs.	U	2
4	Describe the different organ systems of frogs and the key characteristics of both poisonous and non-poisonous snakes.	A	2
5	Demonstrate expertise in the laboratory in mounting scales and identifying specimens.	A, S	2

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C) Skill (S)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Classification of Chordata (13 hours)**			
	1.1	**Introduction** General Characters and outline classification of Chordata up to class.	2	1, 2
	1.2	**Protochordates**: General characters and Classification	1	1, 2
	1.3	Sub phylum: Urochordata Class I Larvacea Eg. Oikopleura (mention paedogenesis and Oikopleuran house) Class II Ascidiacea Eg: Ascidia (Mention Retrogressive Metamorphosis) Class III Thaliacea Eg: Doliolum	4	1, 2
	1.4	Sub phylum: Cephalochordata Example - Amphioxus (Structure and affinities)	3	1, 2
	1.5	Sub phylum: Vertebrata General characters and Classification Division 1– Agnatha Class I Ostracodermi Eg: Cephalaspis Class II Cyclostomata Eg: Petromyzon Division 2 – Gnathostomata	3	1, 2
2	**Superclass Pisces (13 hours)**			
	2.1	Super class Pisces General Characters and Classification	1	1, 2
	2.2	Class: Chondrichthyes - General Characters Subclass – Elasmobranchii Eg: Shark Subclass - Holocephali Eg: Chimaera	2	1, 2
	2.3	Class: Osteichthyes - General Characters Sub class – Choanichthyes Order 1 Crossopterigii (Coelocanths) *Eg: Latimeria* (Evolutionary Significance) Order 2 Dipnoi *Eg*: *Lepidosiren* Sub class: - Actinopterygii Super order 1. Chondrostei Eg: *Acipencer* Super order 2. Holostei Eg: *Amia* Super order 3. Teleostei Eg: *Sardine*	4	1, 2
	2.4	General topics 1. Accessory respiratory organs in fishes. 2. Parental care in fishes. 3. Scales in fishes. 4. Migration in fishes	6	3
	Super class: Tetrapoda (19 hours)			

3	3.1	**General characters**	1	2
	3.2	**Class Amphibia** – General characters, Classification up to Orders. Mention the extinct orders. Order I Anura *Eg: Hyla* Order II Urodela Eg: Ambystoma (mention axolotl larva and Paedomorphosis /neoteny) Order III Apoda Eg: *Ichthyophis*. Mention *Nasikabatrachus sahyadrensis*	3	1, 2
	3.3	Class Amphibia - Type Frog (*Euphlyctis hexadactylus*)	10	4
	3.4	Class Reptilia - General characters, Classification up to Orders Sub class I: Anapsida Order Chelonia Eg: Chelone Sub class II: Parapsida Eg: Ichthyosaurus Sub class III: Diapsida Order I Rhynchocephalia Eg: Sphenodon Order II Squamata Eg: Chamaeleon Order III. Crocodilia Eg:Crocodylus Sub class IV: Synapsida Eg: Cynognathus	2	1, 2
	3.5	General topics 1. Identification of venomous and non- venomous snakes 2. Common venomous and non- venomous snakes of Kerala 3. Biting mechanism of snakes	3	4
4	**Practical (30 hours)**			
	4.1	**Scientific Drawing** Make scientific drawing of 3 locally available vertebrate specimens belonging to different Classes	3	5
	4.2	**Dissections** Frog: Photographs/diagrams/one dissected & preserved specimen each/models /virtual Dissections may be used for study 1. Frog Viscera 2. Frog Digestive System 3. Frog Arterial System 4. Frog 9 th & 1st Spinal nerve 5. Frog Sciatic Plexus 6. Frog Brain	6	
	4.3	Mounting of placoid scales; study of cycloid and ctenoid scales	4	
	4.4	**Osteology** Frog vertebrae - typical, atlas, 8th and 9th Pectoral and pelvic girdles of Frog Turtle/Tortoise - plastron and carapace	4	

	4.5	Study of sections. *Amphioxus* T. S. through pharynx/T.S. through intestine	1	5
	4.6	**Identification**: A. **General identification**; Identify, classify and describe the following animals by their scientific names. Protochordata-1, Pisces-5, Amphibia-5, Reptilia- 5 B. **Taxonomic identification with key**: i) Identification of fishes up to the level of order (any 4 different orders). ii) Identification of snakes up to family (any 2 venomous and 2 nonvenomous snakes). C. Identification of different types of caudal fins	4 4 1	
	4.7	Group activity- Report presentation of homestead/campus biodiversity of Amphibia and Reptilia/fish diversity of the locality	3	
	Teacher Specific Module			

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Videos, PPT, Field trips, Zoo Visit, Fish landing centre visit
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total=25 marks** Quiz, Test Papers, seminar **Practical Total =05 marks** Lab performance, record, submission of group activity
	B. End Semester Examination **Theory Total = 50 marks,** **Practical Total = 20 marks,** Dissection Mounting/ scientific drawing/section Spotter identification/ osteology/taxonomic identification

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DSC - COURSE 07

Discipline	Zoology
Semester	IV
Type of Course	DSC
Course Code	24UZOODSC206
Course Title	Fundamentals of Statistics and Data Visualisation
Course Level	200-299
Course Summary	This course provides a comprehensive exploration of bioenergetics, enzymology, biomolecules and metabolism. Students will have a deep understanding of the chemical foundations of life.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain how energy is released into high-energy compounds capable of driving biochemical reactions.	U	1
2	Describe the role of enzymes in catalyzing reactions.	U	2
3	Illustrate the structure and function of the chemical building blocks of life -carbohydrates, proteins, lipids, and nucleic acids	U	2
4	Explain the primary metabolic pathways that power cells and metabolic disorders.	U	2
5	Prepare standard solutions and test the presence or absence of biomolecules in various samples.	A, S	1,2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description (Theory)	Hrs	CO No.
1		**Biomolecules**	**17**	
	1.1	**Carbohydrates:** Biological function. Classification- Monosaccharides- Fischer's and Haworth's structure of Glucose, Fructose, Galactose, Mannose. Oligosaccharides – Maltose, Lactose and Sucrose.	5	3

		Polysaccharides- Glycogen, Chitin, Hyaluronic acid. Enantiomers, Anomers, and Epimers.		
	1.2	**Proteins:** Biological function. Amino acids- Basic structure. Zwitterions. Isoelectric point. Essential and non-essential amino acids. Ketogenic and Glucogenic amino acids (examples). Levels of organization of proteins - primary (Insulin), secondary (Collagen), tertiary (Myoglobin) and quaternary structure (Haemoglobin). Mention Ramachandran plot. Chaperons.	4	3
	1.3	**Lipids:** Biological function. Basic structure- Triglycerides. Fats, oils and waxes. Saturated and unsaturated fatty acids, Cis and trans fatty acids. Reactions- Saponification, Rancidity. Generation of free radicals and role of antioxidants. Cholesterol and its importance. Physiological functions of Sphingolipids and Phospholipids.	5	3
	1.4	**Nucleic acids:** Biological function. Basic structure- Purines and Pyrimidines, Nucleosides and nucleotides. RNA (m-RNA, t-RNA, r-RNA) and DNA (A, B and Z model).	3	3
2		**Enzymology**	**9**	
	2.1	**Enzyme Chemistry** Chemical nature of enzymes. Holoenzyme, Apoenzyme, Non-proteinaceous enzymes: ribozymes, DNA enzymes, Abzymes. Coenzyme, Cofactor. Classification (I.U.B. system).	2	2
	2.2	**Enzyme Kinetics** Mode of action of enzymes- lowering of Activation energy, Michaelis-Menten Curve. Km and its significance. Factors affecting enzyme-catalyzed reaction.	4	2
	2.3	**Enzyme Inhibition** Reversible inhibition (Mention competitive, uncompetitive and noncompetitive) (eg: methanol inhibition of ADH), irreversible inhibition (eg: Iodoacetate inhibition of SDH), and feedback enzyme inhibition (eg: citrate inhibition of glycolysis). Isoenzymes (eg: LDH) and Allosteric enzymes (eg: PFK-1).	3	2
3.		**Bioenergetics** & **Metabolism** (structural details not expected)	**19**	
	3.1	Free energy changes, coupled reactions, redox	2	1

		reactions. High energy compounds.		
	3.2	Overview of Metabolic pathways- Anabolic and Catabolic pathways **Carbohydrate** - Cellular respiration – Glycolysis - aerobic and anaerobic (alcohol and lactic acid fermentation), Krebs cycle, Oxidative phosphorylation. Glycogen metabolism- Glycogenesis, Glycogenolysis. Gluconeogenesis, HMP shunt	7	4
	3.3	**Amino acid** - Transamination, Deamination, Urea cycle	2	4
	3.4	**Lipid** - Fatty acid activation, Carnitine Shuttle, and Beta Oxidation of fatty acids.	5	4
	3.5	**Metabolic disorders**- Diabetes, Keto acidosis, Lactose intolerance, Hyperlipidemia, atherosclerosis.	3	4
4		**Practicals**	**30**	
		Calculation of Molarity and normality of solutions. Preparation of standard solutions.	6	5
		Study of the structure of Carbohydrates – Glucose and Fructose using Ball and stick model	2	3
		Study of the structure of Nucleic acids- DNA, RNA and Protein using software tools	6	3
		Qualitative analysis of Carbohydrates, Proteins and lipids	6	5
		Qualitative analysis of Urease	4	5
		Saponification test	6	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures and presentations Case studies, Visual aids- charts, animations etc. Interactive lectures, group discussions, Laboratory simulations, hands-on activities, Technology Integrating Laboratory Sessions
	MODE OF ASSESSMENT **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz, Test Papers, seminar **Practical Total = 10 marks** Lab performance, record, Test paper

Assessment Types	**B. End Semester Examination** **Theory Total = 50 marks** **Practical Total = 20 Marks,** **Record and Examination** Qualitative analysis- Carbohydrates, Proteins &lipids; Qualitative analysis urease Spotter identification

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DSC - COURSE 08

Discipline	**ZOOLOGY**
Semester	**IV**
Type of Course	DSC
Course Code	24UZOODSC207
Course Title	**APPLIED ZOOLOGY**
Course Level	200-299
Course Summary	To understand experiential learning on the methodology of Poultry Farming, Dairy Farming, Aquaculture, Vermiculture and Entomology
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Distinguish different breeds of cattle, poultry, duck, quail, and cultivable fish and shellfish species.	An, S	1,2,8
2	Explain common diseases of cattle, poultry, and fish.	A, S	1,2,8
3	Identify economically important insects, castes of honeybees, bee products, pollen basket and cocoon.	R, S	1,2,8
4	Explain different aquaculture methods as well as the management of dairy, quail, ducks, and poultry.	An, S	1,2,8
5	Explain milk, milk by-products, Biogas production and test the purity of milk.	An, S	1,2,8

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Poultry and Dairy Farming**	**20**	
	1.1	**Poultry Farming** Introduction, Poultry breeds in India, Broilers and layers, Poultry Housing and Equipment, Poultry feed and its composition, Importance of egg production,	6	1, 3, 4

		Nutritive value of eggs and meat, Diseases and their management.		
	1.2	Husbandry of quail - Breeds in India, Advantages of quail rearing - Housing, feeding and management of quail.	3	1, 4
	1.3	Husbandry of ducks - Breeds in India, Advantages of duck rearing - Housing, feeding and management of ducks	3	1, 4
	1.4	**Dairy Farming** Importance, Scope and management of farm animals. Breeds of cattle, housing system, nutrition requirements. Importance of artificial insemination	4	1, 4
	1.5	Milk, milk by-products. Biogas production.	1	5
	1.6	Common Cattle diseases: Anthrax, Foot and Mouth disease, Rinderpest	3	3
2		**Economically Important Insects**	**20**	
	2.1	Useful Insects: Honey bee, silk worm, Black soldier fly. Apiculture	10	3
	2.2	Pests of paddy - *Leptocorisa acuta* (Rice bug)]; Pests of coconut - *Oryctes rhinoceros* (Rhinoceros beetle), Pests of stored products - *Sitophilus oryzae* (Rice weevil).	5	3
	2.3	Vectors of public health importance – Mosquitoes- elephantiasis, malaria, chikun guinea, dengue, zika & Housefly – typhoid, dysentery	5	3
3		**Aquaculture**	**20**	
	3.1	Introduction & scope, Advantages and salient features, Types of aquaculture, Biotic and abiotic factors affecting aquaculture.	5	4
	3.2	Pond culture, Brief Description of common cultural fishes of Kerala, Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Mussel culture, Prawn culture. Important Fish Diseases. Fish preservation and processing.	10	4, 2
	3.3	Aquarium management: Setting up of an Aquarium.	5	4

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Report on activities, Videos Group discussions and presentation

Assessment Types	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)** **Theory Total =30 marks** Quiz, Test Papers, seminar, report submission of activity
	B. End Semester Examination **Theory Total = 70 marks,**

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DSC - COURSE 09

Discipline	**ZOOLOGY**
Semester	**V**
Type of Course	DSC
Course Code	24UZOODSC301
Course Title	**ANIMAL DIVERSITY CHORDATA - II**
Course Level	300
Course Summary	The course is designed to understand the characteristics and basic classification of Aves and Mammals along with an attempt to provide an insight on the concepts of comparative anatomy
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge in animal taxonomy

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe the classification and general characters of Aves and mammals	U	1, 2
2	Compare different systems of Pigeon and Rabbit.	An	1, 2
3	Identify the avian and mammalian fauna and their peculiarities.	U, A	1, 2
4	Explain flight adaptations in birds, endemic birds of the Western Ghats, and aquatic mammals.	U	2
5	Field visit/Study tour	A, E	2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Class Aves - 16 hours**			
	1.1	General characters - Aves **Subclass Archaeornithes** Eg.: *Archaeopteryx* **Subclass Neornithes.** Super order Paleognathae: eg: *Struthio* Super order Neognathae: Brahminy Kite	3	1

	1.2	**Type: Pigeon** (*Columba livia*) External characters, Skeletal System (Skull may be excluded), Respiratory System, Digestive system, Circulatory system, Excretory system, Reproductive system, Nervous system and sense organs	10	2
	1.3	**General Topics**. Flight adaptations in Birds. Endemic birds of Western Ghats with special reference to Kerala (Nilgiri - Wood Pigeon, Malabar Grey Hornbill, Malabar Barbet, Malabar Parakeet, Malabar Wood shrike, White-bellied Tree pie, Nilgiri Flower pecker, Crimson-backed Sunbird, Broad- tailed Grass bird, Flame-throated Bulbul, Grey- headed Bulbul, Rufous Babbler, Wynand Laughing thrush, White-bellied Blue Flycatcher, Nilgiri Flycatcher, Malabar Starling, Black-and-orange Flycatcher, Palani Laughing thrush, White-bellied Blue Robin) (brief mention only)	3	4
2	**Class Mammalia- 15 hrs**			
	2.1	General characters and Classification of Mammals. (Modified version of McKenna and Bells Classification - Updated in 2005 with contributions from Don E. Wilson and DeeAnn M Reeder) **Subclass Prototheria** Order Tachyglossa. Eg: Echidna Order Platypoda. Eg: Platypus **Subclass Theria.** Infra class- Metatheria Eg: *Macropus* Infra class - Eutheria Order Rodentia. Eg :*Funambulus* Order Chiroptera. Eg : *Pteropus* Order Soricomorpha Eg : Mole Order Afrosoricida. Eg : Tenrec Order Erinaceomorpha. Eg : Hedgehog Order Primates Eg : Lion tailed Macaque Order Artiodactyla. Eg: Camel Order Perissodactyla Eg. Rhinoceros Order Cetacea. Eg. *Delphinus* Order Hyracoidea. Eg. Procavia Order Sirenia. Eg .Dugong Order Proboscidea. Eg: Elephas Order Tubulidentata Eg : Aardvark Order Carnivora. Eg: *Panthera tigris*	5	1, 3

		Order Lagomorpha. Eg : Rabbit Order Xenarthra. Eg: Armadillo Order Scandentia. Eg: Tree shrews Order Macroscelidea. Eg : Elephant Shrews Order Pholidota. Eg: Pangolin		
	2.2	**Type: Rabbit** External Characters, Integumentary system and Glands, Axial and Appendicular Skeleton (Skull bones may be avoided), Digestive System (Mention Dentition and Secondary digestion), Respiratory System, Circulatory system, Urinogenital system, Nervous system and sense organs	8	2
	2.3	**General Topic** Adaptations of aquatic mammals with representative examples from Sirenia and Cetacea	2	4
3	**Comparative Anatomy of Selected Vertebrates - 14 hrs**			
	3.1	**Type Specimens (**Pigeon and Rabbit - Brief study only) Integumentary System, Locomotor organs, Skeletal System: Axial Skeleton (skull excluded), Appendicular skeleton, Digestive System, Circulatory System, Respiratory system, Sense organs, Urinogenital system	14	2
4	**Practical - 30 hrs**			
	4.1	Field Study/Study tour	15	5
	4.2	Study of specimens (5 Birds and 5 Mammals)		3
	4.3	Prepare and write in the record, the list of the common names and scientific names of smallest/ biggest/tallest/ heaviest/ other peculiarities/ animals of different states /national animal etc. from all classes of animals.		3
	4.4	Study of Skeletal Structures: Bird- Heterocoelous vertebra, Synsacrum, pygostyle, keel and sternum Mammals: Skull with special reference to dentition (Diastema/Carnassial teeth), vertebrae, pectoral girdle, pelvic girdle		2
	4.5	Study of arterial system of bird and mammal using pictures		2
	4.6	Study of different parts of Heart and Kidney of rabbit from photograph/picture		2
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Verbal Teaching, Video Classes, Documentaries, Seminars, Album making,
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 05 marks** • Lab involvement and practical skills - 5 Marks • Record/Any other method as may be required for specific course / student by the course faculty - 2.5 mar
	B. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments. • Record

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DSC - COURSE 10

Discipline	**ZOOLOGY**
Semester	**V**
Type of Course	DSC
Course Code	24UZOODSC302
Course Title	**CELL BIOLOGY AND MOLECULAR BIOLOGY**
Course Level	300
Course Summary	Encompasses the study of cells at the molecular level, exploring topics such as cellular diversity, cell structure, membrane dynamics, cell cycle, DNA structure and replication, prokaryotic gene expression and regulation, and basics of cancer biology. The course emphasizes the practical applications of cellular and molecular biology.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge cell biology and molecular biology and have a natural intelligence.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain cell theory, cell structure, cellular diversity, cell communication, and the structure and functions of the cell organelles, nucleus, and plasma membrane.	U	1, 2
2	Compare the stages of mitosis and meiosis.	A	1, 2
3	Describe the types, diagnosis, and treatment of cancer.	A	1,2
4	Explain the nature of genetic material, the principles of prokaryotic gene expression, and its regulatory mechanisms.	A	1,2
5	Prepare blood and buccal smear to identify blood cells and the Barr body and extract DNA.	C	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Overview of cells and cellular dynamics (16 Hours)**			

	1.1	Diversity of cells: Brief history, Cell theory	1	1
	1.2	Prokaryotes - Bacteria in detail and Mycoplasma Eukaryotic cell (Brief account) Difference between Prokaryotes and Eukaryotes Virus, Virions and Viroids, Prions	2	1
	1.3	Origin of Eukaryotic cell - Endosymbiotic theory Structure and functions of: Cytoskeleton, Endoplasmic reticulum, Ribosomes (Prokaryotic and Eukaryotic), Golgi complex , Lysosomes, Mitochondria	4	1
	1.4	Interphase nucleus, nuclear membrane, pore complex, nucleolus (in detail), Chromatin	3	1
	1.5	Cell cycle - Interphase, Mitosis, meiosis. Difference between Mitosis and Meiosis Cancer - types, diagnosis and treatment (only brief account)	6	2,3
2	**Plasma membrane (14 Hours)**			
	2.1	Structure of plasma membrane (Sandwich model, Unit membrane and Fluid mosaic model)	2	1
	2.2	Modifications of plasma membrane - Cell junctions - Tight junctions, Desmosomes, Gap junctions. Cell coat and Cell recognition - Basic principles of cell communications	4	1
	2.3	Cell signaling - Types of signaling and signaling molecules - hormones, nitric oxide, neurotransmitters, vitamins A and D derivatives, cytokines. Cell signaling pathways - (cAMP and RTK)	6	1
	2.4	Functions of Plasma membrane: Transport - Diffusion, facilitated diffusion, Osmosis, Passive transport, Active transport, bulk transport, role of cell membrane in cell communication.	2	1
3	**Nature of Genetic material and Expression of Gene (15 Hours)**			
	3.1	Structure and types of DNA and RNA.	2	3
	3.2	Modern concept of gene (Cistron, muton, recon)., Brief account of the following -- Split genes (introns, and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons	3	3
	3.3	**Prokaryotic Gene expression and regulation:** Central Dogma of molecular biology and characteristics of genetic code DNA replication (theta and rolling circle) Gene Expression: Transcription, Translation and Reverse transcription.	10	3

		Prokaryotic Gene regulation: (inducible and repressible systems) Operon concept - Lac operon and Tryptophan operon		
4	**Practical (30 hours)**			
		Cell Biology (20 hours)		
	4.1	Squash preparation of onion root tip for mitotic stages.		2
	4.2	Squash preparation of grasshopper testes for meiotic stages (Demonstration).		2
	4.3	Identification of cell organelles (using models, pictures).		1
	4.4	Identification of Barr body from human buccal epithelium.		5
	4.5	Preparation of human blood smear and identification of leukocyte.		5
		Molecular Biology (10 hours)		
	4.6	Study and interpretation of electron micrographs/ photograph of DNA, DNA replication, RNA different types.		4
	4.7	Study of Polytene chromosomes from *Chironomus/Drosophila* larvae (Demonstration).		4
	4.8	Extraction of DNA from plant/ tissue samples.		5
		ACTIVITY Prepare posters on cellular diversity Make models of DNA and RNA		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

<table>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT

A. Continuous Comprehensive Assessment (CCA)
Theory: 25 marks
• Involvement and responses in class room transactions - 5 marks
• Home Assignments/preparedness - 5 marks
• Oral presentation/Viva/Quiz/Open book test/written test - 5 marks)
• Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks
• Any other method as may be required for specific course / student by the course faculty – 5 marks
Practical: 05 marks
• Lab involvement and practical skills
• Record/Any other method as may be required for specific course / student by the course faculty</td></tr>
<tr><td>B. End Semester examination (ESE)

Theory: 50 marks

• Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks
Practical: 20 marks

• Practical based assessments:
• Record</td></tr>
</table>

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1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.
2. Becker, W. M., Kleinsmith, L. J., Hardin, J., & Bertoni, G. P. (2019). The World of the Cell (8th ed.). Benjamin Cummings.
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4. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments (7th ed.). Wiley.
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SUGGESTED READINGS

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DSC - COURSE 11:

Discipline	**ZOOLOGY**
Semester	**V**
Type of Course	DSC
Course Code	24UZOODSC303
Course Title	**FUNDAMENTALS OF GENETICS**
Course Level	300
Course Summary	This course covers the foundational aspects of genetics, offering a comprehensive understanding of inheritance, molecular mechanisms, genetic variation, and their practical applications.
Hours	60 (Lecture/Tutorial – 60)
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Discuss Mendelian principles of inheritance and gene interactions; apply these to predict the outcome of genetic crosses	U, A, An	1,2
2	Understand and analyze genetic recombination, linkage and sex determination, and solve problems related to these phenomena.	U, An	1, 2
3	Evaluate the mechanism of mutation and generate awareness about the impact of various chemicals and drugsused in day-to-day life	E, A	2, 4
4	Comprehend the organization of genetic material	U, An	2
5	Familiarize with genetic diseases and analyze their pattern of inheritance	U	1, 4
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Principles of Transmission Genetics (22 Hours)**			
	1.1	**Mendelian inheritance and Chromosome Theory:** Mendel's Experiments- Monohybrid cross, dihybrid cross, test cross, back cross, reciprocal cross (Genetic problems to	8	1

		be included). Principles of inheritance, Chromosome theory of heredity. Activity Problems on genetics		
	1.2	**Extension of Mendelism:** Interaction of genes: (Brief account with one example each) **I**ncomplete dominance, Co-dominance, Complementary, Supplementary, Dominant and Recessive epistasis, Polygenes, pleiotropism, Modifying genes, Lethal genes. Multiple allelism - ABO Blood group system, Rh group and its inheritance in human, Erythroblastosis fetalis. Pseudo autosomal genes, sex-limited, sex-influenced, sex-linked genes and holandric genes. Mitochondrial inheritance (Brief account only).	10	1
	1.3	**Linkage and Recombination:** Linkage and recombination of genes based on Morgan's work in Drosophila (Complete and incomplete linkage). Recombination mapping using two point test cross.	4	2
2	**Sex determination (10 Hours)**			
	2.1	**Basics of sex determination:** Chromosome theory of sex determination (sex chromosomes and autosomes), Chromosomal mechanism (XX-XO, XX-XY, ZW- ZZ). Genic balance theory	3	2
	2.2	Sex determination in Honey bees, Drosophila (Intersex) and Man. Role of SRY genes and gonad development. Hormonal influence & Environmental influence on sex determination.	4	2
	2.3	Barr bodies, Dosage compensation and Lyon hypothesis, gynandromorphs, mosaic Hermaphroditism-Freemartin	3	2
3	**Mutations (10 hours)**			
	3.1	**Types of Mutations**: Germinal & Somatic, Spontaneous & Induced mutations. Chromosomal mutation - structural and numerical aberrations.	3	3
	3.2	Molecular basis of gene mutation – tautomerism, addition, deletion, substitution, frame shift mutation.	3	3
	3.3	Factors affecting mutation, mutagens and their mode of action. Detection of mutation - CIB method	4	3
	Cytogenetics and Genetic disorders (18 hours)			

4	4.1	Nucleus & Chromosome structure: Chromatin (euchromatin, heterochromatin), Chromosome – structure, types, different levels of organization (Nucleosomes, Solenoid, Chromosome loop), Giant chromosomes (Polytene and Lampbrush chromosomes), Karyotyping - Normal human chromosome complement.	5	4
	4.2	Human chromosomal anomalies: Autosomal (Down syndrome, Edward's syndrome and Cri du chat syndrome). Sex chromosomal anomalies (Klinefelter syndrome, and Turners syndrome), Single gene disorders - Sickle cell anemia, cystic fibrosis¸Tay Sachs disease. **ACTIVITY:** Study of syndromes and karyotypes using photograph	5	5
	4.3	Inborn errors of metabolism: Genetic basis of Phenyl ketonuria, Alkaptonuria, Albinism	3	5
	4.4	Multifactorial disorders - Cleft lip and cleft palate.	1	5
	4.5	Pedigree Analysis (Brief account only) – Pedigree symbols and construction of Pedigree.	2	5
	4.6	Human Genome Project (Brief account only), Genetic counselling- Eugenics and Euthenics.	2	5
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory: 30 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks • Activity – 5 marks

	B. End Semester examination (ESE) **Theory: 70 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks

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1. Benjamin, L. (2004). Gene VIII. Oxford University Press.
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9. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons
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11. Vijayakumaran, N. K. (2017). Cell Biology, Genetics and Molecular Biology. Academica, Trivandrum.

DSC - COURSE 12

Discipline	**ZOOLOGY**
Semester	**V**
Type of Course	DSC
Course Code	24UZOODSC304
Course Title	**BIOTECHNOLOGY: PRINCIPLES & PRACTICES**
Course Level	300
Course Summary	This course encourages the students to master the fundamental principles underpinning genetic engineering and provides insight into the transformative applications shaping the forefront of modern science and industry.
Hours	60 (Lecture/Tutorial – 60)
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the principles and techniques of rDNA Technology	U	1, 2, 7, 8
2	Describe techniques in cell culture & genetic engineering.	U	1, 2, 8
3	Analyze the biotechnological applications in various fields	An	1, 2, 4,5, 6
4	Describe biosafety concerns in biotechnology	U	1, 2, 3, 4, 6
5	Explain the provisions for the protection of intellectual property.	U, E	1, 3, 5, 6, 8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Fundamentals of Recombinant DNA Technology (20 Hours)**			
	1.1	**Introduction to Biotechnology** Historical background, Prospects of biotechnology	2	1

	1.2	**Tools & Techniques** Enzymes- restriction enzymes, ligases, polymerases. Vectors- Plasmids, Bacteriophage-derived vectors, artificial chromosomes. Techniques- DNA Extraction (Brief account of RNA & plasmid extraction), Electrophoresis- Agarose Gel, PAGE. PCR-Principle & application. Hybridization of nucleic acid- Southern and Northern blotting. DNA sequencing-Sanger sequencing, Next Generation Sequencing (NGS) (Brief account only) Brief account of protein/proteome; identification/sequencing - (using a flowchart/schematic representation only)	10	1
	1.3	**rDNA technology** Gene isolation, integration of the desired gene into Vector, Insertion of rDNA into host cell. Screening methods of recombinants. Gene transfer - Transformation, Transduction, Transfection, Retro-virus, Gene gun, Microinjection, Electroporation, Ultrasonication. Genomic and cDNA library. **(Brief description only)**	8	1
2	**Cell culture and Genetic Engineering (13 Hours)**			
	2.1	**Cell culture** Animal cell culture-Media-Natural & Synthetic media (one example each) Stem cell- type & uses	3	2
	2.2	**Genetic Engineering** Organismal cloning by nuclear transfer, transgenic technology: development of transgenic animals- Transgenic mice- knock-in, knock - out models, Transgenic *C.elegans*. Cell line transfections. Gene silencing - RNA interference, gene editing - **CRISPR Cas** (brief account only).	10	2
3	**Biotechnology & Human welfare (17 Hours)**			
	3.1	**Medical Biotechnology & Forensics** Gene therapy (SCID). Stem cell therapy - regenerative medicine, Personalized medicine. Development of Pharmaceuticals- biopharmaceuticals of immune system –**(**interferons, IL)	7	3

		Hormones (insulin, somatostatin), Antibiotics, monoclonal antibodies, vaccines. DNA finger printing and its applications. **ACTIVITY** Case studies and report submission and presentation of: any criminal case, disputed paternity etc. based on DNA fingerprinting, from Newspapers [any one		
	3.2	**Agricultural & Environmental Biotechnology** Agriculture: Transgenic plants -Pest resistant (Bt- cotton), herbicide resistant, disease resistant varieties. Microbial pesticides. Qualitative improvement of livestock-Milk production in cows Environment: Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Bio-fertilizers: Algal and fungal biofertilizers (VAM), Bioleaching. Development of Biodegradable polymers-PHB.	6	3
	3.3	**Fermentation Biotechnology: Principles and applications** Enzymes - Amylase¸ Invertase¸ Zymase¸ General overview of synthesis of vitamins, food and beverages Single Cell Proteins.	4	3
4	**A. Biosafety concerns B. Intellectual Property Protection (10 Hours)**			
	4.1	**A. Biosafety concerns** Levels of Biosafety. Risks associated with Genetically Modified Organisms (terminators seeds, impact on biodiversity, transferring transgenes from food to intestinal microbes, toxins/allergens in foods). Biological warfare & biopiracy. Ethics in Cloning	5	4
	4.2	**B. Intellectual Property Protection** Intellectual Property Rights (IPR)- Patents, Indian Patent law (overview).Copyright-TRIPS agreement, Trade secret, trademark, Plant breeder's right, Geographical indication (GI)	5	5
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **C. Continuous Comprehensive Assessment (CCA)** **Theory: 30 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks • Activity- 5 marks
	D. End Semester examination (ESE) **Theory: 70 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 70 marks

REFERENCES:

1. Bhojwani, S.S. & Razdan (2004). Plant Tissue Culture and Practice.
2. Brown, T.A. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
3. Curell, B.R. et al., (2004) Techniques for Engineering Genes.
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15. Stephenson, F. H. (2016) Calculations for Molecular Biologyand Biotechnology. Academic Press
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17. Wainwright , M. (2012). Introduction to Environmental Biotechnology. Springer, NY.

DSC - COURSE 13:

Discipline	**ZOOLOGY**
Semester	**V**
Type of Course	DSC
Course Code	24UZOODSC305
Course Title	**WILDLIFE MANAGEMENT**
Course Level	300
Course Summary	To convey basic information of Forests, Wildlife, Man wildlife conflict and Wildlife Conservation.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain biodiversity hotspots, forest ecosystems, and species richness-diversity indices.	U	1,2,8
2	Describe primate biology, ecology, and behaviour; animal barriers; and wildlife, with special reference to mammals, birds, and reptiles.	U	1,2,4
3	Describe conflict.	A	1,2,4,5
4	Explain the threats faced by wildlife, protected areas; research institutes, and types of wildlife conservation.	A	1,2,8
5	Summarise the advances in wildlife conservation.	U	1,2, 4, 5,8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Forest ecosystems (14 Hours)**			

	1.1	Introduction to Forest ecosystems. Structure and functioning, forest succession. Keystone species, flagship species, Umbrella species	5	1
	1.2	Types of Forests - classification, distribution, composition and structure. Estimation of volume of individual tree and forest stands. Species richness- diversity indices (Shannon Weiner; Simpson).	5	1
	1.3	Biodiversity hotspots with special reference to Western Ghats.	4	1
2	**Introduction to wildlife & Man wildlife conflict (18 Hours)**			
	2.1	Wild life - with special reference to Mammals, Birds and reptiles in international, national and local perspective	4	2
	2.2	Introduction to Biology, ecology and behaviour of Primates (Bonnet Macaque), Carnivora (Tiger, Leopard) and Elephants.	7	2
	2.3	Man wildlife conflict- Case studies-(one each) Elephant, Monkey (Bonnet Macaque), Large carnivores (Tiger/leopard) & Wild boar.	6	3
	2.4	Animal barriers: Mechanical and electrical.	1	2
		ACTIVITY: Compilation of newspaper reports and seminar presentation of Wildlife/ Man- Wildlife conflict		
3	**Wildlife Conservation (15 Hours)**			
	3.1	Threats faced by wildlife. Conservation of wildlife- Ex-situ conservation and in-situ conservation. Management of Protected Areas.	6	4
	3.2	National Park, Sanctuaries, Tiger reserves, Biosphere Reserves, Community reserves. Ramsar Sites. Protected areas of Kerala	4	4
	3.3	Research institutes of Wildlife in India. Special projects for wildlife conservation- Project Tiger, Project Elephant, Crocodile Conservation Initiative. Wildlife (Protection) Act, 1972 and 2022 amendments. CITES, TRAFFIC. IUCN red list categories, Red Data Book.	5	4
4	**Advances in Wildlife Conservation (13 hours)**			
	4.1	• Remote sensing (RS): Introduction, definition, brief history, fundamental principle of RS, Stages of RS, Classification of RS: Active and Passive RS- based on	10	5

		source of energy and wavelength; Aerial and space remote sensing, Merits and limitations of RS. Recent developments.		
	4.2	• GIS; GPS; Radio collaring.	3	5
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos
Assessment Types	**MODE OF ASSESSMENT** **E. Continuous Comprehensive Assessment (CCA)** **Theory: 30 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks • Activity – 5 marks
	F. End Semester examination (ESE) **Theory: 70 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 70 marks

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12. Van Dyke, F. (2008). Conservation Biology: Foundations, Concepts, Applications. Springer Science & Business Media.
13. Whitaker, R., & Captain, A. (2008). Indian Snakes: A Field Guide. Draco Books

DSC - COURSE 14:

Discipline	ZOOLOGY
Semester	VI
Type of Course	DSC
Course Code	24UZOODSC306
Course Title	MICROBIOLOGY AND BASIC IMMUNOLOGY
Course Level	300-399
Course Summary	Equips with a solid understanding of the microscopic world and the body's defence mechanisms, laying the groundwork for various professional paths in the biological sciences. Covers the study of microorganisms. explores their structure, function, classification, & role in various processes. Basic immunology delves into the body's defense mechanisms, examining components like antibodies, antigens, & immune responses.
Hours	75 (Lecture/Tutorial – 45, Practical-30)
Credits	4
Pre-requisite, if any	Have basic idea about Microbiology and immunology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Classify major groups of microbes.	U	1
2	Apply skills to isolate, cultivate, and identify microorganisms.	A, S	2
3	Describe the viral replication, viral cultivation, and morphology of bacteria and viruses.	U	1
4	Explain the etiology, symptoms, causative organism, modes of transmission and treatment of specific infections.	A	2
5	Explain the basic concepts of immunology.	A	2
Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.

1		**Introduction and Methods in Microbiology**	**16**	
	1.1	Scope of microbiology-Mention the relevance of Beneficial and harmful microbes.	1	1
	1.2	A brief description of different types of microbes - Bacteria and Archaea, Fungi, Viruses. Outline classification of microbes.	2	1
	1.3	Microbiome –Principles of microbial ecology and interactions within microbial communities. Human microbiomes, Environmental microbiomes. Microbiome research and its applications.	2	1
	1.4	Sterilization methods and disinfection. Culture media, Culture methods, Culture preservation technique. Staining techniques-Gram staining, Capsule staining	6	2
	1.5	Bacterial nutritional requirements. Microbial growth - Growth curve, Measurement of microbial growth- Direct method (viable count) & indirect method (turbidometry). synchronous growth, batch culture, continuous culture.	5	2
2	**A. Microbial Morphology and viral cultivation & B. Infections and Diseases**		**18**	
	2.1	A. Microbial Morphology, Viral Replication and viral cultivation Bacteria- Size, Shape and arrangement, Ultra structure of bacteria, spheroplast, protoplast. Virus: morphology - size, structure & shape. Bacteriophages - T4 Phages & life cycle (Lytic & Lysogenic cycle). Virions¸viroids, prions. Viral cultivation - Chick embryo and cell culture methods.	8	3
	2.2	B. Infections and Diseases Host pathogen interactions. Types of infections- Primary, Secondary and nosocomial infections. Contagious diseases- epidemic, endemic and pandemic Routes of infection-inhalation, ingestion, skin (Direct inoculation), iatrogenic and congenital. Modes of transmission-food, water, air, vectors and carriers. STDs (HIV), Emerging diseases (Corona Virus eg: SARS - Cov-2, Zika Virus), Re-emerging infections (Tuberculosis), Zoonoses (Rabies, Avian Influenza)	10	4
3		**Basic Immunology**	**11**	
	3.1	Cells of the Immune system- (B Cells, T cells, Macrophages, Dendritic cells, Natural Killer cells), Organs of Immune system. Mention Toll-like receptors	3	5

	3.2	Types of Immunity (Innate and Acquired, Passive and Active, Humoral and Cell Mediated)	3	5
	3.3	Antigens. Factors that influence immunogenicity. Haptens, Adjuvants, Epitopes (T cell and B cell Epitopes), Vaccines, Immunoglobulins - structure (basic only), classes and functions of immunoglobulins. Mention Hypersensitivity.	5	5
4		**Practicals**	**30**	
	1	Microbiology lab techniques: Autoclave, Incubator, Oven, Laminar airflow, cotton plugging, sterilization Disinfection.	4	2
	2	Preparation of culture media.Nutrient agar, Nutrient broth	2	2
	3	Culture methods: Streak plating, pour plating	4	2
	4	Viable plate count. (Demonstration)	4	2
	5	Gram Staining, Capsule staining, Fungal Staining	5	2
	6	Hanging drop experiment for motility.	2	2
	7	Identification of Bacterial species – IMViC	4	2
	8	Standard plate count SPC (Demonstration only)	2	2
	9	Antibiotic sensitivity test. (Demonstration)	2	2
	10	Blood typing-ABO	1	5
5		Teacher Specific Module		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	Classroom Procedure (Mode of transaction), Lecture, Tutorial, Videos, Practicals
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory Total = 25 marks: Quiz, Test Papers, seminar Practical Total = 05 marks: Lab performance, record, Lab Test
	B. End Semester Examination Theory Total = 50 marks, Practical Total = 20 marks, Record, Examination.

REFERENCES:

1. Ananthanarayan, R. (2006). Ananthanarayan and Paniker's Text Book of Microbiology. Orient Blackswan.
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1. **Virtual textbook:** Inglis, T. J., Fu, B., & Kwok-Chan, L. (1995). Teaching microbiology with hypertext: first steps towards a virtual textbook. Medical Education, 29(6), 393-396.
2. **You Tube Channel** Birth of microbiology - :https://youtu.be/uKLrhp4Kw2A?si=D75ytk7SNoLYdgBA
3. **Virtual labs:**

a) Virtual amrita laboratories-

1. https://vlab.amrita.edu/?sub=3&brch=73
2. https://vlab.amrita.edu/index.php?sub=3&brch=76

b) McGraw-Hill Virtual Lab: online simulations covering microbiology experiments.

https://www.mheducation.ca/higher-education/learning-solutions/virtual-labs

4. **Interactive websites** :BioMan Biozone, PhET Interactive simulations
5. **Educational platforms**: Swayam, coursera and edX Platforms offering microbiology courses from reputable universities.
6. **Podcasts:** "This week in microbiology (TWiM) podcasts discussing recent developments in the field of microbiology

DSC - COURSE 15:

Discipline	ZOOLOGY
Semester	VI
Type of Course	DSC
Course Code	24UZOODSC307
Course Title	PHYSIOLOGY AND ENDOCRINOLOGY
Course Level	300-399
Course Summary	Provides an enthralling exploration of human physiology. Learn the mysteries of nutrition, the ways in which food nourishes our bodies, and the multifaceted mechanism of respiration - the inhalation of oxygen that maintains life. Unravel the enigmatic realm of excretion, where the removal of waste preserves the equilibrium of our systems. Uncover the mysteries of movement and feeling by venturing into the realm of muscle and neuron physiology. Know about the secret capabilities of hormones in the endocrine system and how these chemical messengers regulate our physical selves.
Hours	75 (Lecture/Tutorial – 45, Practical-30)
Credits	4
Pre-requisite, if any	Have a basic idea about human body systems

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Describe the structure, functions, and mechanisms of human systems such as the cardiovascular, endocrine, respiratory, and nervous systems.	An	1,2
2	Analyse the physiological underpinnings, mechanisms, and impacts of prevalent health issues such as diabetes, nutritional disorders, cardiovascular ailments, neural disorders, kidney disorders, endocrine disorders, and respiratory disorders.	A	1,2
3	Explain homeostasis and feedback mechanisms, renal physiology, and basic aspects of nutritional science.	An	1,2
4	Investigate the intricate interactions between the nervous system and muscles, the mechanisms governing muscle contractions, and the impact of neuromuscular complexities on human movement and physiological function	C	1,2
5	Demonstrate skills in analyzing physiological data and evaluating bodily functions.	A,S	2,8
	Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)		

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	**1**	**Cardiopulmonary Physiology**	**12**	
	1.1	Overview of circulatory system, Cardiac cycle and cardiac output, Haemostasis: Pathways of blood coagulation	3	1
	1.2	Cardiovascular diseases: Atherosclerosis, Myocardial infarction, stroke. ECG (brief) Cardiopulmonary resuscitation (CPR)	2	2
	1.3	Overview of respiratory system, Mechanism of breathing: Inspiration and Expiration, Gas exchange in the alveoli, Oxygen and Carbon Dioxide transport, Oxygen-Hemoglobin dissociation curve; Factors affecting the curve.	3	1
	1.4	Neural and chemical control of respiration, Respiratory problems (Hypoxia, Asphyxia, Hypercapnia, Oxygen toxicity, CO poisoning). Respiration in unusual environments (High Altitude, Diving, foetal).	2	1,2
	1.5	Importance of lung capacity and respiratory efficiency. Breathing exercises: Diaphragmatic Breathing, Pursed lip breathing, and lung expansion techniques, Physical activities and practices to enhance respiratory fitness (very brief account)	2	1
2		**A. Nutritional Science &** **B. Neuromuscular Physiology**	**17 Hours**	
	2.1	A. Nutritional Science Introduction to nutrition, balanced diet, RDA, antioxidants, importance of dietary fibre and water.	2	3
		Disorders: Ulcer, Bulimia nervosa, anorexia nervosa, irritable bowel syndrome. obesity. BMI .		
	2.2	Digestion, absorption, and assimilation of carbohydrates, proteins, and lipids	4	3
	2.3	B. Neuromuscular Physiology Types of neurons, mechanism of nerve impulse conduction, neuromuscular junction, synaptic transmission, types of neurotransmitters Neural disorders: Dyslexia, Parkinson's, Dementia, Alzheimer's, Schizophrenia	5	4

	2.4	Ultrastructure of striated muscle, mechanism of muscle contraction: Sliding filament theory, role of ATP in muscle contraction. Electrophysiology of muscle contraction, Muscle twitch, summation, fatigue, treppe, tetanus. Cori cycle, Rigor mortis.	6	4
3		**A. Renal Physiology & B. Endocrinology 16 Hours**		
	3.1	A. Renal Physiology Structure of nephron, mechanisms of urine formation: glomerular ultrafiltration, tubular re- absorption, tubular secretion, countercurrent exchange	3	3
	3.2	Kidney disorders: glomerular nephritis, pyelonephritis, kidney stones, dialysis, kidney transplantation (brief account)	3	2
	3.3	Role of kidney in homoeostasis	1	3
	3.4	B. Endocrinology Hormone - classification and mechanism of action	1	1
	3.5	Major endocrine glands, their secretions, functions, and disorders (Hypothalamus, pituitary, pineal gland, thyroid, parathyroid, islets of Langerhans, adrenal gland, gonads)	7	1
	3.6	Homoeostasis and feedback mechanisms	1	1
4		**Practical 30 Hours**		
	1	Estimation of the RBC count of blood.		5
	2	Estimation of the WBC Count of blood.		5
	3	Estimation of hemoglobin content.		5
	4	Determination of bleeding time.		5
	5	Determination of clotting time.		5
	6	Determination of erythrocyte sedimentation rate (ESR).		5
	7	Determination of heart rate, pulse rate and blood pressure using sphygmomanometer		5
	8	Analyze the effect of different concentrations of NaCl solution on RBC..		5
	9	Study of endocrine glands		5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction) lecturing with ICT**
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory Total =25 marks, Quiz-, Test Papers, seminar Practical Total = 05 marks, Lab performance, record, Lab Test
	B. End Semester Examination Theory Total = 50 marks, Practical Total = 20 marks – Record, Estimation of RBC/WBC count Estimation of Haemoglobin content/ ESR Spotter identification

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2. Marshall, P., Gallacher, B., Jolly, J., & Rinomhota, S. (2017). Anatomy and Physiology for Healthcare. EBSCO eBook.
3. Morton, D. A., Foreman, K. B., & Albertine, K. H. (2018). Big Picture: Gross Anatomy, Medical Course & Step 1 Review [Access Medicine].
4. Netter, F. H. (2014). Atlas of Human Anatomy. R2 Digital Library eBook.

DSC - COURSE 16:

Discipline	ZOOLOGY
Semester	VI
Type of Course	DSC
Course Code	24UZOODSC308
Course Title	REPRODUCTIVE BIOLOGY AND TERATOLOGY
Course Level	300-399
Course Summary	This Course aims to give an idea about the development process, defects in development and the techniques applied in reproductive biology to rectify the developmental defects which can be an added milestone to the fertility related medicinal filed.
Hours	75 (Lecture/Tutorial – 45, Practical-30)
Credits	4
Pre-requisite, if any	Have basic idea about Microbiology and immunology.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the basic concepts and theories in Reproductive biology.	U	1
2	Describe the different developmental stages in animals.	U	3
3	Analyse various techniques in prenatal diagnostics and assisted reproduction.	An, A	3
4	Differentiate the concepts of Experimental embryology	U	1
5	Compare teratogens, their effects and other common developmental defects.	An	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description (Theory)	Hrs	CO No.
1		**Reproductive Biology**	**22**	
	1.1	Introduction to Reproductive biology, Definition, Theories of development- Preformation theory, Theory of Epigenesis, Recapitulation theory,	2	1

		Germplasm theory, Mosaic theory and Regulative theory		
	1.2	Patterns of development – Oviparity, Ovo-viviparity and Viviparity	1	1
	1.3	Gonads - anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Oestrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, Types of placenta, parturition and lactation.	7	1
	1.4	**Early Embryonic development** **Egg types:** Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and non-cleidoic eggs. Polarity and symmetry of egg. **Fertilization:** Mechanism of fertilization- (Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, capacitation of sperm, Activation of Ovum, Migration of Pronuclei and Amphimixis), Significance of fertilization, Polyspermy. Parthenogenesis- Different types and significance.	5	2
	1.5	**Developmental patterns with special reference to frog and chick** **Blastulation:** Morula, blastula formation, types of blastula with examples. **Fate maps:** Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map. **Gastrulation:** Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Concept of germ layers and derivatives.	7	2
2		**Prenatal diagnostic techniques Assisted**	10	

		Reproductive Techniques		
	2.1	Invasive techniques: Amniocentesis, Chorionic villi sampling, Alfa fetoprotein test, cordocentesis, Foetoscopy, fetal tissue biopsy, Maternal serum beta- HCG. Non-invasive techniques: Ultra sound scanning, MRI, Cell free fetal DNA	4	3
	2.2	Assisted Reproductive Techniques**:** *In vitro* fertilization (IVF) and Embryo transfer (ET), ZIFT, GIFT, ICSI TET in detail	6	3
3		**Experimental embryology & Teratology**	13	
	3.1	Spemann's constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning.	5	4
	3.2	**Significance of model organisms** (*Caenorhabditis elegans, Danio rerio and Mus musculus)* in embryological studies (brief account).	2	4
	3.3	**Teratology:** Teratogenesis, Teratogenic agents [Physical (Radiations), Chemical (Environmental toxins and drugs), Biological (infectious agents)], Teratogenic mechanisms- Genetic mutations, cellular processes and physiological disruptions).	3	5
	3.4	**Developmental defects**: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).	3	5
4		**Practical**	30	
	1	Calculation of gonado-somatic index of fish.	4	3
	2	Male and female reproductive organs in a teleost fish	3	2
	3	Study of placenta – pig and man.	2	2
	4	Study of permanent slides of blastula of frog and chick	3	2
	5	Study of permanent slides of gastrula of frog and chick	3	2
	6	Study of permanent slides of 18 hour, 24 hour, 33 hour and 48 hour chick embryo.	4	2

	7	Candling of eggs	1	3
	8	Study of chick development using live eggs – Vital staining-Window method (Demonstration)	3	2,3
	9	Blastoderm mounting and age determination of chick embryo (18hr/ 24hr/ 33 hr/ 48 hr/ 72 hr) using vital stains.	7	2,3
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure(Mode of transaction)** Lecture, Tutorial (Videos , Practicals)
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory Total =25 marks, Quiz-, Test Papers, seminar Practical Total = 05 marks, Lab performance, record, Lab Test
	B. End Semester Examination Theory Total = 50 marks, Practical Total = 20 marks – Record & Examination.

REFERENCES:

1. Anthony S. Fauci, Eugene Braunwald, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, J. Larry Jameson and Joseph Loscalzo; 2008; Harriosns Principles of Internal Medicine; Chruch Livingston 17th Ed.
2. Balinsky B.I.; 1981 An Introduction to Embryology, W.B. Saunders and Co.
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6. Melissa A Gibbs, 2006; A Practical Guide to Developmental Biology, Oxford university press (Int. student edition)
7. Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc., U.S.; 7th Revised edition.
8. Taylor D J, Green NPO & G W Stout. (2008) Biological Science 3rd edition. Cambridge university press.
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DSC - COURSE 17:

Discipline	ZOOLOGY
Semester	VI
Type of Course	DSC
Course Code	24UZOODSC309
Course Title	ZOOGEOGRAPHY AND EVOLUTIONARY BIOLOGY
Course Level	300-399
Course Summary	Uncover the mysteries of evolution, unravel the geographical distribution of species, and journey through the fossilized record of Earth's evolutionary tapestry.
Hours	75 (Lecture/Tutorial – 45, Practical-30)
Credits	4
Pre-requisite, if any	Have basic idea and terms in evolution.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the origin of earth and life.	U	1,2,5,08
2	Discuss the patterns and factors affecting the distribution of animals on earth.	U	1, 2,3
3	Describe the concept of evolution.	U	2,3, 08
4	Extrapolate evolutionary mechanisms.	A	1, 2, 08
5	Analyse the central role of fossils in evolution.	An	1,2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Zoogeography**	**20**	
	1.1	**Introduction to Zoogeography** Historical Biogeography Origin of oceans and continents, Plate tectonics – continental drift theory, rift valley, African great rift and its consequences- *(recent trends)*	4	1

	1.2	**Dispersal & Migration** Types and means of animal distribution, Factors affecting animal distribution.; Types of animal distribution, Insular fauna – oceanic islands and continental islands with examples	8	2
	1.3	**Zoogeographic realms** Different Zoogeographical Realms- Palearctic, Nearctic, Neotropical, Ethiopian, Oriental, Australian- with their sub regions - their boundaries, physical characteristics, climatic conditions, vegetation and fauna. Wallacea and its fauna; Zealandia **ACTIVITY:** Locating on the world map, zoogeographical realms and the animals endemic	6	2
	1.4	**Biogeography of India** Topographic features and Zoogeography, Western Ghats and its fauna and conservation measures	2	2
2		**Theories and genetic basis of organic evolution**	**14**	
	2.1	**Evolution of life- origin & theories** Brief account of Origin of Earth, Theory of origin life - biochemical origin- by Oparin and Haldane. Urey Miller experiment Lamarckism - Critical analysis of Lamarck's propositions Weisman's germplasm theory, Mutation theory Darwinism-Critical analysis of Darwinism Neo Darwinism Synthetic Theory of Evolution(brief account only) Neutral theory of molecular evolution by Kimura	9	1,3
	2.2	**Genetic basis of organic evolution** Genetic basis of variation, population genetics Hardy Weinberg law-gene pool, gene frequency, gene flow. Factors affecting gene frequencies	5	3
3		**Mechanism of evolution**	**17**	

	3.1	**Isolating Mechanisms** Types of isolating Mechanisms- Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution	3	4
	3.2	**Species and Speciation** Species concept, subdivisions of species- sibling species, deme, cline, semi species, sub-species. Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation.	8	4
	3.3	**Nature of Evolution** Microevolution, Macroevolution Mega evolution, Adaptive radiation – process, causes, types (Darwin's finches, adaptive radiation in placental mammals). Punctuated equilibrium vs Gradualism Homologous and analogous structures	6	4
4		**Palaeontology**	**9**	
	4.1	**Fossils & Fossilization** Definition and scope of Palaeontology Types of Fossilization, Types of fossils, microfossils, Index fossils, trace fossils and living fossils, Transitional fossils Dating of fossils	4	5
	4.2	**Trends in Evolution** Convergent evolution. Co-evolution. Mass extinction. Geological Time Scale: Major events in different stages with special reference to connecting links and fossils in human evolution (brief reference to African origin on modern man- Mitochondrial Eve and Y chromosomal Adam).	5	5
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning.

Learning Approach	
Assessment Types	MODE OF ASSESSMENT A. Continuous Comprehensive Assessment (CCA) Theory Total =25 marks, Quiz-, Test Papers, seminar Practical Total = 05 marks, Lab performance, record, Lab Test
	B. End Semester Examination Theory Total = 50 marks, Practical Total = 20 marks – Record & Examination

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1. Bell, G. (1996). Selection: The Mechanism of Evolution. Chapman & Hall
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6. Stearus, S. and Hoeksra, R. (2000). Evolution: An Introduction. OUP, USA
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DSC - Course 18:

Discipline	**ZOOLOGY**
Semester	**7**
Type of Course	DSC
Course Code	24UZOODSC401
Course Title	**BIOPHYSICS, INSTRUMENTATION AND DIAGNOSTIC IMAGING TECHNIQUES**
Course Level	400-499
Course Summary	To understand and interpret the basics of biophysics & facilitate an understanding of the principle, design, working & applications of various instruments & imaging techniques relevant to biology and medicine.
Hours	75 (Lecture/Tutorial – 45, Practical-30)
Credits	4
Pre-requisite, if any	Should have inclination towards have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No.
1	Explain the theoretical underpinnings of biophysics and bioenergetics.	A	2
2	Describe the concepts of radiation physics, radiation detection, & applications.	A	1
3	Compare the underlying principles, designs, and workings of different separation techniques, microscopes, analytical instruments, diagnostic imaging techniques, and electrophysiological methods.	An	2
4	Explain the utility of bio instruments and their importance in biology.	U	2
5	Apply skills in using the camera Lucida, TLC, micrometry, colorimetry, centrifuge, and pH meter.	A, S	2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Foundation Concepts in Biophysics and Bioenergetics**	**7 Hours**	

	1.1	**Principles of Biophysics** Diffusion- Kinetics of diffusion, Fick's law and diffusion coefficient, Stoke-Einstein's law, Gibb's Donnan equilibrium, Biological importance of diffusion. Applications of diffusion process in Biology. Osmosis - osmotic concentration, osmotic pressure and osmotic gradient, Ant Hoff's laws, Electro-osmosis, Electrolyte and ionic balance in biological fluid. Biological significance of osmosis.	5	1
	1.2	**Bioenergetics** Laws of Thermodynamics, Reversible and Irreversible Thermodynamics, Entropy, Enthalpy, Gibb's Free energy, Carnot cycle, Chemical potential.	2	1
2		**Radiation Biophysics**	**12 Hours**	
	2.1	**Radiation Biology** Nature of radioactivity, Units of radioactivity. Interaction of radiation with matter. Ionizing radiations, Cherenkov radiations. Radioactive isotopes. Radiation dosimetry. Biological effects of radiation.	3	2
	2.2	**Radiation detection** Ionization chamber, Liquid scintillation counter, Geiger-Muller (GM) counter, Semiconductor detectors	3	2
	2.3	**Applications:** Diagnosis and Radiotherapy, Radioimmunoassay, Autoradiography, Radio tracer techniques, Nuclear Medicine.	2	2
	2.4	R**adio-Ultrasound Imaging Techniques for diagnosis**: X-ray radiography**,** Angiography, PET, MRI, fMRI, CAT, Ultrasound Imaging.	4	3
3		**Instrumentation**	**26 Hours**	
	3.1	**Microscopy:** Light microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Confocal Microscopy, Electron Microscopy- Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), STEM, Specimen preparation- shadow casting, freeze fracturing, Freeze etching. Electron Cryo-Microscopy.Micrometry and Camera Lucida	5	3,4
	3.2	**Separation Techniques** Centrifuge- Principle and applications, high-speed centrifuge, Density gradient centrifuge,		

		Ultracentrifuge, Decanter centrifuge. Chromatography-Principle and applications, Column Chromatography, Ion exchange chromatography, HPLC, Gas Chromatography. Electrophoresis- Principle and applications, Gel electrophoresis-SDS PAGE, 2D Gel electrophoresis, Disc electrophoresis, Agarose Electrophoresis, High voltage electrophoresis, Capillary electrophoresis, Electrophoretic mobility shift assay (EMSA), Isoelectric focusing. BRIEF ACCOUNT ONLY	8	3,4
	3.3	**Analytical Instrumentation** Colorimetry&Spectrophotomety Beer-Lambert's Law Spectroscopy- Raman Spectroscopy, Circular Dichroism, Fourier Transform Infrared Spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR) Spectroscopy Electron Spin Resonance (ESR) Spectroscopy, Mass Spectroscopy-MALDI-TOF, LCMS, Tandem Mass, pH Meter, Flow Cytometry	10	3,4
	3.4	E**lectrophysiological methods** Single neuron recording, Patch-clamp recording, Tread mill test, Application of Deep Brain Stimulator and Pacemaker	3	3,4
4		**PRACTICALS**	**30 Hours**	
		1. Micrometry- Principle and measurement of microscopic objects. 2. Camera Lucida- Drawing of specimens using Camera Lucida 3. TLC using amino acids and calculation of RF values 4. Identification of absorption maxima of given sample by colorimetry 5. Determine the pH of two prepared buffer samples 6. Separation of Casein from milk using centrifugation 7. Demonstration/Institutional Visit for understanding the instrumentation and working of any three Techniques from Microscopy/ Spectroscopy/ Electrophoresis/Flow Cytometry/ Imaging Techniques and submit the report		**5**
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Group Discussion, Practical
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total =25 marks** Quiz, Test Papers, Seminar **Practical Total = 05 marks** Lab performance, record, Lab Test
	B. End Semester Examination Theory Total = 50 marks, Practical Total = 20 marks, Record & Examination

REFERENCES

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2. https://doi.org/10.1146/annurev-bioeng-081622-025405

DSC - Course 19:

Discipline	**ZOOLOGY**
Semester	**7**
Type of Course	DSC
Course Code	24UZOODSC402
Course Title	**BIOSTATISTICS & RESEARCH METHODOLOGY**
Course Level	400-499
Course Summary	Introduce students to key concepts in designing and conducting scientific studies. Modules include understanding the research process, exploring study designs, and learning data collection techniques. Students delve into descriptive and inferential statistics, with a focus on applying these principles in biology-related research. Practical skills are honed through hands-on experience with statistical software, and the course concludes with sessions on reporting findings & critically appraising research.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have an inclination towards having a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the basic concepts of biostatistics and research methodology.	U	2 ,3
2	Demonstrate skills to collect, organise, and present data for biological research.	S, I	2
3	Analyse biological data using appropriate statistical methods and software.	An	1,2
4	Demonstrate skills in scientific documentation and communication.	A	2,4
5	Test hypotheses in biological research with appropriate statistical tools and interpret the derived information to aid in the decision-making process.	S, C, E	1,2, 3
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1		**Overview of Biostatistics and Descriptive Statistics**	15 Hours	
	1.1	Scope and application in life sciences. Steps in Statistical Investigation. Meta analysis. Data and Variable (Types, Sources). Data collection methods: Census and Sampling techniques, Sampling Errors. Organization of Data -	4	1,2

		Tabulation, Types, and characteristics of a Frequency table. Presentation of Data - Graphs and Diagrams		
	1.2	Measures of central tendency: mean, median, mode. Corrected mean.	5	3
	1.3	Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation. Corrected standard deviation. Skewness and kurtosis.	6	3
		ACTIVITY: 1. Preparation of frequency distribution table from raw data 2. Problems related to mean, median and mode (Individual, discrete and continuous series) 3. Problems related to range, Quartile deviation, mean deviation and standard deviation (Individual, discrete and continuous series) 4. Preparation of bar diagrams, pie diagram, line graph, frequency polygon, frequency curve, histogram and ogives. Computation of mean, standard deviation, correlation, regression equation, 't' test, ANOVA (Using MS Excel or any other package) **Note:** Use Clinical/Biological data for the problems		
2		**Correlation, Regression, Probability, Statistical Inference & Statistical Software**	**25 Hours**	
	2.1	Correlation Analysis: Types and methods of correlation analysis, Karl Pearson's correlation coefficient.	5	5
2	2.2	Regression analysis: Graphic methods - Scatter method, Line of best fit; Algebraic method- Regression equations. Relationship between correlation and regression	6	5
	2.3	Classical definition of probability. Addition and multiplication theorems. Probability distributions: Binomial and Normal distribution.	5	5
	2.4	Testing of hypothesis - null and alternative hypothesis, test statistic, type-I and type-II errors, critical region, level of significance, p-value. Parametric Tests: t-test, Z test, ANOVA (one way). Non-parametric Test - Chi-square test.	7	5
	2.5	Statistical Software: SPSS, R, PRIMER (Brief account only)	2	3,5
		ACTIVITY: 1. Calculation and interpretation of corrected mean and corrected standard deviation 2. Calculation and interpretation of Pearson correlation coefficient. 3. Calculation and interpretation of regression equation (x on y & y on x) 4. Calculation and interpretation of Chi square test (2×2 table only) 5. Calculation and interpretation of 't' test 6. Calculation and interpretation of one-way ANOVA		

3		**Research: Types, Design, Literature review and Ethics in Research**	**8 Hours**	
	3.1	Types of Research –Deductive/Inductive, Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical. Defining and formulating the research problem.	2	4
	3.2	Research Design: Basic principles, Significance and features of good design. Types of research designs.	2	4
	3.3	Literature review - Importance of literature review in defining a problem, Critical literature review.	2	2,3
	3.4	Ethics in research - Plagiarism, Plagiarism checking software - Turnitin, Viper, Urkund. Citation and Acknowledgement	2	3,5
4	**Scientific Documentation and Communication**			**12 Hours**
	4.1	Structure and components of Scientific Report. Types of Report –Technical Reports and Thesis/dissertations.	3	4,5
	4.2	Preparation of Project Proposal to Project funding agencies. Preparing Research papers for journals, Seminars and Conferences. SCOPUS, Web of Science, Impact factor, Citation Index, h-index. DOI. ISBN & ISSN.	5	4,5
	4.3	Conventions and strategies of authentication – Citation styles, bibliography, referencing and foot notes. Software for managing bibliographies – EndNote, Mendley. Global Information System – BIOSIS, Medline and Medlars, AGRIS, PubMed, Google Scholar.	3	4,5
	4.4	**ACTIVITY:** 1. Publish a scientific paper in any peer reviewed journal/ publish a book chapter / present a paper (Oral/Poster) in a seminar. (Any one compulsory) 2. Review a scientific article in Biology and submit the report 3. Prepare bibliography in APA format from the given details of a published scientific paper		
5	**Teacher specific course components**			

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecturing, problem solving, writing a review of any published article. Preparing a sample project proposal.

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) Theory Total = 30 marks** Quiz, Test Papers, Problems from module 1 &2, Activity from module 4
	B. End Semester Examination **Theory Total = 70 marks,**

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RESEARCH METHODOLOGY

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DSC - Course 20:

Discipline	**ZOOLOGY**
Semester	**7**
Type of Course	DSC
Course Code	24UZOODSC403
Course Title	**Advanced Genetics**
Course Level	400-499
Course Summary	The course is designed for students with a solid foundation in basic genetics who seek a deeper understanding of advanced topics and their practical applications. The course aims to prepare students for advanced studies or careers in research, healthcare, biotechnology, and related fields by providing a comprehensive understanding of the latest advancements in genetics.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have an inclination towards having a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the molecular organization of the chromosome, linkage, recombination, and transposons.	R	2
2	Explain the role of chromatin remodelling complexes in modulating gene expression through epigenetic changes.	U	2
3	Describe the latest developments and advancements in the field of cytogenetics.	U	1
4	Explain the genetic basis of familial cancer and the implications for risk assessment and genetic counselling.	U	4.5
5	Analyse the ethical implications of HGP, GM crops, personal DNA data, and gene therapy.	An	2,4,6
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Molecular organization of Chromosome, Linkage, Recombination & Transposons**		**20 Hours**	

	1.1	Genome size and c-value Paradox. Molecular structure of centromere and telomere, telomere shortening and aging process, Repetitive nucleotide sequences in eukaryotic genomes - mini and microsatellites.	5	3
	1.2	**Linkage and recombination:** Crossing over as the physical basis of recombination, Molecular mechanisms of recombination (Holliday model), Recombination mapping with two-point and three - point test cross in *Drosophila*, Coincidence and Interference. Mitotic recombination. Genetic recombination in Phage, complementation test, deletion mapping, conjugation mapping.	10	1
	1.3	**Transposable genetic elements:** Transposons in prokaryotes (IS elements, composite elements - Tn10, non-composite elements - Tn3) and eukaryotes (DNA transposons, Retrotransposons - SINE and LINE, Ac/Ds elements in maize).	5	2
2	**A. Epigenetics & B. Cytogenetic techniques**			**15 Hours**
	2.1	**A. Chromatin modifications and their mechanism of action:** Histone code hypothesis, Modification of histone proteins - acetylation, phosphorylation, methylation, ubiquitylation SUMOylation, Chromatin remodelling, Genomic imprinting.	6	1
	2.2	**Epigenetics in *Drosophila*:** Position effect variegation (PEV) and Polycom Group Genes (PcG)in *Drosophila* model	3	2,3
	2.3	**B. Cytogenetic techniques** Karyotyping - G-banding, C-banding, R-banding Sex chromatin analysis (buccal mucosa, hair bud), and COMET assay.	3	2,3
	2.4	FISH (Fluorescent In-situ Hybridization), CGH (Comparative genomic hybridization), aCGH (Array comparative genomic hybridization)	3	2,3
3	**Cancer Genetics**		**15 Hours**	
	3.1	Oncogenes, tumour suppressor genes, DNA repair genes and genetic instability, epigenetic & post translational modifications.	5	4
	3.2	Role of proto-oncogenes in regulating cell growth and survival, mechanisms of activation of oncogenes, Cell cycle and Cancer.	3	3,4
	3.3	**Familial cancers** (Retinoblastoma, Colorectal cancer and Breast cancer), Biomarkers and Cancer therapy: at cellular, gene and protein level. Chemotherapeutics for cancer; Advance therapies in cancer; Monoclonal antibody therapies for cancer.	7	4

4		**Genetics and Society**	**10 Hours**	
	4.1	**Pedigree:** Analysis of Pedigree charts for different inheritance patterns, Consanguinity and its effects in the pedigree pattern.	**2**	**4,5**
	4.2	**Genetic counselling:** Components of genetic counselling - Physical examination, Patterns of inheritance, risk assessment and counselling, Indications for chromosomal testing.	**4**	**4,5**
	4.3	**Human Genome Project (HGP):** Sequencing of the Human Genome, promises and achievements, ethical, legal, and social issues of the HGP. Areas of concerns in modern genetics (GM crops, personal DNA data, Gene Therapy)	**4**	**4,5**
5		**Teacher specific module**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing with ICT, Assignments/ Seminar, Group discussion/ Presentation**.**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total =30 marks Quiz, Test Papers, seminar, Assignment
	B. End Semester examination (ESE) **Theory Total = 70 marks,** •

REFERENCES:

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2. Brooker, R. (1999). Genetics: Analysis and Principles. Addison-Wesley, NY.
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DSC Course 21:

Discipline	**ZOOLOGY**
Semester	**7**
Type of Course	DSC
Course Code	24UZOODSC404
Course Title	**ECONOMIC ENTOMOLOGY**
Course Level	400-499
Course Summary	Economic Entomology is a specialised field of study that focuses on the economic impact of insects on agriculture, forestry, and other human activities. This course typically covers a wide range of topics related to insect biology, ecology, and management strategies to mitigate their economic impact.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have an inclination towards having a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify major insect pests and beneficial insects that are economically significant in agriculture, forestry, and urban settings.	A	1
2	Explain the life cycles, behaviour, and ecology of key insect pests and beneficial insects.	U	2
3	Describe the principles and practices of IPM.	A	4,5
4	Explain emerging trends and issues in forensic, medical, and industrial entomology.	A	7
5	Demonstrate skills to analyse complex pest management problems and propose practical solutions.	A	4,8

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	hrs	CO No.
1		**Insects as pests**	**15hr**	

	1.1	Kinds of insect pests - Major pests, minor pests, sporadic pests, endemic pests, exotic pests, seasonal pests, occasional pests, regular pests, persistent pests. Causes of pest outbreak- deforestation, destruction of natural enemies, pest resurgence, secondary pest outbreak, intensive and extensive cultivation, introduction to new crops, hybrid varieties, introduction to new pests.	5	1.2
	1.2	Damages caused by selected insect pests and their management. (i) **Pests of Crops:** 1. Coconut Pests - *Oryctes rhinoceros* and *Rhyncophorus ferrugineus* 2. Paddy Pests - *Leptocorisa acuta* and *Spodoptera mauritia*. (ii) **Stored grain pests -** *Trogoderma granarium* and *Tribolium castaneum* (iii) **Pests of vegetables -** 1. Brinjal: *Leucinodes orbonalis* and *Euzophera perticella,* 2. Gourds: *Bactrocera cucurbitae* and *Anadevidia peponis*. (iv) **Pests of fruits:** 1. Citrus fruits - Citrus leaf miner (*Phyllocnistis citrella*) and Citrus psylla (*Diaphorina citri*) *2.* Banana Pests - *Cosmopolites sordidus* and *Pentalonia nigronervosa* 3. Mango Pests - Stem borer (*Batocera rufomaculata*) and Scale insect (*Chloropulvinaria polygonata, Aspidiotus destructor*) **ACTIVITY** 1. Insect collection and preservation: Collection and submission of insect pests of crops and vegetables and prepare an Insect Pest Box. 2. Collect & submit different pests of stored grains from the local provision shops or houses and prepare a power point presentation	2	1,2
2	**CONTROL OF INSECT PESTS**		**15 Hours**	
	2.1	**Control of insect pests**	4	3
	2.1	**Integrated pest management** (**IPM)** What is IPM? Need for IPM. Planning of IPM, Different techniques used in IPM; Few examples and advantages of IPM. (Pest surveillance- Forecasting pest outbreaks and surveillance, short term and long- term forecasting, legal/Regulatory practices, cultural, physical, Mechanical, genetic, biological and chemical control)	3	3
	2.2	**Chemical Control:** **I.** Broad classification of insecticides. Inorganic insecticides (Arsenicals, Lime Sulphur, Mercury compounds, Fluorine compounds), Fumigants (Para dichlorobenzene, Methyl bromide, Hydrogen cyanide)	7	5

		ii. Natural organics – oils, insecticides of plant origin (Pyrethrins, Nicotine, Azadiractin) Synthetic Organics – Chlorinated Hydrocarbons (BHC, Methoxychlor) Organophosphate (Malathion, Parathion, Dicrotophos, clorpyriphos) Carbamates (Carbaryl, Propoxur) and Pyrethroids (Allethrin, Cypermethrin). **iii.**Advantages and disadvantages of chemical control.		
	2.3	**Biological control** by [predators, parasites and microbes i.(Bacteria, viruses), fungi, Nematodes]; Biological control Strategies - Introduction, Augmentation and Conservation i. Use of Hormones and Pheromones. ii. Autocidal control - Sterile male technique, male confusion technique, genetic technique	5	5
3	**Beneficial Insects**		**15 Hours**	
	3.1	**Industrial Entomology:** Apiculture & Sericulture. Lac insects and Black Soldier Flies **ACTIVITY**: Set up a waste management unit involving Black Soldier Fly and submit report with geotagged photos.	8	4
	3.2	Importance of insect Pollinators with example- honey bee, wasp, butterfly, Edible insects & human nutrition	2	4
	3.3	**Forensic Entomology**: Brief mention of Common insects of Forensic importance - Order Diptera- Calliphoridae, Sarcophagidae & Muscidae Order Coleoptera - Staphylinidae, Histeridae, Silphidae,MDermestidae & Cleridae **Steps involved**: i) Collection of entomological evidence during a death investigation. ii) Temperature and climatic records, iii) collection, preservation and handling of insects/maggots from the crime scene. iv) Analysis of entomological evidence and estimating PMI (Post Mortem Index) using Maggot age and Insect succession.	3	4
4	**MEDICAL ENTOMOLOGY**			**15 Hours**
	4.1	Pests of man and their management: Mosquitoes- *Anopheles*, *Culex*, *Aedes*, houseflies, bed bugs, head lice, house dust mites. Diseases caused by insects.	8	4
	4.2	Pests of domestic animals and their management: cattle, poultry, pet animals: - (bird louse, *Hypoderma*, screwworms, *Gasterophilus*) Diseases caused.	7	4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory: 30marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks
	B. End Semester examination (ESE) Theory Total = 70 marks, Duration 2 hrs

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2. NPCS Board of Consultants & Engineers, Chennai.(2015) The complete book on Beekeeping and honey processing, 2nd Edition, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.
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DSC - Course 22:

Discipline/Programme	**ZOOLOGY**
Semester	**7**
Type of Course	DSC
Course Code	24UZOODSC405
Course Title	**AQUAFARMING**
Course Level	400-499
Course Summary	Course will help the students to understand the various aspects of Aqua farming.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have inclination towards have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify the different aquaculture systems.	U	2
2	Demonstrate skills in advanced aquaculture technologies, aquarium management, breeding of ornamental fish, seed production of common cultivable species, and aquaponics.	U, S	2
3	Explain nutritional requirements and the processing and preservation of farming products.	A	2
4	Analyse the symptoms, diagnosis, and prevention/control of aquatic animal diseases.	An	2
5	Explain the effects of aquaculture methods on the environment.	A	3,8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Introduction to Aquaculture**		**15 hr.**	

	1.1	Definition, scope, importance & types. Fin fish & shellfish culture. Different aquaculture systems: Pond, embankment pond, cage, pen, running water/race ways, extensive, intensive and semi-intensive culture systems, Integrated Multi trophic Aquaculture (IMTA)	3	1
	1.2	Pond preparation & management (Soil & Water quality management), Breeding & nursery rearing. Hatchery management. Prawn culture. Mussel culture - raft, pole.	10	1,2
	1.3	Nutritional requirements, Probiotics used in aquafarming. Types of feed, Methods and techniques involved in the formulation of fish feed. Processing & preservation of farming products **ACTIVITY** 1.Identify live fish food organisms & culture any one organism. Survey of different feeds used in different hatcheries.	2	
2	**Aquarium management, Integrated farming & Aquaponics (18 Hours)**			
	2.1	Aquarium - water quality management, biological filter & aeration. Breeding of ornamental fishes - Angel, Gourami, Fighter and Guppy (live bearer), rearing, brood-stock management & transport	6	2
	2.1	Aquarium - water quality management, biological filter & aeration. Breeding of ornamental fishes - Angel, Gourami, Fighter and Guppy (live bearer), rearing, brood-stock management & transport	6	2
	2.2	Integrated farming: Fish-cum-livestock/poultry farming, paddy-cum-fish farming, Sewage-fed fish culture	4	1

	2.3	Aquaponic systems **ACTIVITY** Construct aquaponics systems at home & report submission (attach Geo-tagged photos)	2	2
3	**Advanced technologies and Health management practices in aquaculture**		**14**	
	3.1	Recirculating Aquaculture System (RAS) for the sustainable development of Aquaculture	3	2
	3.2	Monosex culture or Neo-female technology, GIFT (Genetic Improvement of Farmed Tilapia), Biofloc Technology	4	2
	3.3	Bio security & quarantine.	2	4
	3.4	Diseases (Viral, bacterial, fungal & parasitic) of fin fish & shellfish, treatment & prophylactic measures	5	4
	Module 4:		**13**	
4	4.1	**Positive**: Utilization of waste from other farming systems in aquaculture Utilization of derelict water bodies for aquaculture. Weed control	3	5
	4.2	**Negative**: Environmental consequences related to hyper-nutrification, leaching of chemicals/ drugs into the environment, misuse of productive land. Introduction of exotic pathogens / diseases into the environment through indiscriminate/clandestine movement of fish seeds Remedial measures	5	5
	4.3	Aquacultural wastes and new developments in waste minimization. Enforcement of rules & regulations for sustainable aquaculture	5	4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **C. Continuous Comprehensive Assessment (CCA)** **Theory: 30 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks
	D. End Semester examination (ESE) **Theory Total = 70 marks, Duration 2 hrs**

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DSC - Course 23:

Discipline/Programme	**ZOOLOGY**
Semester	**7**
Type of Course	DSC
Course Code	24UZOODSC406
Course Title	**SOLID WASTE MANAGEMENT**
Course Level	400-499
Course Summary	Principles, practices, and challenges associated with the management of solid waste, generation, collection, transportation, treatment, disposal, recycling and the environmental and public health implications of improper waste management, and the regulatory frameworks governing waste disposal. Students explore the importance of adopting sustainable waste management practices to minimize environmental pollution, conserve natural resources, and promote public health. They also examine the social, economic, and cultural factors influencing waste generation and management decisions.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have inclination towards have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the types, sources, composition, and characteristics of solid waste, including hazardous and non-hazardous materials.	U	2,4,5
2	Describe waste management techniques, including waste reduction, recycling, composting, and landfill management, and the benefits and limitations of each approach.	U	2,4,5
3	Demonstrate skills in composting and thermal conversion methods.	A, S	2
4	Acquire skills in developing comprehensive and sustainable waste management plans tailored to specific contexts, considering factors such as waste generation rates, local regulations, community needs, and available resources.	A, S	2,6
5	Analyse landfill design, construction, operation, and closure procedures to determine their environmental impacts and propose mitigation measures for environmental sustainability.	An	1,6
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1		**Introduction**		**15 Hours**
	1.1	Definition, overview of solid waste management, types of solid wastes, sources of solid wastes, properties of solid wastes, Factors affecting the type and quality of waste, causes of solid waste generation, associated risks of solid wastes, Physical and chemical composition of municipal solid waste, hierarchy of waste management options.		1,4
2	2	**Solid Waste Management**		**15 Hours**
	2.1	Key components of solid waste management, Generation, storage (containers), collection, transportation (human powered, animal powered and motorized) and disposal (Landfills, composting, incineration and pyrolysis), Recycling and resource recovery. Lay out of routes. Methods of handling and processing of solid wastes: separation, screening, size reduction, densification, baling, cubing, compaction, and pelleting.		2
3		**Landfilling**		**15 Hours**
	3.1	Site selection criteria, landfill layout, landfill sections, Occurrence of gases and leachate in landfills: composition and characteristics, generation factors, initial adjustment phase, transition phase, acid formation phase, methane formation phase, maturation phase of gases and leachate, advantages and disadvantages.	8	4
4	**Composting and thermal conversion methods**			**15 Hours**
	4.1	Composting: definition, types, process description, design and operational consideration of aerobic composting; process description, design and operational consideration of anaerobic composting. Vermicomposting: species of earthworms used. Black soldier flies for waste decomposition, Thermal conversion methods: incineration/combustion, pyrolysis and gasification, energy recovery system. **ACTIVITY**: Prepare a vermicomposting unit and submit report along with geo-tagged photos		3
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA) Theory: 30marks** Involvement and responses in class room transactions - 5 marks Home Assignments/preparedness - 5 marks Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks Any other method as may be required for specific course / student by the course faculty – 5 marks
	C. End Semester examination (ESE) **Theory Total = 70 marks, Duration 2 hrs**

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DSC - Course 24:

Discipline	**ZOOLOGY**
Semester	**8**
Type of Course	DSC
Course Code	24UZOODSC407
Course Title	**ADVANCED IMMUNOLOGY**
Course Level	400-499
Course Summary	Covers concepts in immunogenetics, immunotherapy and the molecular basis of immune-related diseases. Students gain a deep understanding of cutting-edge research, including the role of immunology in cancer, autoimmunity, and infectious diseases. Practical applications in advanced areas such as vaccine development and emerging immunotherapies are also discussed. Overall, this course equips students with a comprehensive knowledge of advanced immunological principles and their relevance in modern biomedical research
Hours	75 (Lecture/Tutorial – 45, Practical - 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe fundamental understanding of Antigens and Antibodies¸ Antigen- Antibody reactions and their clinical applications¸ structure of Immunoglobulins¸ Hypersensitivity reactions	U	1
2	Assess the role of MHC and Complement system in immunological mechanisms	E	2
3	Differentiate autoimmune diseases and immunodeficiency disorders	An	4
4	Appraise the recent trends in vaccine production immunotherapy and transplantation immunology	E	4
5	Develop skills in performing immunological tests	S & I	3
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Ornamental fish farming- Management aspects**		**(17 Hours)**	
	1.1	Antigens: Types - Haptens, Adjuvants, Epitopes (T cell and B cell Epitopes).		1
	1.2	Immunoglobulins: fine structure, classes and functions. Antigenic determinants of immunoglobulin – Isotype, Allotype and Idiotype. Mechanisms of antibody diversity (V(D)J recombination).		
	1.3	Hybridoma technology. Monoclonal antibodies and clinical uses. Novel antibody engineering techniques		
	1.4	Strength of antigen-antibody interaction- antibody affinity and avidity.		
	1.5	Types of antigen-antibody reactions - Cross-reaction, Precipitation, Agglutination and Flocculation		
	1.6	Immunological Techniques - ELISA, RIA, Immunoprecipitation, Widal, Coombs, VDRL and Radio-allergosorbent Test (RAST). Flow cytometry and fluorescence. Immunoelectron microscopy and Immunofluorescence.		
2	**Complement system and MHC**		8 Hours	
	2.1	The Complement system and its activation pathways- Classical, Alternate and Lectin Pathways. Terminal sequence of complement activation (MAC).		2
	2.2	Regulation of complement activity and complement deficiencies.		2
	2.3	General organization and inheritance of MHC. MHC genes - HLA Complex in humans. MHC-peptide interaction. Expression of MHC molecules on different cell types. Biological significance of MHC.		2
3	**A. Immunodeficiency diseases, Autoimmunity and Hypersensitivity**. & **B. Vaccines and Transplantation Immunology**		20 Hours	
	3.1	**A. Immunodeficiency diseases, Autoimmunity and Hypersensitivity**		

		Congenital immunodeficiency diseases. A brief account on SCID, Wescott-Aldrich Syndrome (WAS), Ataxia, Chronic Granulomatous Disease (CGD),Leukocyte Adhesion Deficiency (LAD). Acquired Immunodeficiency Disease (AIDS).		
	3.2	Autoimmunity. Organ- specific autoimmune diseases (Hashimoto's thyroiditis) and Systemic auto-immune diseases (Pernicious Anemia).		
	3.3	Acute and Chronic Inflammation. A brief account on Role of Chemokines and cytokines in immune system. Hypersensitivity. A brief account on different types with example. IgE- mediated (type- I) hypersensitivity (Anaphylaxis). Antibody- mediated cytotoxic (type- II) hypersensitivity (Transfusion reaction). Immune complex-mediated (type- III) hypersensitivity (Arthus reaction). Delayed type (type- IV) hypersensitivity (Mantaux test). Stimulatory (type V) hypersensitivity (Grave's diseases)		
	3.4	B. **Vaccines and Transplantation Immunology** Types of Vaccines-Whole organism vaccines, Purified macromolecules as Vaccines, Recombinant vector vaccines, DNA, and mRNA vaccines. Synthetic peptide vaccines, Multivalent subunit vaccines. Therapeutic cancer vaccines.		4
	3.5	Vaccine Development Process - Preclinical research and animal testing, Clinical trial phases (I, II, III), Regulatory approval and post-marketing surveillance. Ethical aspects of vaccine research and distribution: Public perception and vaccine hesitancy, Balancing individual rights and public health		4
	3.6	Transplantation Immunology: Different types of Transplantations. Immunologic basis of graft rejection. Clinical manifestation of graft rejection. General and specific immunosuppressive therapy for transplant recipients.		4
4	**Practical**		**(30 hours)**	
	1	Differential leucocyte and total leucocyte count		5
	2	Histological study of Bone marrow, Thymus, Spleen and lymph nodes through slides/ Photographs		
	3	Principle and procedure of separation of lymphocytes from whole blood, showing videos of the experiment		

	4	Principle and procedure of separation of T and B lymphocytes, showing videos of the experiment		
	5	Virtual lab/Demonstration/Lab visit/ Short video of WIDAL Test, Western Blotting, ELISA, VDRL Test		
	6	Single diffusion in one dimension (Oudin test)		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **C. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 5 marks** • Lab involvement and practical skills • Record/Any other method as may be required for specific course / student by the course faculty
	D. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments, Record

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DSC - Course 25:

Discipline	**ZOOLOGY**
Semester	**8**
Type of Course	DSC
Course Code	24UZOODSC408
Course Title	**ANIMAL SYSTEMATICS**
Course Level	400-499
Course Summary	Covers principles of classification, evolutionary relationships, and the development of taxonomic systems. Students learn to identify and classify organisms based on morphological, molecular, and ecological characteristics. Emphasis is placed on understanding phylogenetic relationships &the hierarchical structure of taxonomy, from species to higher taxonomic levels. Students explore the history of taxonomy, current methods, and the impact of technology on modern systematics. Practical aspects include fieldwork and specimen collection for species identification.
Hours	75 (Lecture/Tutorial – 45, Practical - 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the principles of taxonomy¸ Principles and application of Zoological nomenclature	U	1,8
2	Appreciate the role of taxonomy in biodiversity conservation and its significance in understanding and preserving natural ecosystems.	Ap	4
3	Identify and classify organisms using taxonomic keys, molecular techniques and morphological characteristics.	E	2
4	Understand the principles of phylogeny¸ recent trends and its applications	U	1,2
5	Analyze and interpret phylogenetic trees to understand the evolutionary relationships among different species and their common ancestors.	An	1
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),skill ,interest(I), Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Ornamental fish farming- Management aspects**		**(12 Hours)**	
	1.1	Taxonomy and Systematics – Definition¸ Significance. Linnaeus and taxonomy. Hierarchical system of taxonomy- taxon, category, taxonomic rank, stages in taxonomy.		1
	1.2	Species concept - types, sub species, deme and other intra specific categories, Polytypic and monotypic species (Brief account).		
	1.3	Principles and applications of Zoological nomenclature: Zoological nomenclature - International Commission for Zoological Nomenclature - features, principles and rules, structure of ICZN code. Zoobank		
	1.4	Scientific name - uninomial, binomial and trinomial.		
2	**Taxonomic tools and techniques**		**20 Hours**	
	2.1	Taxonomic procedures: collection, preservation, curation and process of identification.		2
	2.2	Zoological type: Definition and significance of Holotype, Paratype, Allotype, Neotype, Syntype, Lectotype.		4
	2.3	Taxonomic keys: Different types of taxonomic keys - single access keys, synoptic keys, dichotomous, polytomous keys and computer aided keys. Merits and demerits of keys.		4
	2.4	Taxonomic publications: Types of taxonomic publications - atlas, catalogue, checklist, field guide, field book, hand book, manual. (Brief account). Encyclopedia of Life (EOL).		2
	2.5	**Modern trends in Taxonomy:** Approaches in taxonomy – Morphological, embryological, ecological, behavioural, cytological, biochemical, numerical, molecular approaches in taxonomy. e-taxonomy, Cybertaxonomy, Integrative taxonomy		3
	2.6	DNA Barcoding: steps involved in barcoding and applications of barcoding. Barcoding of life. International Barcode of Life (iBOL).		3
3	**Phylogenetics and Cladistics**		**13 Hours**	
	3.1	Phylogenetics: Phylogenetic tree - types (cladogram, phenogram, phylogram, dendrogram, curvogram, eurogram, swoopogram, chronogram), Molecular phylogeny – DNA		2,3

		markers (mitochondrial markers- Cyt b, Cyt C oxidase; nuclear markers – 16S rRNA, ITS, microsatellite repeats) (Brief description only). Molecular clock hypothesis. Phylocode. Tree of life.		
	3.2	Cladistics: Clade (monophyletic, paraphyletic, polyphyletic) Phenotypic trait, ancestral versus derived characters - Plesiomorphy, apomorphy, synapomorphy and autapomorphy.		
4	**Practical**		**(30 hours)**	
	1	Study of museum specimens - 25 invertebrates and 25 vertebrates.		1
	2	Preparation of dichotomous key of 4 specimens up to family/order (Insects/Spiders/ Fishes/ Snakes - any three taxa).		
	3	Comparative study across different species to identify similarities and differences (Mosquito, Ant, Butterfly, Moth, Honeybee, Earthworm, Prawn, Spider, Crab – minimum two species each from any five taxa).		
	4	Preparation of Cladogram based on the specimens provided (based on at least five museum specimens).		
	5	Visit to a Zoology Museum.		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **E. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 05 marks** • Lab involvement and practical skills • Record/Any other method as may be required for specific course / student by the course faculty
	F. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments, Record

REFERENCES:

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5. SYLLABUS FOR DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE) IN ZOOLOGY

DSE - COURSE 01:

Discipline	**ZOOLOGY**
Semester	**8**
Type of Course	DSE
Course Code	24UZOODSE401
Course Title	**DEVELOPMENTAL BIOLOGY**
Course Level	400-499
Course Summary	Explore the fundamental concepts and mechanisms that regulate animal development from fertilization of the egg to formation of the adult organism. Encompasses the biology of regeneration, metamorphosis and growth and differentiation of stem cells.
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Discuss the genetic, cellular and tissue control of development	U	1,4
2	Explain the sequence of events and the mechanism of fertilization in invertebrates and vertebrates.	*U, An*	2
3	Compare and contrast early developmental strategies of model organisms.	*An, E*	3
4	Understand integrated processes that transforms anamorphous mass of cells into a complete organ in the developing embryo	*U, An*	4
5	Analyse the different developmental stages of organisms like drosophila chick embryo and frog through thetechniques like sectioning staining etc.	*U, An*	6
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.

	PATTERNS AND PROCESSES OF ANIMAL DEVELOPMENT		**10 Hours**	
1	1.1	**Levels of commitment** **Specification**-mechanism of developmental patterning Autonomous, Conditional and Syncytial specification **Determination**-mechanism of cell differentiation Differential gene expression and gene transcription Selective nuclear RNA processing Selective messenger RNA translation Differential protein modification		1
	1.2	**Cell-to-cell communication-mechanism of morphogenesis** Induction and competence **Paracrine signaling**: Morphogen gradients, Fibroblast growth factors, RTK pathway and JAK- STAT pathway, Hedgehog pathway, Wnt pathway, TGF-β superfamily and Smad pathway **Juxtacrine Signaling** :The Notch pathway: Juxtaposed ligands and receptors for pattern formation Brief account only		
	1.3	**Stem cells:** Embryonic stem cells; adult stem cells; medical applications and ethical issues.		
	FERTILIZATION & EARLY DEVELOPMENT		**18 Hours**	
2	2.1	**External Fertilization in Sea Urchins** Biochemical and molecular aspects of fertilization Species-specific sperm-egg recognition. Polyspermy: fast block and slow block		2
	2.2	**Internal Fertilization in Mammals** Translocation and capacitation Hyperactivation, thermotaxis, and chemotaxis The acrosome reaction and recognition at the zona pellucida Gamete fusion and the prevention of polyspermy Activation of the mammalian egg		2
	2.3	**Early development of Drosophila** Egg, cleavage, mid-blastula transition, gastrulation. Gene action in development of drosophila:- Maternal effect genes, zygotic genes, gap genes, pair rule genes, segment		4

		polarity genes; homeotic genes Anterior- posterior patterning in Drosophila; Dorsal- Ventral patterning; Left-right patterning. Dorsal protein gradient.		
	2.4	**Early development of Amphibia** Fertilization, Cortical Rotation, and Cleavage The mid-blastula transition: Preparing for gastrulation; Amphibian Gastrulation The dorsal-ventral and anterior-posterior axes formation , Primary embryonic induction; Molecular Mechanisms of Amphibian Axis Formation Organizer and its functions; Nieuwkoop centre Molecular basis of mesoderm induction Neural induction and its regional specificity. Left-Right Axis formation		4
3	**ORGANOGENESIS & POST EMBRYONIC DEVELOPMENT**		**17**	**hours**
	3.1	**Vulva formation in *Caenorhabditis elegans*** Generation of vulval precursor cell Vulval cell induction and differentiation RTK pathway, Notch-delta and lateral induction Anchor Cell invasion Vulval morphogenesis		3
	3.2	**Tetrapod limb development** Limb Anatomy and Limb Bud formation Hox Gene Specification of Limb Outgrowth: Generating the Proximal-Distal Axis of the Limb The apical ectodermal ridge Specifying the Anterior-Posterior Axis Generating the Dorsal-Ventral Axis Cell Death and the Formation of Digits and Joints		
	3.3	**Metamorphosis in Insects** Types, Hormonal control and molecular mechanism of insect metamorphosis		3
		Amphibian Metamorphosis		3

	3.4	Changes associated with amphibian metamorphosis Hormonal control of amphibian metamorphosis Regionally specific developmental programs		
	3.3	**Regeneration** Types and histological processes Polarity and metaplasia in regeneration Lens regeneration in amphibians		3
4	**Practical**		**(30 hours)**	
	1	Developmental stages of Drosophila – Culturing method and larval instar identification		3
	2	Developmental stages of frog (egg, blastula, gastrula, neurula, tadpole, with external gill and internal gill) using permanent slides/Diagrams		
	3	Serial sections of embryo (tadpole/chick).		
	4	Vital staining of early gastrula of chick and tracing the development of stained parts - Window method.		
	5	Blastoderm mounting and age determination of chick embryo (18hr/ 24hr/ 33 hr/ 48 hr/ 72 hr) using vital stains.		
	6	Preparation of permanent slides of blastoderm of chick embryo- at least one (18hr, 24hr, 33 hr, 48 hr or 72 hr)		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **G. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 05 marks** • Lab involvement and practical skills - 5 Marks • Record/Any other method as may be required for specific course / student by the course faculty - 2.5 marks
	H. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments • Record

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SUGGESTED READING

https://web.as.uky.edu/Biology/faculty/cooper/Population%20dynamics%20examples%20with%20fruit%20flies/08Drosophila.pdf

DSE - Course 02:

Discipline	**ZOOLOGY**
Semester	**8**
Type of Course	DSE
Course Code	24UZOODSE402
Course Title	**FISHING AND FISH PROCESSING TECHNOLOGIES**
Course Level	400-499
Course Summary	Describes traditional and modern fishing techniques, ecological impacts, & sustainable management. Explores fish handling, preservation, & transformation into marketable products, emphasizing quality control, food safety & technological advancements. Through lectures, demonstrations, & field trips, students gain practical insights into industry challenges & opportunities, preparing them for informed decision-making in the seafood sector
Hours	75 (Lecture/Tutorial – 45, Practical -30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe various fishing methods, including traditional practices and modern technologies and their ecological impact and sustainability in the seafood industry.	U	2,4
2	Explain fish handling, preservation, and processing techniques, such as chilling, freezing, and canning, and the quality control standards and food safety regulations.	U	2,4,5
3	Apply the sustainable management strategies for fisheries, resource conservation, ecosystem health.	A	1,4,5
4	Evaluate the technological advancements of fish processing equipments,packaging materials for improving efficiency, product quality, and market competitiveness.	E	1,2,4
5	Compare different fishing methods, fish processing technologies, fishery by products and sustainability practices in the fisheries sector	A, E	1,4,5

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), skill (S),interest(I), Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Fishing Technologies**		**15 hours**	
	1.1	**Fishing Crafts:** Classification of fishing crafts: Types of fishing crafts: traditional, motorized; different traditional fishing crafts of India. Outline of the method of construction of fishing boats in wood, fibre glass and Ferro cement and steel. Recent advances in fishing craft technology		1
	1.2	**Fishing Gears:** Basic principles of gear design and capture mechanism. Fishing gear for closed water systems. Classification of gears: **Active** Gears - Design and operation of – trawls, purse seines, ring seines, beach / shore seine, boat seine, pole and line, squid jigs, trolling. **Passive** (low energy fishing) Gears - Design and operation of - gill nets, long lines, hooks, traps, stake net, dol net, Chinese dip nets, cast nets. Destructive fishing methods like electrical fishing, poisoning and use of dynamites. Prohibited fishing practices. Preservation of fishing gears. Fishing gear materials and their properties. Recent advance in fishing gear technology. Estimation of weight of netting.		
	1.3	**Advancements in fishing technology and responsible fishing** Fish aggregating devices and artificial reefs. Light fishing and Lantern fishing. Impact of artificial reefs on fish stock. Fish Finding Devices: Introductory information on echo-sounder, sonar, netsonde, global position systems, remote sensing, and potential fishing zones. Code of conduct of responsible fishing – Illegal, Unreported and Unregulated (IUU) fishing, Turtle Exclusion Devices (TED), By-catch Reduction Devices (BRD).		
2	**Fish Processing technology**		**20 Hours**	
	2.1	Principles of fish preservation. Precautions taken in handling fish in the fishing vessel, landing center and processing plant. Importance of hygiene and sanitation in fish handling. Quality of water and ice in fish handling and processing. Common equipment and utensils used in		2,3

		the processing plant. Preparation of ice. Different types of ice used in the seafood industry and their merits. Preservation by refrigerated seawater and chilled sea water		
	2.2	**Freezing** : Refrigeration, refrigeration load, refrigerants, cold storage of fish. Crystallization, freezing curves for pure water and water in fish, physical and chemical changes on freezing, effect of freezing on location and size of ice crystals **Technological aspects of freezin**g: Slow freezing and quick freezing, Air blast freezing, tunnel freezing, fluidized bed freezing, spiral freezing, immersion freezing, contact plate freezing, cryogenic freezing and high pressure freezing. **Freezing on board fishing vessels**, IQF freezers, selection of a freezing method, cold store and cold storage, and chemical, physical and sensory changes during freezing and cold storage. Chemical treatment of fish prior to freezing, TTT and PPP factors, packing of frozen products, processing and freezing of frozen sea food products for export from India.		2,3
	2.3	Canning :Principles of canning: Heat transfer in canned fish, thermal destruction of bacteria, D and D0value,F0 value, Z value, determination of process time, cook value, Aseptic packing, containers for canning, unit operations, equipment used for canning, canning of sardine, tuna, and prawns. Retort pouch packaging. Waste management in canning industry, defects of canned product		3
	2.4	**Curing and drying:** Water content and water activity, water activity and microbial spoilage, drying of fish, constant rate and falling rate drying period, salting and salting methods, drying methods for fish, packaging and storage. Quality problems and solutions. Maillard reaction, lipid oxidation, microbial, fungal and insect's infestation. Packaging of dried products. **Smoking**: objectives, smoke production, smoke components, quality, safety and nutritive value, processing and equipment, Freeze drying of fish. Accelerated freeze drying. Packaging of freeze dried products. Hurdle technology.		3

	2.5	Radiation: Radiation preservation, principles of radiation, ionizing radiations and their sources, units, applications ofradiation, Shelf life extension, radappertization, radurisation, radicidation and radiation doses for irradiation of different fish products. Safety of irradiated fish.		3
3	**Other methods of processing**		**10 Hours**	
	3.1	**By-products**: Mince and surimi – Processing, packaging, freezing and storage. Fish protein concentrate, fish meal and oil, fish liver oil, fish hydrolysate, fish silage, Caviar, gelatin, glue, pearl essence, dehydrated jelly fish, squalene, fish maws and isinglass, Ambergris, Beche de mer. Chitin, chitosan, and glucosamine hydrochloride, Utilization of prawn waste and fish processing waste. Processing and extraction of algin, alginic acid, alginates, agar, manitol, and carragernan. Value added products: Coated fish products, batter, bread crumbs, and general procedure for preparation of battered and breaded products, objectives, packaging and storage, equipment for making coated products, quality ofcoated products. Types of coated products: coated fish fillets, fish fingers, coated shrimp products, moulded products, fishcutlets, fish balls, fish burger (patties).Seafood analogues and imitation products.		3
4	**Practical**		**(30 hours)**	
	1	Study of various fishing gears (10)		1,3
	2	Visit to net making factory, identify different types of nets and their operating mechanism and report submission. Netting twines, rope, netting, cutting, tailoring, mounting, design of nets.		
	3	Visit to boat building yard/institute – submit report: Boat building materials, back bone assembly, planking, and maintenance of fishing boats, traditionaland modern fishing vessels.		
	4	Conduct a survey on indigenous fishing technologies used in and around and submit an account with geo tagged photos and mode of operation		

	5	Biochemical and microbiological test for assessing the quality of fish. **The record must be a compilation of all the 5 above.**		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **I. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 05 marks** • Lab involvement and practical skills • Record/Any other method as may be required for specific course / student by the course faculty
	J. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments: • Record:

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DSE - Course 03:

Discipline	**ZOOLOGY**
Semester	**8**
Type of Course	DSE
Course Code	24UZOODSE403
Course Title	**BIOLOGICAL SPECIMEN PREPARATION TECHNIQUES**
Course Level	400
Course Summary	Helps to acquire knowledge on preparation of laboratory specimens for display in Biology museums for study purpose and also as an entrepreneurship. Develops research aptitude by introducing frontier areas of biological science such as historic genetic analysis- a valuable tool for study and application of Conservation Genetics- of endangered species.
Hours	75 (Lecture/Tutorial – 45, Practical -30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Describe different animal collection techniques and their application	U	1,2
2	Explain the methods of skeleton preservation blood and smear preparation	U	1,2
3	Apply the knowledge acquired in preserving the specimens	An	8
4	Formulate innovative ideas to taxidermize a dead specimen	C	1,8
5	Demonstrate skills in Alizarin preparation.	S,C	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C),),skill (S),interest(I), Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Importance and applications of the specimen preparation techniques**		**10 Hours**	
	1.1	Introduction: importance and applications of the specimen preparation techniques – laboratory/ study purpose; museum		1,4,3

		display; entrepreneurial. Probable application in DNA extraction, Conservation Genetics.		
2	**Collection and Preservation of animals**		**15 Hours**	
	2.1	Collection techniques for insects, fishes, and birds. Preservation methods for animals belonging to various taxa		1,2
3	**Preparation of museum specimens, permanent slides and blood smear**		**20 Hours**	
	3.1	Preparation of museum specimens, Display methods: - wet & dry.		2,3
	3.2	Skeletal techniques: - Articulated skeleton, general methods- Clearing- fleshing, maceration, boiling, degreasing, mounting. Staining techniques (alizarin preparations). Taxidermy		
	3.3	Preparation of permanent slides- whole mounts, various tissues, sections, stages of cell divisions		
	3.4	Preparation of thick and thin blood smear, & its significance		
4	**Practical**		**(30 hours)**	
	1	Whole mount preparation of small animals, tissues and sections of animals		2
	2	Alizarin preparation of small invertebrates and vertebrate skeletal system		
	3	Preparation of articulated skeletons		
	4	Demonstration of Taxidermy		
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

<table>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT

K. Continuous Comprehensive Assessment (CCA)
Theory: 25 marks
• Involvement and responses in class room transactions - 5 marks
• Home Assignments/preparedness - 5 marks
• Oral presentation/Viva/Quiz/Open book test/written test - 5 marks)
• Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks
• Any other method as may be required for specific course / student by the course faculty – 5 marks
Practical: 5 marks
• Lab involvement and practical skills
• Record/Any other method as may be required for specific course / student by the course faculty</td></tr>
<tr><td>L. End Semester examination (ESE)

Theory: 50 marks

• Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks
Practical: 20 marks

• Practical based assessments
• Record</td></tr>
</table>

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6. SYLLABUS FOR DISCIPLINE SPECIFIC COURSES (DSC) IN ZOOLOGY (Minor)

DSC Minor - Course 01

Discipline	ZOOLOGY
Semester	I
Type of Course	DSC
Course Code	24UZOODSC101
Course Title	Introduction to Zoology
Course Level	100-199
Course Summary	The course includes several marvellous facts about the animal world which can foster sense of interest¸ connection, empathy and caring towards the animals. They feel responsible and enthusiastic to learn more about the animal world.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify the wonders of the animal world and the facts behind the phenomena	U	2
2	Explain Coloration, Mimicry & Parental care.	U	2
3	Discover the research avenues & career opportunities in Zoology	U	2
4	Predict the Entrepreneurial Possibilities in the field of Zoology	E	1, 2
5	Prepare detailed reports of field visits to environmentally important places research institutions and career orientation centers	A	2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Wonders of Animal world**		**(15 Hours)**	

	1.1	Incredible Animal Architects Introduction to Animal Societies		1
	1.2	Honeybees – Skilled Engineers of Nature Comb building in Honey bees		
	1.3	Architectural secret of Termite hills		
	1.4	Weaver Bird-Wonderful Architect		
	1.5	Glowing Wonders Bioluminescence – Mechanism Noctiluca – Sparkle of the sea Firefly- Stars on earth Octopus – Wild Glowing Wonder Angler fish – the glowing monster		
	1.6	Story of Pearl, Types of Pearl, Pearl Formation, Process of Picking best Pearl		
2	**Coloration , Mimicry & parental care**		**(15 Hours)**	
	2.1	Coloration & Mimicry Fakers of Nature- Secret behind Coloration & Mimicry Beautiful Butterflies, Colorful Earthworms, Painted Starfish Blue beauty Frog , Lovely Chameleon , Handsome Peacock Magnificent Owl Butterfly Leaf insect – The Walking leaves		2
	2.2	Parental care Animal Parenting – Facts & examples Who will take care? Father or Mother. Mother – Velvet Spider - Epitome of sacrifice Father – Water bug - Model father Pregnant Father – Sea Horse Father Brooder – Male Darwin frog. Sophisticated parents – Python parenting Supermom – Humming Bird Aggressive Mother – Otter		
3	**Major Research Areas & Careers in Zoology**		**15 hours**	
	3.1	Exciting avenues for research Bioinformatics, Molecular biology, Biostatistics, Wildlife Biology, Toxicology & Pharmacology, Forensic biology, Physiology, Genetics, Microbiology, Immunology, Developmental Biology, Ethology, Biotechnology, Environmental Biology, Animal Systematics, Marine biology, Fisheries, Cell biology, Entomology, Biochemistry, Parasitology, brief description only		4
	3.2	Attractive career opportunities General- All general UPSC jobs especially IFS (Indian Forest Service), Kerala PSC (all general degree based jobs), jobs in Kerala Forest and wildlife department (Range Forest Officer and Beat Forest officer), Scientists, Research assistants, Lab technicians, Animal house keepers in reputed research centers like ZSI, CSIR,		4

		ICAR, RGCB, KFRI, NCBS, TIFR, SACON, BARC, ICZN etc. Jobs in NGOs like WWF, ATREE, Wildlife SOS, Wildlife Trust of India, Center for Wildlife Studies, Nature Conservation Foundations etc. Specific- Entomologist in Vector control board and in research institutes like KFRI; Teaching; Biologist and Curator in Museum and Zoological Parks; Fisheries officer in Fisheries department, Junior scientific assistant in pollution control board, District Malaria Officer, forensic assistant in police department and health department; ecologist, conservation biologist and nature education officers in various wildlife sanctuaries and protected areas; jobs in Pharmaceutical companies. Embryologist, Cytological specimen preparation, Cytogeneticist in diagnostic labs and hospitals. Medical coding		
	3.3	Lucrative Entrepreneurial Possibilities Products, byproducts & value added products of: Apiculture, Sericulture, Dairy Farming, Poultry Farming, Pets and their management, Aqua culture (Edible and ornamental) and Vermiculture		
4	**Practical**		**(30 hours)**	
	4.1	Identification of any 10 specimens coming under the following categories 1. Animal architects, 2. Glowing animals, 3. Animal mimicry 4 Animal coloration 5. Parental care.		5
	4.2	Search wonders of animal world and make short videos/reports/photos: 1. Animal architects, 2. Glowing animals, 3. Animal mimicry, 4 Animal coloration, 5. Parental care.		
	4.3	1. Field visit - Nature camp, butterfly garden, museum, pearl culture farm. (any 2) 2. Visit to any 2 research institutes 3. Visit and interact with any two entrepreneurs from different fields and submit the report 4. Career Orientation class by experts		

5	**Teacher specific course components**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **M. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 5 marks** • Lab involvement and practical skills - 5 Marks • Record/Any other method as may be required for specific course / student by the course faculty - 2.5 marks
	N. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 20 marks** • Practical based assessments • Record:

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DSC Minor – Course 02

Discipline/Programme	**BSc (Honours) ZOOLOGY**					
Semester	**2**					
Type of Course	**DSCA**					
Course Code	**24UZOODSCZOO103**					
Course Title	**Foundations of living system**					
Course Level	**100**					
Course Summary	This course explores basic understanding of cell biology focus on animal cells, types of cells and tissues. Students can delve into the diversity of animal cells and their structure and functions, additionally students will learn about the organisation and functions of animal tissues- epithelial, muscular, nervous and connective tissue.					
Lecture,Tutorial, Practical	**45/30**					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any	Should have basic knowledge in sceince					

	CO No.	Expected Course Outcome	Learning Domains*	PO No
	1	Recall cell as the basic unit of life	K	1, 3
	2	Compare and contrast various types of cells	An	1, 3
	3	Analyse the structural organisation of cells	An	1, 3
	4	Develop the skill to distinguish between various types of cells in animal body	S	1, 4
	5	Analyse the various biomolecules in the cell	An	1, 3
		Imagine the organisation of various cells and the Location of Biomolecules like nucleic acids	C	1, 3, 4

(K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	The Cell		**(15 Hours)**	
	1.1	Cell as the machinery Life Prokaryotic and eukaryotic cells	1, 2, 3, 4	15
	1.2	Difference between plant and animal cells		
	1.3	Basic structure of animal cell		
	1.4	Plasma membrane, Protoplasm, Cytoplasm		
	1.5	Cell inclusions- nucleus, mitochondria, ER, Golgi apparatus, lysosomes and ribosomes (Brief account of the structure and function)		
	1.7	Hierarchial organisation of Animal complexity		
	1.6	Levels of organization in Organismal Complexity		
	1.7	Extracellular components of the metazoan body		
	1.8	Complexity and body size		
2	**Types of Animal cells and Tissues**		**(15 Hours)**	
	2.1	Why Study Animal Cells? (Applications in Health, Biotechnology, and Research)	1, 2, 4	15
	2.2	Epithelial Cells Types of Epithelial Cells (Squamous, Cuboidal, Columnar) Structure and Function (Protection, Absorption, Secretion) Specialized Epithelia (Ciliated Cells in Respiratory Tract)		
	2.3	Connective Tissue Cells Fibroblasts: Structure and Role in Matrix Production Adipocytes: Fat Storage and Endocrine Functions Chondrocytes and Osteocytes: Cartilage and Bone Formation Mast Cells and Macrophages: Immune Response		
	2.4	Muscle cells and Specialized Supporting Cells Types of Muscle Cells (Skeletal, Cardiac, Smooth) Structural Differences and Functions Specialized Muscle Cells (Pacemaker Cells in Heart) Applications in Sports Science and Medicine Specialized Supporting Cells: Bone Cells (Osteocytes, Osteoblasts): Role in Structure and Growth Cartilage Cells (Chondrocytes): Cushioning and Support		
	2.5	Nervous Cells: Cells of communication		

		Neurons: Role in Communication Supporting Cells: Glial Cells and Their Functions Understanding Nerve Damage and Regeneration		
	2.6	Blood Cells – Circulatory Heroes Red Blood Cells (RBCs): Types of RBC White Blood Cells (WBCs): Role in Defense Platelets: Role in Dengue		
	2.7	Immune Cells – Defenders of the Body Overview of Immune Cells (Macrophages, T Cells, B Cells) Role in Fighting Infections and Diseases Modern Relevance: Vaccines, Immunotherapy, and Allergies		
	2.8	Reproductive Cells Gametes: Sperm Cells and Oocytes (Structure and Function) Processes of Fertilization and Zygote Formation Supporting Cells (Sertoli and Granulosa Cells)		
	2.9	Stem Cells and Differentiation Types of Stem Cells (Embryonic, Adult, Induced Pluripotent) Role in Development and Tissue Repair Cellular Differentiation into Specialized Cells		
3	**Biomolecules in the cell (15 Hours)**			
	3.1	**Introduction to Biomolecules** Definition and significance of biomolecules.		
	3.2	***I****ntroduction to Vitamins and Minerals, Classification of Vitamins and Minerals ,Functions and Deficiency Disorders of Vitamins and Minerals*		
	3.2	**Proteins**:Structure of amino acids and peptide bonds.Levels of protein structure: Primary, secondary, tertiary, and quaternary.Functions of proteins.Examples of biologically important proteins e.g., haemoglobin		
	3.3	**Carbohydrates**:Classification: Monosaccharides, disaccharides, oligosaccharides, and polysaccharides.		
	3.4	**Lipids**:Types of lipids: Fats, phospholipids, steroids, and waxes.		

	3.5	**Enzymes:**Definition and Nature of Enzymes Classification of Enzymes (Six Major Classes)		
	3.6	**Nucleic Acids**: Structure and function of DNA and RNA.Central Dogma of Molecular Biology.		
4	**Practical**			**(30 hours)**
	4.1	Adequately use light microscopes to observe cells at a magnification up to 100X (oil immersion) The Steps in the tissue preparation for light microscopy		30 hours
	4.2	Identification and recognition of Blood cells using light microscope Microscopic observation of tissues- Muscle tissue-skeletal muscle and smooth muscle, skeletal tissue, epithelial tissue, adipose tissue, nervous tissue Cell organelles identification- Mitochondria, Golgi bodies, ER, Nucleus, Lysosomes, Ribosomes Structure of DNA, RNA and proteins (Models /Images	1, 2, 3, 4	
	4.3	Estimation of Haematocrit value		
	4.4	Preparation of whole mounts- Mounting of cheek epithelium, Observe sperm and egg		
	4.5	Comparison of cheek epithelium, plant epithelia, fungus, protista and bacterial cell		
5	**Teacher specific course components**			

Assessment Types	**MODE OF ASSESSMENT** **B. Continuous Comprehensive Assessment (CCA)** **Theory: 25 marks** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks **Practical: 7. 5 marks** • Lab involvement and practical skills - 5 Marks • Record/Any other method as may be required for specific course / student by the course faculty - 2.5 marks

	C. End Semester examination (ESE) **Theory: 50 marks** • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical: 17.5 marks** • Practical based assessments: 15 marks • Record: 2.5 marks

Recommended Reading

1. Becker, W. M., Kleinsmith, L. J., Hardin. J. & Bertoni, G. P. (2009). The World of the Cell (7th ed.). Pearson Benjamin Cummings Publishing, San Francisco.

2. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith & Watson James (2008). Molecular Biology of the Cell (5th ed.). Garland publishing Inc. New York and London.

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4. Janet Iwasa, Wallace Marshal ., (2021) CARP_S Cell and molecular Biology, 9th edition: Wiley Online publication Asia Edition

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DSC Minor – Course 03

Discipline	**ZOOLOGY**
Semester	**III/IV**
Type of Course	DSC
Course Code	24UZOODSC204
Course Title	**APPLIED ZOOLOGY**
Course Level	200-299

Course Summary	To understand experiential learning on the methodology of Poultry Farming, Dairy Farming, Aquaculture, Vermiculture and Entomology
Hours	60 (Lecture/Tutorial – 60)
Credits	4
Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Distinguish different breeds of cattle, poultry, duck, quail, and cultivable fish and shellfish species.	An, S	1, 2, 8
2	Explain common diseases of cattle, poultry, and fish.	A, S	1, 2, 8
3	Identify economically important insects, castes of honeybees, bee products, pollen basket and cocoon.	R, S	1, 2, 8
4	Explain different aquaculture methods as well as the management of dairy, quail, ducks, and poultry.	An, S	1, 2, 8
5	Explain milk, milk by-products, Biogas production and test the purity of milk.	An, S	1, 2, 8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1		**Poultry and Dairy Farming**	**20**	
	1.1	**Poultry Farming** Introduction, Poultry breeds in India, Broilers and layers, Poultry Housing and Equipment, Poultry feed and its composition, Importance of egg production, Nutritive value of eggs and meat, Diseases and their management.	6	1, 3, 4

	1.2	Husbandry of quail - Breeds in India, Advantages of quail rearing - Housing, feeding and management of quail.	2	1, 4
	1.3	Husbandry of ducks - Breeds in India, Advantages of duck rearing - Housing, feeding and management of ducks	3	1, 4
	1.4	**Dairy Farming** Importance, Scope and management of farm animals. Breeds of cattle, housing system, nutrition requirements. Importance of artificial insemination	4	1, 4
	1.5	Milk, milk by-products. Biogas production.	1	5
	1.6	Common Cattle diseases: Anthrax, Foot and Mouth disease, Rinderpest	3	3
2		**Economically Important Insects**	**15**	
	2.1	Useful Insects: Honey bee, silk worm, Black soldier fly. Apiculture	9	3
	2.2	Pests of paddy - *Leptocorisa acuta* (Rice bug)]; Pests of coconut - *Oryctes rhinoceros* (Rhinoceros beetle), Pests of stored products - *Sitophilus oryzae* (Rice weevil).	3	3
	2.3	Vectors of public health importance – Mosquitoes- elephantiasis, malaria, chikun guinea, dengue, zika & Housefly – typhoid, dysentery	3	3
3		**Aquaculture**	**15**	
	3.1	Introduction & scope, Advantages and salient features, Types of aquaculture, Biotic and abiotic factors affecting aquaculture.	4	4
	3.2	Pond culture, Brief Description of common cultural fishes of Kerala, Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Mussel culture, Prawn culture. Important Fish Diseases. Fish preservation and processing.	8	4, 2
	3.3	Aquarium management: Setting up of an Aquarium.	3	4

4		**Practicals**	**30**	
	4.1	Poultry breeds (picture identification)	6	1
	4.2	Cattle breeds (picture identification), Purity analysis of milk	8	1
	4.3	Study of Pests of paddy *Leptocorisa acuta* (Rice bug), Pests of coconut *Oryctes rhinoceros* (Rhinoceros beetle) Pests of stored products [*Sitophilus oryzae* (Rice weevil) through damaged plant parts / photographs. Identification different species and castes of honey bees and bee products. Identification of pollen basket using picture, photograph. Identification of Silk worm moth, cocoon. Identification of black soldier fly.	8	3
	4.4	General Identification, scientific names and common names of the following a. cultivable fish species (Catla, Rohu, Mrigal, Etroplus, Tilapia) and b. shellfish species (Any 3: *Fenneropenaeus indicus / F.monodon / Macrobrachium, Perna viridis / P. indicus*)	8	1
		ACTIVITY - Visit to any 2 units (Poultry, Dairy, Apiculture or Aquaculture) and submit report		4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos, Visit to any 2 units (Poultry, Dairy, Vermiculture or Aquaculture).
	MODE OF ASSESSMENT **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar

Assessment Types	**Practical Total 15 Marks** Lab performance, record, Activity Reports
	B. End Semester Examination **Theory Total = 50 Marks;** **Practical Total = 20 Marks,** **Record & Examination:** Spotter Identification Field Study Report, Viva

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3. Chapman, R.F. (1998). The Insects: Structure and Function. (4th ed.). Cambridge University Press.
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9. Pedigo, L.P. (2002). Entomology and Pest Management. Prentice Hall.
10. Pillai, T.V.R., & Kutty, M.N. (2011). Aquaculture: Principles and Practices. Wiley India Pvt Ltd.
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14. Sarkar, Kundu, & Chaki. (2014). Introduction to Economic Zoology. NCBA Publisher.
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20. Sreenivasaiah, P.V. (2015). Textbook of Poultry Science. Write and Print Publications.
21. Tembhare, D.B. (1997). Modern Entomology. Himalaya Publishing House.
22. Venkit Sivaraman, P.R. (1983). Text Book of Economic Zoology. Sudarsana Publ. Cochin.
23. Yadav, M. (2003). Economic Zoology. Discovery Publishing House.
24. Zoological Society of Kerala. (2002). Applied Zoology
25. Composting with Black Soldier Flies, Direct Compost Solutions, https://directcompostsolutions.com › composting-with black flies

DSC Minor – Course 04

Discipline	ZOOLOGY
Semester	III/IV
Type of Course	DSC
Course Code	24UZOODSC208

Course Title	Functional Zoology
Course Level	200-299
Course Summary	To impart deep knowledge in physiology, endocrinology and immunology
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domain*	PO No
1	Explain the physiology of nutrition, respiration, circulation, excretion, and disorders.	A	1,2,8
2	Describe Muscle and Neuro physiology and neural disorders.	A	1,2,8
3	Explain Endocrine system and Hormonal disorders	U	1,2,8
4	Distinguish types of immunity, lymphoid organs, antigen-antibody reactions, auto-immune diseases, immunodeficiency diseases, hypersensitivity, and vaccines.	An	1,2,8
5	Test human blood groups, leukocytes, tonicity, lymphoid organs, estimate haemoglobin, monitor blood pressure, heart rate, and opercular movement in fish.	An, S	1,2,8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Physiology**	**16**	
	1.1	Nutrition: Introduction & Types, Nutritional requirements, nutritional disorders	1	1
	1.2	Respiration: Transport of respiratory gases, Respiratory disturbances- Hypoxia, Hypercapnia, Physiological effect of smoking, carbon monoxide poisoning	3	1
	1.3	Circulation: Composition and function of blood, Mechanism of blood clotting, ECG, Blood pressure, Arteriosclerosis, Haemophilia	3	1

	1.4	Excretion: Structure of nephron, Urine formation and concentration, Kidney stone, dialysis	3	1
	1.5	Neuro physiology: Structure of neuron, Nerve impulse production and propagation, synapse and synaptic transmission, Neurotransmitters, EEG, Neural disorder: Parkinson's & Alzheimer's diseases	3	2
	1.6	Muscle Physiology: Types of muscles, Structure of striated muscle, Mechanism of muscle contraction, Cori cycle, Muscle fatigue, Oxygen debt, Rigor mortis	3	2
2		**Endocrinology**	**15**	
	2.1	Endocrinology: Introduction to Endocrine system, Mechanism of hormone action, Endocrine glands, Hormonal disorders (brief account only).	15	3
3.		**Immunology**	**14**	
	3.1	Introduction to immunology, types of immunity (innate & acquired immunity, Humoral & Cell mediated)	2	4
	3.2	Structure of immunoglobulins, Classes of immunoglobulins, Types of antigen.	3	4
	3.3	Lymphoid organs, T cells, B cells and other cells of immune system.	2	4
	3.4	Antigen-Antibody reactions (Precipitation test, agglutination test, WIDAL, VDRL, ELISA), monoclonal antibodies	3	4
	3.5	Auto immune diseases (Rheumatoid arthritis), Immune deficiency diseases (AIDS), Hypersensitivity	2	4
	3.6	Vaccines (BCG, DPT, Polio, recombinant vaccines, DNA & mRNA vaccine)	2	4
4		**Practicals**	**30**	
	1	Preparation of blood smear and identification of leukocytes	8	5
	2	Identification of human blood groups	3	5
	3	Study of lymphoid organs	3	5
	4	Demonstration of effect of tonicity on RBC	3	5
	5	Estimation of haemoglobin (Demonstration)	5	5
	6	Effect of temperature on opercular movement of fish	4	5
	7	Instruments- (Principle and Use)-Sphygmomanometer, Stethoscope (Students are expected to learn how to monitor blood pressure and heart rate)	4	5
		Teacher Specific Module		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Tutorial, Videos
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA):** **Theory Total = 25 Marks** Quiz, Test Papers, seminar **Practical Total = 05 Marks** Lab performance, record, Other assignments
	B. End Semester Examination **Theory Total = 50 Marks;** **Practical Total = 20 Marks,** **Record, Examination** Spotter Identification: Identification – lymphoid organs, instruments. Practicals. Blood smear preparation and identification of leucocytes.

REFERENCES

1. Adelman, D. C., Casale, T. B., & Corren, J. (Eds.). (2002). Manual of allergy and immunology. Lippincott Williams & Wilkins.
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3. Ananthanarayan, R., & Jayaram Paniker, C. K. (2020). Textbook of Microbiology. Orient Longman Private Ltd.
4. Delves, P. J., et al. (2017). Roitt's Essential Immunology. John Wiley & Sons.
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7. SYLLABUS FOR MULTIDISCIPLINARY COURSES (MDC) IN ZOOLOGY

MDC - COURSE 01

Discipline	ZOOLOGY
Semester	I

Type of Course	MDC
Course Code	24UZOOMDC101
Course Title	ORNAMENTAL FISH FARMING AND AQUARIUM KEEPING
Course Level	100-199
Course Summary	The course includes several marvelous facts about the animal world which can foster sense of interest, connection, empathy and caring towards the animals. They feel responsible and enthusiastic to learn more about the animal world.
Hours	60 (Lecture/Tutorial – 30, Practical – 30)
Credits	3
Pre-requisite, if any	Should have basic knowledge of Zoology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Identify various commercially important freshwater ornamental fishes, aquarium accessories, aquarium fish diseases.	U, An, A	1
2	Understand and apply fish transportation techniques while transporting brooders and fish seeds.	U, A	1
3	Employ skills for breeding and rearing of egg-layers and live- bearers and aquarium setting.	A, S	1
4	Apply the knowledge in aquascaping, water quality management and feed administration.	A	8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Ornamental fish farming- Management aspects**		**(15 Hours)**	
	1.1	Introduction to ornamental fish farming**.** Common freshwater ornamental fishes; Live bearers (Guppy, Platy, Molly, Sword tail), Egg layers (Varieties of Gold Fish, Gourami, *Betta*, Tetra, Angel Fish, *Puntius* sp.).		1,2,3,5
		Study of Two examples each of Indigenous, Endemic and Exotic ornamental fishes of Kerala		

	1.2			
	1.3	**Food and feeding**: Nutritional requirements of fishes. Types of Feed: Dry feeds, Non -Dry feeds (Moist feeds, Wet or paste feeds), Feeds for colour enhancement. Live feed and live feed culture. Preparation and composition of formulated fish feeds. Feeding rate and management.		
	1.4	**Water quality management** (pH, hardness, salinity, oxygen, carbon dioxide, chlorine, ammonia, nitrites, temperature); Water filtration systems – biological, physical; types of filters. Aerators, Aquarium Plants.		
	1.5	**Common diseases of aquarium fishes** Parasitic (protistan, helminthic, arthropodan), microbial (Bacterial, Fungal, Viral) (Any two from parasitic and microbial) and nutritional deficiency diseases.		
	1.6	Conditioning, packing, transport and quarantine methods.		
2	**Breeding and rearing of ornamental fishes & Construction and maintenance of aquarium**		15 Hours	
	2.1	Breeding of Live bearers (Guppy, Molly, Sword tail) and Egg layers (Gold Fish, Gourami, *Betta*).-any one from each group. Sex identification, brooder selection and conditioning, induced spawning, hatching and rearing of frys.		3
	2.2	Types of aquaria, Setting up of a freshwater aquarium. **ACTIVITY:** Visit ornamental fish farm & submit a report		3,4
3	**Practical**		**(30 hours)**	
	1	Identification of aquarium fishes-Egg layers and live bearers, both indigenous, exotic and endemic.		1,3,4
	2	Identification of fish diseases - symptom, causative organism and control measures.		
	3	Study of aquarium accessories		
	4	Determination of pH of water sample		
	5	Demonstration of construction and setting up of an aquarium		
	6	Study of breeding behaviour of any one ornamental fish.		

	7	Identification of live fish feeds and culturing of any one.		
4	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** • Involvement and responses in class room transactions • Home Assignments/preparedness • Oral presentation/Viva/Quiz/Open book test/written test • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course • Any other method as may be required for specific course / student by the course faculty **Practical:** • Lab involvement and practical skills • Record/Any other method as may be required for specific course / student by the course faculty
	B. End Semester examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report – 50 marks **Practical:** Practical based assessments, Record

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2. Ahilan, B., Felix, N., Santhnam, R. (2008). Textbook of Aquariculture. New Delhi, Daya

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9. Ganguly, S., (2017). Viral Diseases Infecting Finfishes and Ornamental Fishes: A Review of Relevance to Sustainable Aquaculture. *Int. J. Pure App. Biosci.* 5(1): 282-284.
10. Halver, J. E., Hardy, R. W. (2002). Fish Nutrition. Academic Press.
11. Haridas, H. *et al*., (2019), Training Manual on Freshwater Ornamental Fish Breeding and Aquascaping Techniques, ICAR, Port Blair, India.
12. Jayasree K. V., Tharadevi C. S., and Arumugam N., (2015). Home Aquarium and Ornamental Fish Culture. Saras Publication, Tamil Nadu, India.
13. John Dawes (1995). Live bearing Fishes (A guide to their Aquarium care, Biology and Classification). Cassell Pvt., London.
14. Mohanta, K. N. & Subramanian , S. , (2011) Nutrition of common fresh water Ornamental Fishes, Technical Bulletin, No. 27, ICAR, Goa.
15. Sebastian J. Kuravamveli, (2002). The Aquarium Handbook. Amity Aquatech Pvt. Ltd., Cochin.
16. Sreekanth G. B., Trivesh S. Mayekar, Sudhir Kumar, Purva Rivonkar, Tincy Varghese, Sikendra Kumar, Chakurkar E. B. Fresh Water Ornamental Fish culture and Management, Technical Bulletin Number 69, Published by Dr. Eaknath B. Chakurkar, Director ICAR- Central Coastal Agricultural Research Institute, Old Goa.

MDC - COURSE 02

Discipline	**ZOOLOGY**
Semester	**2**
Type of Course	MDC
Course Code	24UZOOMDC102
Course Title	**REPRODUCTIVE HEALTH AND SEX EDUCATION**
Course Level	100-199
Course Summary	This course is designed to provide students with a thorough understanding of reproductive health & sex education, covering biological, psychological & sociocultural aspects. The course aims to equip students with the knowledge and skills necessary to make informed decisions about their sexual health, foster healthy relationships & contribute to the promotion of sexual well-being in diverse communities.
Hours	60 (Lecture/Tutorial – 30, Practical – 30)
Credits	3
Pre-requisite, if any	Should have inclination towards have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Summarise the necessity of sex education, primary and secondary sexual characteristics, and reproductive health.	U	1,2,4
2	Describe teenage pregnancy, sexual harassment, sexual awareness, and policies related to adolescent sexual behaviour.	U	4
3	Appreciate the broad spectrum of sexual orientations and gender identities, equity, inclusivity, and healthy relationships.	U, Ap	5,6
4	Explain sexual health, sexually transmitted infections (STIs) and contraception methods.	U	4
5	Analyse safe sex practices, various options for reproductive choices, responsible parenthood and family planning	U, An	4,6
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C) (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Introduction to Sexual and Reproductive Health**		**17 Hour**	
	1.1	Definition of reproductive health and sex education, Importance of comprehensive sex education	3	1
	1.2	Cultural and societal perspectives on sexuality, Ethical considerations in sex education	3	1
	1.3	Primary and secondary sexual characters and puberty, Physical and emotional changes during puberty. Neural and hormonal peculiarities of male and female brain. Role of hormones in the development of secondary sexual characters.	5	1
	1.4	Personal hygiene and self-care during adolescence, Emotional well-being, self-esteem, and body image.	3	2
	1.5	Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects)	3	2
2	**Healthy Relationships, Sexual orientations and gender identities 14 Hours**			

	2.1	Healthy relationships (Five Es-empathy, enthusiasm, empowerment, equality, energetics, Five As-acceptance, accommodation, appreciation, adaptability, agreement, Five Ls- love, loyalty, listening, laughter, lust, Five Ts- trust, talking, time together, tenderness, thoughtfulness), Consent, boundaries, and respect in relationships, Recognizing and respecting boundaries, sexual assault, harassment, and coercion and supporting survivors.	8	3
	2.2	Sex Determination in Humans, diverse sexual orientations and gender identities (LGBTQ), Addressing stereotypes and prejudices related to sexuality.	6	3
		Safe Sex, Reproductive Choices and Parenthood	**14 Hours**	
3	**3.1**	Importance of safe sex practices**,** Types of contraceptives (condoms, birth control pills, IUDs, Emergency contraception and its availability etc.)	3	4
	3.2	STDs and Prevention of sexually transmitted infections (STIs)**,** Testing, treatment, and counselling for STIs	5	4
	3.3	Options for reproductive choices (parenting, adoption, abortion, surrogacy), Postpartum care and mental health.	3	5
	3.4	Responsible parenthood and family planning, Balancing career, education, and parenthood.	3	5
4	**Teacher specific course components**			

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, videos.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous and comprehensive assessment (CCA)** **Theory Total =25 marks:** Quiz, Test Papers, assignment
	B. End Semester Examination **Theory Total = 50 marks, Duration 1.5 hrs**

	Short Essays 5 out of 7 x4 =20 marks, Short questions- 10 out of 12 x2 =20 marks, Fill in the blanks 10x1 =10 marks

REFERENCES:

1. Czerwinski, B. S. (1992). Relationship between feminine hygiene practices, body image, and self-esteem. Texas Woman's University.
2. Frankowski, B. L., & Committee on Adolescence. (2004). Sexual orientation and adolescents. Pediatrics, 113(6), 1827-1832.
3. Goldberg, A. E. (Ed.). (2016). The SAGE encyclopedia of LGBTQ studies. SAGE publications.
4. Leon, I. (2008). Psychology of reproduction: Pregnancy, parenthood, and parental ties. Global Library of Women's Medicine.
5. Owen, R. R., & Matthews, D. (1982). Developmental and acquired disabilities in adolescence. In Adolescent Health Care (pp. 131-141). Academic Press.
6. Tortora, G. J., & Derrickson, B. H. (2018). Principles of Anatomy and Physiology. John Wiley & Sons.

SUGGESTED READING

1. SOGIE handbook
2. https://www.lausd.org/cms/lib/CA01000043/Centricity/domain/156/pdfs/SOGIE%20Handbook.pdf
3. https://www.health.ny.gov/prevention/sexual_violence/docs/sogie_handbook.pdf

MDC - COURSE 03

Discipline	**ZOOLOGY**
Semester	**3**
Type of Course	MDC
Course Code	24UZOOMDC201
Course Title	**HUMAN DISEASES AND THEIR MANAGEMENT**
Course Level	200-299
Course Summary	Familiarizing various causative organisms and factors for human diseases, how and what preventive and therapeutic measures can be adopted against these diseases, the need to keep away/manage communicable diseases and life style diseases, thereby creating a healthy society, the need for maintaining vectors below damage threshold levels.
Hours	45 (Lecture/Tutorial – 45)
Credits	3

Pre-requisite, if any	Should have basic knowledge of Zoology and have a natural intelligence

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the aetiology, symptoms, diagnosis, treatment, and preventive measures of common airborne, waterborne, foodborne, and microbial infectious diseases.	U	1, 2, 3
2	Distinguish infectious zoonotic diseases and diseases spread by mosquito vectors.	U	1, 2, 3
3	Differentiate the aetiology, symptoms, diagnosis, treatment, and preventive measures of disorders of the central nervous system, immune system, and blood vascular system, as well as genetic, lifestyle, and nutritional deficiency diseases.	An	1, 2, 3
4	Explain the causes and types of cancer, the characteristics of cancer cells, and theories of carcinogenesis.	U	1, 2, 3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Infectious diseases**	**15**	
	1.1	Introduction, health:- Need for being healthy. Classification of diseases:- infectious and non - infectious	5	1, 2
	1.2	Infectious diseases :-Description of disease, etiology, symptoms, diagnosis, treatment and preventive measures required for 2 disease each from a category. Air borne (Covid 19, measles), water borne (typhoid, hepatitis A), food borne (Botulism, shigellosis), Microbial —bacterial (TB, whooping cough), viral, (Covid 19, chickenpox) fungal (Candidiasis, Aspergillosis), protozoan (Malaria, leishmaniasis), helminthic (Schistosomiasis, ascariasis)	10	

		Mosquito the terrible vectors – Dengue, Zika, chikunguinea. Bats- Nipah Zoonotic diseases- plague, rabies		
2		**Non infectious diseases - 1**	**15**	
	2.1	Non infectious diseases ---Description of disease, etiology, symptoms, diagnosis, treatment and preventive measures required for 2 diseases each from a category. 1. Genetic disorders (autism, sickle cell anaemia, haemophilia) Life style diseases (Diabetes, obesity). 2. Nutritional Deficiency diseases- Kwashiorkar, Night Blindness, Hypovitaminosis, Pernicious Anaemia.	15	3, 4
3		**Non infectious diseases - 2**	**15**	
	3.1	Non infectious diseases 3. Disorders of blood vascular system (Atherosclerosis, myocardial infarction), disorders of immune system:-Immune deficiency disorders (AIDS, SCID), Autoimmune disorders (Rheumatoid arthritis, SLE), Allergy. Disorders of central nervous system (Parkinson's disease, Alzheimer's disease)	8	3, 4
	3.2	4. Cancer: causes, types, characteristics of cancer cells, theories of carcinogenesis	7	
4		**Teacher Specific module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, Presentation of report of the activity.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **Theory Total = 25 Marks** Quiz, Test Papers, Seminar
	B. End Semester Examination **Theory Total = 50 Marks, Duration 1.5 hrs** Short Essays 5 out of 7 x4 =20 Marks Short questions 10 out of 12 x 2 =20 Marks Fill in the blanks 10 x1 =10 Marks

REFERENCES

1. Anil Aggarwal (2001) Modern Diagnostics; National Book Trust
2. Bhattacharya K. & G.K. Chakraborty, (1999) Hand Book of Clinical Pathology. Amer Society of Clinical; 2nd edition
3. Chaterjee K D (2019): Parasitology- Protozoology and Helminthology, Chatterjee Medical Publishers. Kolkatta.
4. Emily Reisner and Howard Reisner (2004) Crowley's An introduction to human diseases: Pathology and Pathophysiology Correlations. 11th edition, Jones and Bartlett Learning
5. Margaret Schell Frazier and Tracie Fuqua (2020) Essentials of human diseases and conditions. 7th edition. Published by Elseivier Health sciences.
6. Marianne Neighbors, Ruth Tannehill Jones (2018) Human diseases 5th Edition, Delmar Cengage Learning

8. SYLLABUS FOR SKILL ENHANCEMENT COURSES (SEC) IN ZOOLOGY

SEC - COURSE 01

Discipline	**ZOOLOGY**
Semester	**V**
Type of Course	SEC

Course Code	24UZOOSEC301
Course Title	**AQUARIUM FABRICATION AND SETTING**
Course Level	300
Course Summary	Aquarium Keeping and Aquarium Fish Breeding is one of the most popular and enticing hobbies in the world today. It is in fact a multi-billion dollar industry and needs trained expertise. India, with its rich resources of endemic and unique specimens is slated to become a major player in the field. The country needs trained personnel and expertise in order to utilize its rich potential of resources. The course is aimed at imparting skill in the preparation of varieties of aquaria using the latest materials and techniques available
Hours	45 (Lecture/Tutorial – 45)
Credits	3
Pre-requisite, if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Illustrate the design and construction of home and public aqua-ria	U	1
2	Illustrate the setting and maintenance of aquariums in addition to water quality management.	U	1
3	Management of home as well as commercial aquariums.	A	2
4	Develops skills to handle different aquarium equipments.	A	1
5	Manage and Maintain aquascaping and Decorations in an aquarium	A	1
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Introduction to Aquaria (10 Hours)**			
	1.1	Definition of aquarium, scope and history	2	1
	1.2	Fabrication of home aquarium **ACTIVITY:** Construction of a Freshwater Aquarium	3	1

	1.3	Design and construction of public fresh water and marine aquaria.	3	1
	1.4	Types of materials used in aquarium fabrication- Suitability, Advantages and Disadvantages	2	1
2	**Aquarium Accessories (10 Hours)**			
	2.1	Aeration of water and Types of Aerators	2	2
	2.2	Different kinds of Filters and Lighting	2	2
	2.3	Thermostat for aquaria	2	2
	2.4	Hand nets and other equipments	2	2
	2.5	Aquarium gravels, pebbles, hood and aquarium plants	2	2
3	**Aquarium Setting, Maintenance and Trade (25 Hours)**			
	3.1	Site selection for Aquaria	2	2
	3.2	Setting up of fresh water aquarium **ACTIVITY:** Set up a Freshwater Home Aquarium	3	2,5
	3.3	Setting up of marine aquarium	3	2
	3.4	Aquascaping- Different styles and Types	2	2
	3.5	Water quality parameters, Cleaning of aquarium, Filtration of Aquarium water: – different types of Filters and Filtration. **ACTIVITY** Measurement of water Quality parameters Setting up of a Biofilter and Recirculating System	5	2
	3.6	Nutritional requirements of aquarium fishes, Artificial and Live Feeds for Aquarium Fishes, **ACTIVITY** Hatching of Artemia cysts	5	3
	3.7	Present Status of aquarium trade in India and the world.	5	4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** lecturing with ICT, Activities, Transactions
Assessment Types	**MODE OF ASSESSMENT** **G. Continuous Comprehensive Assessment (CCA)** • Involvement and responses in class room transactions - 5 marks • Home Assignments/preparedness - 5 marks • Oral presentation/Viva/Quiz/Open book test/written test - 5 marks) • Field study report/Group discussion on a recent research or review article (≤ 5years) related the course – 5 marks • Any other method as may be required for specific course / student by the course faculty – 5 marks
	H. End Semester examination (ESE) • Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report

REFERENCES:

1. John Dawes, 1995. Live bearing Fishes (A guide to their Aquarium care, Biology and Classification) Cassell Pvt., London, 240 pp.
2. Lieske, E, Myers, R. 1996. Coral Reef Fishes, Princeton University Press, Prenceton, New Jersey, 400 pp
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8. Matthew L. Wittenrich, 2007. The Complete Illustrated Breeder's Guide to Marine Aquarium Fishes - Microcosm/TFH (ca), 304 Pages.
9. Vincent Hargreaves, 2007. Complete Book of the Freshwater Aquarium: A Comprehensive Reference Guide to

10. More Than 600 Freshwater Fish And Plants, Plus How to Set Up And Maintain an Aquarium, Thunder Bay Press, 304 Pages.

SUGGESTED READINGS

1. Jayashree K. V., Tharadevi C. S., and Arumugam N., (2015) Home Aquarium and Ornamental Fish Culture, Saras Publication, Tamil Nadu, India .
2. Training Manual on Freshwater Ornamental Fish Breeding and Aquascaping Techniques (2019), Haridas, H. et al, ICAR-Central Island Agricultural Research Institute, Port Blair, India.
3. The Simple Guide to Freshwater Aquariums" by David E. Boruchowitz.

SEC - Course 02:

Programme	**ZOOLOGY**
Semester	**VI**
Course Name	**RESPONSIBLE TOURISM**
Type of Course	**SEC**
Course Code	**24UZOOSEC302**
Course Level	**300 -399**

Course Summary	Responsibility drives sustainability. Responsible Tourism is about making better places for people to live in and better places for people to visit. This course explores the principles and practices essential for responsible tourism including sustainable tourism focusing the inclusiveness of the local people, eliminating poverty, generating job opportunities, preserving cultural heritage and conserving natural resources.
Hours	60 (Lecture/Tutorial – 30, Practical - 30)
Credits	3

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Identify and describe the core concept of tourism and its impact on the environment.	**R**	1,3
2	Manage the key factors of responsible tourism and implement strategies to make the tourism sector profitable.	**C**	1,2,3, 4
3	Facilitate destination management and responsible tourist behaviour.	**A**	1,2,3, 4
4.	Integrate policies to promote responsible tourism.	**An**	1,2,3, 4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1		**Introduction to Responsible Tourism (RT) & Responsible Tourism Practices**	**15**	
	1.1	**Introduction** Tourism - Positive & Negative impacts . Types of Tourism	2	1

	1.2	Why Responsible Tourism? Principles & Practices of RT. Benefits- Ecosystem benefits, Tourism industry, tourist & host communities of the locality.	3	3
	1.3	Pillars of Responsible Tourism and their roles– environmental, social, economic, cultural.	3	2
	1.4	**Responsible Tourism Practices** Green & Sustainable Tourism Practices - Environment conservation; culture & heritage preservation; Inclusiveness of local community, minimize waste production, recycle & reuse of waste water, Reduce carbon footprint.	7	3
2		**Responsible Tourism Management**	14	
	2.1	Concept of Destination Management-Responsible action to address the social, economic and environmental issues affecting the sustainability that arise in destinations. Destination Management organizations (DMO) – Vision, Functions, Responsibilities.	4	3
	2.2	Tourist management strategies. Responsible Tourist Guidelines- Responsible behavior including responsible travelling, respecting different cultures, visiting heritage sites with a clear understanding of rules and regulations, and making purchase or usage decisions without generating waste	4	2
	2.3	Implementation of Green tourism in hospitality management	2	2
	2.4	Responsible & Sustainable tourism spots in Kerala: Thenmala, Wayanad, Thekkady, Aymanam, Maravanthuruthu.	4	2
3		**A. Policies to promote Responsible Tourism & B. Instruments for RT**	16	
	3.1	**A. Policies to promote Responsible Tourism** National strategies for: Sustainable tourism, Ecotourism, National Tourism Policy, Swadesh	4	4

		Darsan Scheme Policies for States,		
		Kerala Tourism Policy		
	3.2	Strategies for RT promotion: Environmental Sustainability, Biodiversity, Economic Sustainability, Socio-Cultural Sustainability; Criteria for accreditation of Sustainable Tourism: Environmental impact Social policy Capacity Building and Governance.	6	3
	3.3	**Instruments for RT:** Monitoring the Sustainability indicators. Identifying the limits of tourism: Geographic, Economic. Voluntary & Supporting Instruments: Voluntary - Guidelines and codes of conduct; Reporting and auditing; Voluntary certification Supporting - Infrastructure provision and management; Capacity building Implementation instruments for successful RT: Selection of location, Land use, balance between environmental protection and conservation. **ACTIVITY:** 1. Pick up two responsible tourism practices and present them before the class. 2. Conduct a survey on the award winners in the Responsible Tourism sector locally for the past 2 years and prepare the case study report. 3. Identify an unpopular tourist spot and formulate strategies to revive and turn it to successful 4. Conduct any one field trip to tourist destinations and prepare report on its functioning.	6	2, 5

		Information to be collected during field trip: Visit to a hospitality enterprise (hotel, restaurant, travel agency etc) and discussion with the managers and employers about the sustainability innovations, products and technologies used by the company (e.g. renewable energy sources, bio energy, growing own fruits and vegetables, use of natural construction materials or organic household detergents and waste management). (**Minimum 4 days for all the 4**)		
4		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecture, group interaction, seminar presentations
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous and comprehensive assessment (CCA) Theory** Case study report & Presentation, Test Papers, Field study reports
	B. End Semester Examination Written Examination,

REFERENCES:

1. Anukrati S. (2019). Sustainable Tourism & Development, Apple Academic Press.
2. Fennell, D., and Malloy, D., (2007). Codes of Ethics in Tourism. Practice, Theory, Synthesis. Clevedon: Channel View Publications.
3. Goodwin, H. (2011). Taking responsibility for tourism. Oxford: Goodfellow Publishers Ltd.
4. Goodwin, H., and Francis, J., 2003. Ethical and responsible tourism: Consumer trends in the UK, Journal of Vacation Marketing 9 (3) pp. 271–284.
5. Goodwin, Harold. (2014), Responsible Tourism and the Green Economy, Green Growth & Travelism, p.133

6. Hall, D., and Brown, F., 2006. Tourism and Welfare. Ethics, Responsibility and Sustained Well-being. Wallingford: CAB International.
7. Harrison, L., and W. Husbands 1996 Practicing Responsible Tourism. New York: Wiley.
8. Husbands, W. & Harrison, C. 1996. Practicing responsible tourism. Toronto: John Wiley & Sons, Inc.
9. J. Policy Res. Tour. Leis. Events, (2012) Responsible tourism and sustainability: the case of Kumarakom in Kerala, India 4 (3) pp. 302-326.
10. Jarvie, L. 1993. Trends and Challenges in Developing Responsible Tourism. Proceedings of the 5th PATA Adventure Travel and Ecotourism Conference.
11. Parikshat Singh Manhas 2010. Sustainable & Responsible tourism.PHI Publishers.
12. Romila Chawla, (2005). Responsible Tourism, Sonali Publications

9. SYLLABUS FOR VALUE ADDITION COURSES (VAC) IN ZOOLOGY

VAC - Course 01:

Programme	**ZOOLOGY**

Course Name	**FUNDAMENTALS OF PARASITOLOGY**
Type of Course	**VAC**
Course Code	**24UZOOVAC301**
Course Level	**300-399**
Course Summary	A broad and multi-disciplinary approach to the complex and dynamic relationships between parasites and their hosts. This course offers an overview of the biological and epidemiological bases of important parasitic diseases and an understanding of the impact of parasitic diseases on endemic communities.
Hours	45 (Lecture/Tutorial – 45)
Credits	3
Pre- requisites, if any	Basic idea of parasitism

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the fundamentals of host-parasite interactions, adaptations, and parasitism.	U	1,2
2	Describe the morphology, life cycle, pathogenicity, preventative measures, and control strategies of parasitic protists, nematodes, Platyhelminthes, and arthropods.	A	2
3	Identify parasitic vertebrates.	U	2
4	Demonstrate techniques used in molecular diagnosis and clinical parasitology.		
5	Determine career options in parasite research and the medical sciences.	A	2
Remember (K), Understand (U), Apply (A), Analyze (An), Evaluate (E),Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO
1		**Parasites – An introduction**	**8**	
	1.1	Parasites, parasitoids, host, zoonosis, Origin and evolution of parasites, Basic concept of Parasitism, Symbiosis, Phoresy, commensalisms and mutualism,		1

		Host-parasite interactions, and adaptations.		
2		**Parasitic Protists and Parasitic Platyhelminthes**	**19**	
	1.2	**Parasitic Protists** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Entamoeba histolytica, Giardia intestinalis, Leishmania donovani,* *Toxoplasma gondii*	10	2
	2.2	**Parasitic Platyhelminthes** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Fasciolopsis buski, Diphyllobothrium latum, Hymenolepis nana* ACTIVITY: Isolation, observation and documentation of trematode larval stages.	9	
3		**Parasitic Nematodes, arthropods and vertebrates**	**15**	
	3.1.	**Parasitic Nematodes** Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of *Ascaris lumbricoides, Ancylostoma duodenale, Brugia malayi, Trichinella spiralis* Nematode plant interaction; Gall formation	10	2,3
	3.2.	**Parasitic Arthropods** Biology, importance and control of Ticks (Soft tick *Ornithodoros*, Hard tick *Ixodes*), Mites (*Sarcoptes*), Lice (*Pediculus*).Flea (*Xenopsylla*), Bug (*Cimex*), Parasitoid (Wasps)	5	
	3.3	**Parasitic Vertebrates** Cookicutter Shark, Hood Mocking bird and Vampire bat and their parasitic behavior and effect on host	3	

4		**Molecular diagnosis & clinical parasitology**	**15**	
	4.1	General concept of molecular diagnosis for parasitic infection Advantages and disadvantages of moleculardiagnosis Fundamental techniques used in molecular diagnosis of endoparasites Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules (*Giardia intestinalis*, E. *coli, Entamoeba Histolytica, Leishmania donovani).* Malarial parasite using ELISA, RIA, Counter Current Immunoelectrophoresis (CCI), Complement Fixation Test (CFT), PCR, DNA, RNA probe		4
5		**Teacher Specific Module**		

EVALUATION AND ASSESSMENT

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lecturing, Tutorial, ICT Enabled Learning. Experiential learning.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory Total = 15 marks** Quiz, Test Papers, Seminar/Activity report
	B. End Semester Examination **Theory Total = 35 marks,**

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1. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group.

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3. Chatterjee K.D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBSnP.
4. Gunn, A. and Pitt, S.J. (2012). Parasitology: An Integrated Approach. Wiley Blackwell.
5. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers.Noble, E. R. and G.A.Noble (1982) Parasitology: The biology of animal parasites. V th Edition, Lea &Febiger.
6. Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi.
7. Roberts, L.S and Janovy, J. (2009). Smith & Robert's Foundation of Parasitology. 8th Ed.. McGraw Hill.

SUGGESTED READINGS

1. Bogitsh, B. J. and Cheng, T. C. (2000). Human Parasitology. 2nd Ed. Academic Press, New York.
2. Chandler, A. C. and Read. C. P. (1961). Introduction to parasitology, 10th ed. John Wileyand Sons Inc.
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5. Schmidt, G. D. (1989). Essentials of Parasitology. Wm. C. Brown Publishers.
6. John Hyde (1996) Molecular Parasitology Open University Press.
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10. SYLLABUS FOR DISCIPLINE SPECIFIC COURSES (DSC) IN ZOOLOGY – Minor Pathway Courses for Physiology

COURSE 01

Discipline	Zoology
Semester	I
Type of Course	DSC
Course Code	24UZOODSC111
Course Title	**Introduction to Physiological Psychology**
Course Level	100-199
Course Summary	This course in Introduction to Physiological Psychology will bridge the gap between the biological and the behavioral, offering a captivating exploration of the physical underpinnings of our thoughts, feelings, and actions. The course begins with the intricate workings of the nervous system, the body's complex network of communication. We'll dissect the structure and function of the brain, spinal cord, and peripheral nerves, understanding how they interact to control movement, sensation, and all our internal processes. Next, we'll explore how our eyes, ears, nose, tongue, and skin translate sights, sounds, smells, tastes, and touches into electrical signals the brain can interpret. Finally, the course will investigate the biological processes underlying how we form, store, and retrieve memories. By the end of this course, you'll gain a deeper appreciation for how the brain orchestrates our thoughts, feelings, and behaviors, revealing the fascinating biological basis of human psychology.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Learning Domains	PO
1	Analyse the physiological processes behind cognition, learning and memory.	An	PO1, PO2, PO8
2	Examine the relationship between the brain and behaviour.	An	PO1, PO2

3	Examine the components of the Central Nervous System and their functions.	An	PO1
4	Examine the anatomy and functions of the Peripheral Nervous System.	An	PO1

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Module 1 – Nervous System (29 Hrs)**			
	1.1	Brain- Behaviour relations	2	CO1, CO2
	1.2	Cells of the Nervous system - Neurons. Structure of neuron, External, internal and supporting structures, types of neurons. Membrane potential, resting potential, depolarization, hyper polarization, sodium-potassium pump, action potential.	8	CO1, CO2
	1.3	Neurotransmitters. Role of neurotransmitters in transmission of impulses. Excitatory and inhibitory post synaptic potentials.	3	CO1, CO2
	1.4	Central Nervous system. Forebrain, Midbrain and Hindbrain, Hypothalamus, Cortex, Spinal cord.	8	CO1, CO2, CO3
	1.5	Autonomic Nervous system. Sympathetic and Parasympathetic Nervous system	3	CO1, CO2, CO4
	1.6	Structure of the Nervous System. Structure, functional asymmetry (surgical studies, clinical studies, behavioural studies), capabilities of the right and left hemispheres, language, handedness, cortex and learning	5	CO1, CO2, CO3, CO4
2	**Module 2 – Sensory Systems (8 Hrs)**			
	2.1	Visual System. Anatomy of the eye, Nervous connections of the eye- optic nerve, lateral geniculate nucleus, Superior colliculus, Visual cortex.	4	CO1, CO2

	2.2	Auditory System. Anatomy of the Auditory system, Nervous connections of the ear, pathway- Organ of Corti, Ventral cochlear nucleus, inferior colliculus, medial geniculate body, auditory cortex.	4	CO1, CO2
3	**Module 3 – Physiology of Learning and Memory (8 Hrs)**			
	3.1	Physiology of Learning: Physiological changes during learning, Anatomical requirements for Learning	4	CO1, CO2
	3.2	Physiological mechanisms for memory in the brain, triggers for memory retrieval. Disorders of Memory: Amnesia, Dementia and Alzheimer's disease.	4	CO1, CO2
4	**Practicuum (30 hours)**			
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, Laboratory record. *Any other method as may be required for a specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/ Standardized Test (MCQ)/ Open book/ Problem based assignments/ Individual project report/ Team project report**.** **Practical:**

	Practical based assessment, Record, *Any other method as may be required for a specific course by the course faculty*.

References:

Guyton, A. Medical Physiology (8th ed.), W. B. Saunders' Co.

Leukal, F. (1985). An Introduction to Physiological Psychology. (1sted.). New Delhi: CBS Publishers and Distributors.

Levinthal, C.F. (1996). Introduction to Physiological Psychology (3rd ed.) Prentice-Hall of India Pvt. Ltd.

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Schneider, A.M. &Tarshis, B. (1986). An Introduction to Physiological Psychology (3rd ed.). New York: Random House, Inc.

COURSE 02

Discipline	Zoology
Semester	II
Type of Course	DSC
Course Code	24UZOODSC112

Course Title	**Physiological Psychology II**
Course Level	100-199
Course Summary	This course will explore how different physiological systems influence our motivations, emotions, sleep patterns, and even our stress responses. The course begins with the intricate workings of the endocrine system and hormones, chemical messengers produced by glands throughout the body, and how they impact our moods, energy levels, and even our development. Next, we'll bridge the gap between the physiological and the psychological, examining how our bodies generate the experiences of motivation, emotion, and stress. Finally, we'll turn our focus to the realm of sleep and arousal. We'll explore the biological rhythms that govern our sleep-wake cycles, the different stages of sleep and their importance for our physical and mental well-being, and the physiological factors that influence our levels of alertness and arousal. By the end of this course, you will gain valuable insights into how our bodies not only react to the world around us, but also actively shape our thoughts, feelings, and behaviors.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Learning Domains	PO
1	Explain the functioning of the endocrine system and illustrate its relationship with psychological processes.	U, A	PO1, PO2
2	Differentiate between the physiological responses associated with positive emotions and negative emotions by comparing and contrasting the neural and hormonal pathways involved.	An	PO1, PO2
3	Apply their understanding of the biology of sleep and arousal to evaluate the different states of consciousness.	E, A	PO1, PO2
4	Analyse the physiological factors underlying various motivational states.	An	PO1, PO2

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Module 1 - Endocrine System (23 Hrs)**			
	1.1	Introduction. The endocrine glands and hormones	10	CO1
	1.2	Role of Hypothalamus: Hypothalamus-Autonomic nervous system, Hypothalamo hypophysial endocrine system (HPT and HPA axis).	8	CO1
	1.3	Psychoneuroendocrinology. Hormonal influence on learning and memory and behavior, Behaviour (emotion) and the limbic system.	5	CO2
2	**Module 2 - Physiology of Motivation, Emotion and Stress (12 Hrs)**			
	2.1	Emotionality. Physiological basis of emotionality, Hypothalamus in emotionality, Limbic system in emotionality	6	CO2
	2.2	Motivation. Defining sexual behavior, Dynamics, Hormones and its impact, External cues, The brain and sexual behaviour, Role of Hypothalamus and amygdala (Physiological motives and emotion - hunger, fear and anger)	6	CO4
3	**Module 3 - Physiology of Sleep and Arousal (10 Hrs)**			
	3.1	Arousal, Sleep and Circadian Rhythms. Physiological measures of alertness and arousal-EEG. Physiological conceptions of wakefulness and sleep. Conceptions of sleep. Circadian rhythms and biological clock. The role of melatonin. Gut-brain axis.	10	CO3

4	**Practicuum (30 hours)**
5	**Teacher specific course components**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, Laboratory record. *Any other method as may be required for a specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for a specific course by the course faculty*.

References:

Guyton, A. Medical Physiology (8th ed.), W. B. Saunders' Co.

Leukal, F. (1985). An Introduction to Physiological Psychology. (1sted.). New Delhi: CBS Publishers and Distributors.

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Schneider, A.M. &Tarshis, B. (1986). An Introduction to Physiological Psychology (3rd ed.). New York: Random House, Inc.

COURSE 03

Discipline	ZOOLOGY
Semester	III/IV
Type of Course	DSC

Course Code	24UZOODSC211
Course Title	**Behavioural Genetics & Psychoneuroimmunology**
Course Level	200-299
Course Summary	This course provides the students an interdisciplinary approach between genetics & behaviour. It also explores the intricate connection between mind, nervous system and immune system. Module 1 begins by laying the foundation with an exploration of genetic mutations and their role in various genetic disorders. Module 2 explores the different components of the immune system, how it recognizes and fights off pathogens, and its crucial role in maintaining health. Module 3 bridges the gap between the immune system and the brain, how these two systems communicate, how immune responses can affect mental health, and how psychological factors can influence immunity. Module 4 explores the physiological and psychological effects of stress, its potential impact on the immune system, and strategies for managing stress for better overall health. By the end of this course, you'll have gained a holistic understanding of the intricate connections between genes, behavior, and the immune system.
Hours	75 (Lecture/Tutorial – 45, Practical – 30)
Credits	4

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Learning Domains	PO
1	Interpret the principles of genetic transmission and explain the structure of DNA, RNA, Chromosomes, Gene mutation, Central Dogma.	An, U	PO1, PO2
2	Explain the overview of Immune System, Antigen and different types of Antibodies and their interaction	U	PO1, PO2
3	Explains Psychoneuroimmunology, Meditation and Biofeedback	An, U	PO1, PO2
4	Analyse Stress, Hormonal, Anatomical and Physiological indicators of Stress and development strategies for the regulation of Stress.	An, E, C	PO1, PO2

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Module 1 - Genetic Mutation and Genetic Disorders (15 Hrs)**			
	1.1	Mendel's Principles	3	CO1
	1.2	Modern concept of gene and gene action	3	CO1
	1.3	sex - linked, sex – limited, sex-influenced characters	1	CO1
	1.4	Gene mutation: Kinds of mutation, classification (Somatic, gametic, point, spontaneous, induced, dominant, recessive and silent mutations)	3	CO1
	1.5	Gene mutation disorders: albinism, phenylketonuria, alkaptonuria, galactosemia, brachydactyly	3	CO1
	1.6	Autosomal anomalies: Down's syndrome, Edward's syndrome, Cri du chat syndrome	1	CO1
	1.7	Sex chromosomal anomalies: Klinefelter's syndrome and Turner's syndrome.	1	CO1
2	**Module 2 - Introduction to Immunology (13 Hrs)**			
	2.1	Immunity - Innate and Acquired	2	CO2
	2.2	Mechanisms (non-specific defenses)	3	CO2
	2.3	Antigen & Antibody: Antibody Types, Antigen Antibody interactions	2	CO2
	2.4	Cells & Organs involved in Immunity	1	CO2
	2.5	Cell mediated immunity	2	CO2
	2.6	Humoral immunity, Vaccines	3	CO2
3	**Module 3 – Immunopathology and Psychoneuroimmunology (15 Hrs)**			
	3.1	Hypersensitivity reactions (Type 1, 2, 3 & 4)	3	CO3
	3.2	Autoimmunity-Types & Diseases	3	CO3
	3.3	Immunodeficiency - Primary & Secondary, AIDS	3	CO3
	3.4	Psychoneuroimmunology - Connections between emotions, nervous system and immune function	2	CO3
	3.5	Placebo effect	1	CO3
	3.6	Effect of Meditation	2	CO3
	3.7	Biofeedback	1	CO3

4	**Module 4 – Stress (17 Hrs)**			
	4.1	Stress response- General Adaptation Syndrome	2	CO4
	4.2	Types of Stress	1	CO4
	4.3	Hormonal, anatomical, and physiological indicators of stress	3	CO4
	4.4	HPA & HPT axis	3	CO4
	4.5	stress and disease	2	CO4
	4.6	Stress, emotionality and endorphins	6	CO4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:**
	Observation of practical skills, Laboratory record. *Any other method as may be required for a specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for a specific course by the course faculty*.

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Ashim K. Chakravarthy. 1998. Immunology. Tata McGraw-Hill, New Delhi.

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