# SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

## THREE YEAR UNDERGRADUATE PROGRAMME

## B.Sc. ZOOLOGY (NEP)

## LEVEL – 5.0 (SEMESTER III &IV)

## FACULTY: SCIENCE AND TECHNOLOGY

## (Courses effective from Academic Year 2025-26)

# SYLLABUS

# THREE YEAR UNDERGRADUATE PROGRAMME
# B.Sc. ZOOLOGY under FACULTY: SCIENCE AND TECHNOLOGY
## Board of Studies in Zoology (Including Apiculture)

| | |
|---|---|
| Dhote Dr. Jayashree Dipak (Chairman)<br>Shri Shivaji Science College Amravati. | Gadhikar Dr. Yashashri A.<br>G.V.I.S.H. Amravati |
| Joshi Dr. Pravin Purushottam<br>Amolakchand Mahavidhyalay, Yeotmal. | Kale Dr. Gokul B.<br>G.S. Science Arts, Commerce College, Khamgaon, Dist. Buldhana. |
| Nandurkar Dr. Sou. H.P.<br>Head Department Of Zoology,<br>SGBAU Amravati. | Makode Dr. Pravin.M.<br>Shri. Dr. R.G. Rathod Arts and Science College, Murtizapur, Dist. Akola |
| Patil Dr. Pradip S.<br>R.A. Arts, Shri M.K. Commerce and S.R. Rathi Science College, Washim. | Sapkal Dr. Hemant P.<br>Shri Shivaji Arts, Commerce and Science College, Akola. |
| Zilpe Dr. Suvarna K.<br>Smt. Radhabai Sarda Arts, Commerce and Science College, Anjangaon Surji Dist. Amravati. | Bobade Dr. Atul D.<br>Department of Zoology<br>Shri Shivaji Science College, Nagpur. |
| Mali Dr. Rajendra P.<br>Indira Gandhi Senior College, CIDCO New Nanded Dist. Nanded. | Dr. Qureshi Syed Obaid<br>Adarsha Sc., J. B. Arts and Birla Commerce Mahavidyalaya, Dhamangaon Rly. Dist. Amravati. |
| Karlekar Dr. Mangla B.<br>Bhamburkar Niwas, Old Biyani Square, Camp Amravati. | Virani Dr. Ramzan S.<br>Shivramji Moghe Science College, Pandharkawada, Dist. Yeotmal |

# Sant Gadge Baba Amravati University, Amravati

## Structure of 3 /4 Year under Graduate Degree Program in Zoology Discipline In the faculty of Science & Technology (Science Group) applicable to Non-autonomous affiliated colleges.

## Credit Distribution over Six Vertical for Zoology Discipline.

| Vertical | Vertical Type | | Semester | | | | | | | Total Credits | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I | II | | III | IV | V | VI | | |
| | **(i) Three-year UG Degree Programme (Level 4.5.to 5.5)** | | | | | | | | | | |
| a | **Major - Zoology** (DSC) **60-64** (Minimum 50% of Total Credits) | | 2+2 (4) | 2+2 (4) | **Major** Mandatory | 4+2 (6) | 4+2 (6) | 6+4 (10) | 4+4 (8) | 22+16 (38) | **48** |
| | | | | | IKS (Subject Specific) | 2 | 0 | 0 | 0 | 2 | |
| | | | | | Elective | 0 | 0 | 2+2 (4) | 2+2 (4) | 4+4 (8) | |
| b | **Minor - Zoology** (from same facultyof DSC) **18-20** | | 2+2 (4) | 2+2 (4) | **Minor** | 2+2 (4) | 2+2 (4) | 2+2 (4) | 2+2 (4) | 12+12 (24) | **24** |
| c | **Generic/ Open Elective Courses (OE)** (faculty wise Basket Other than faculty of Major/Minor Subject) **10-12** | | 4 | 4 | | 2 | 2 | 0 | 0 | 12 | **12** |
| d | **(i)Vocational Skill Courses (VSEC)** corresponding to Major - **Zoology** (Skill based/ Advance Practicals wherever applicable) **8-10** | | 0 | 2 | | 2 | 2 | 2 | 2 | 10 | **10** |
| | **(ii) Skill Enhancement Courses** SEC (Basket of skill courses approved by the University) **6** | | 2 | 2 | | 0 | 2 | 0 | 0 | 6 | **6** |
| e | **(i)Ability Enhancement Courses** (AEC)- Focus: Linguistic & Communication Skills (Eng.+ Modern Indian Language) **8** | | 2 | 2 | | 2 | 2 | 0 | 0 | 8 | **8** |
| | **(ii)Indian Knowledge System (IKS)2** (Generic) | | 2 | 0 | | 0 | 0 | 0 | 0 | 2 | **2** |
| | **(iii)Value Education Courses (VEC)** *Understanding India, EVS, Digital & Technological Solution*. **4** | | 2 | 2 | | 0 | 0 | 0 | 0 | 4 | **4** |
| f | **(i) Internships/ Apprenticeship** corresponding to Major - **Zoology OJT 8** | | 0 | 0 | | 0 | 0 | 0 | 4 | 4 | **4** |
| | **(ii)Field Projects/Community Engagement & Service(CEP)** corresponding to Major -Zoology **4-6** | | 0 | 0 | | 2 | 2 | 2 | 0 | 6 | **6** |
| | **(iii) Co-curricular courses (CC)** (health & wellness, yoga education, sports, fitness, cultural activities, NSS/NCC & Fine/ Applied/ Visual/ Performing Arts **8** | | 2 | 2 | | 2 | 2 | 0 | 0 | 8 | **8** |
| | **Total Credits** | | **22** | **22** | | **22** | **22** | **22** | **22** | **132** | **132** |
| | **(ii) Four-year UG Degree programme (Level 6.0) A. Honors Degree in Major and Minor** | | | | | | | | | | |
| | **Vertical Type** | | | | **Semester VII** | | | | **Semester VIII** | | |
| | **Major** (Offered at Three yearUG Programme) | **Mandatory** | | | **12-14 (2*4+2*2 or 3*4+2)** | | | | **12-14 (2*4+2*2 or 3*4+2)** | | **28** |
| | | **Elective** | | | 4 | | | | 4 | | **8** |
| | **Research Methodology (RM)** | | | | 4 | | | | 0 | | 4 |
| | **On the Job Training (OJT)** | | | | 0 | | | | 4 | | 4 |
| | **Total** | | | | **22** | | | | **22** | | **44** |
| | **Cumulative** | | | | | | | | **176** | | |
| | | | | | **(132+44)** | | | | | | |
| | **(ii) Four-year UG Degree Programme (Level 6.0) B. Honors with Research Degree in Major and Minor** | | | | | | | | | | |
| | **Vertical Type** | | | | **Semester VII** | | | | **Semester VIII** | | |
| | **Major** (Offered at Three yearUG Programme) | **Mandatory** | | | 8-10 (2*4+2 or 2*4) | | | | 8-10 (2*4+2 or 2*4) | | 20 |
| | | **Elective** | | | 4 | | | | 4 | | 8 |
| | **Research Methodology (RM)** | | | | 4 | | | | 0 | | 4 |
| | **Research Project (RP)** | | | | 4 | | | | 8 | | 12 |
| | **Total** | | | | **22** | | | | **22** | | **44** |
| | **Cumulative** | | | | | | | | **(132+44) 176** | | |

**Faculty: Science & Technology (Science Group)**
**(Teaching and Learning Scheme: B.Sc. - Zoology with Minor ---------- )**
**(Three Years- Six Semesters Bachelors Degree Programme)**
**SECOND YEAR: SEMESTER – III**

| Mode of Teaching | Vertical Number | The Vertical | Type of Course | Course Code | Course Name | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|---|---|---|---|---|---|---|---|---|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | a. | Major ( Zoology ) | Theory 3 | 133212 | Cytology | 2 | 2 | **10** |
| | | | Theory 4 | 133213 | Developmental Biology of Vertebrates | 2 | 2 | |
| | | | Lab/Practical 8 | 133214 | Practical based on Theory 3 & 4 | 2 | 4 | |
| | | IKS (Major Specific) | Theory 5 | 133215 | Amazing World of Animals & Scope in Zoology | 2 | 2 | |
| | b. | Minor (Other subject in combination with Zoology) | Theory1 | 133216 | Forensic Zoology | 2 | 2 | **6** |
| | | | Lab/Practical 9 | 133217 | Practical based on Minor Theory 1 | 2 | 4 | |
| | c. | Generic/ Open Elective ( other than Science & Technology faculty) | Theory 5 | 133218 | From basket of open elective – Ornithology Insights | 2 | 2 | **2** |
| | d. | VSC | Lab/Practical 10 | 133219 | Practical on Microtechnique | 2 | 4 | **4** |
| | e. | AEC - English | Theory | - | -- | 1 | 1 | **2** |
| | | AEC –MIL | Theory | - | -- | 1 | 1 | |
| | f. | FP/CES | Project | 133220 | -- | 2 | 4 | **8** |
| | | CC | Outdoor | - | Course on health & wellness, yoga education, sports, fitness, cultural activities, NSS /NCC & Fine/ Applied/ Visual/ Performing Arts. | 2 | 4 | |
| | | **TOTAL** | | | | **22** | **32** | **32** |

**Note:**

a. The strength of the batch of the Practical for UG Classes shall be 16 with an addition of 10% with the permission of Hon'ble Vice Chancellor. However, for Music Discipline the batch size shall be of 7 students. The number of the students required to constitute a batch or calculate the workload shall be in accordance with the relevant Government Resolution in force at the time, applicable to specific time, region, course type, mode of instruction, and other pertinent factors.

b. 1 Credit shall mean 1 Hour Teaching per Week per Semester (Total 15 Hrs/ Semester), the duration of 1 Teaching Period will be 60 Minutes. For Practical 1 Credit shall mean 2 Hour Teaching per Week per Semester (Total 30 Hrs/ Semester).

c. For Examination and Evaluation of Theory Courses, 40 % Marks shall be assigned to Internal Examination and 60% Marks shall be assigned to end-semester external university examination.

d. Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III, IV, V and VI. These courses may be taught by Physical Education Director or may be assigned to Language Teacher by the Principal of HEI based on the expertise of the concerned.

e. Value Education Courses to be selected from the Basket of Courses provided by the University. These courses may be assigned to the Language Teacher by the Principal of HEI based on the expertise of the concerned.

f. Generic / Open Elective Courses (GE/OE): Courses to be selected from the Basket of Courses provided by the University

g. Abbreviations: Department Specific Core: DSC, Department Specific Elective: DSE, FSC: Faculty Specific Core, FSE: Faculty Specific Elective, Indian Knowledge System: IKS, Inter Faculty Specific Core: IFSC, Inter Faculty Specific Elective: IFSE, Theory : Th, Practical/Practicum: Pr, Environment Studies: ES, Pre-requisite Course mandatory if applicable: Prq, Laboratory: Lab (Practical), Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community Engagement and Service: CES; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP; MIL: Modern Indian Language

## Examination and Assessment Process:

i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.

ii. Exit options are provided with Certificate, Diploma and Basic Bachelor's degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor's degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.

iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on 'Evaluation Reforms in Higher Educational Institutions (2019).

# Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination.

Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in Teaching Learning Scheme prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table –

| Vertical No. | The Vertical | Mode of Examination, Evaluation & Assessment | Theory | | | | Theory (Total) | | Practical | | | | Practical (Total) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | External | | Internal | | | | External | | Internal | | | |
| | | | Max. Marks | Min. Marks | Max. Marks | Min. Marks | Max. Marks | Min. Marks | Max. Marks | Min. Marks | Max. Marks | Min. Marks | Max. Marks | Min. Marks |
| a | Major | External & Internal | 30 | 9 | 20 | 6 | 50 | 20 | 25 | 10 | 25 | 10 | 50 | 20 |
| | IKS (Major) | | 30 | 9 | 20 | 6 | 50 | 20 | -- | -- | -- | -- | -- | -- |
| b | Minor | | 30 | 9 | 20 | 6 | 50 | 20 | 25 | 10 | 25 | 10 | 50 | 20 |
| c | Generic/ Open Elective | | 30 | 9 | 20 | 6 | 50 | 20 | -- | -- | -- | -- | -- | -- |
| d | VSC (Major) | Internal | -- | -- | 50 | 20 | - | - | -- | -- | 50 | 20 | 50 | 20 |
| | SEC (Major) | Internal | -- | -- | 50 | 20 | - | - | -- | -- | 50 | 20 | 50 | 20 |
| e | AEC (Eng. & One MIL Composite) | External & Internal | 30 | 9 | 20 | 6 | 50 | 20 | -- | -- | -- | -- | -- | -- |
| | VEC | External & Internal | 30 | 9 | 20 | 6 | 50 | 20 | -- | -- | -- | -- | -- | -- |
| f | Internship/ Apprenticeship | Internal | Assessment of these verticals shall be based on various activities/practices. It shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately. | | | | | | | | | | | |
| | FP/CEP | | | | | | | | | | | | | |
| | CC | | | | | | | | | | | | | |

## Continuous Assessment Tests (CAT)

**For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-**

i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
   - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
   - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
   - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.

ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.

iii. Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations

iv. Internal assessment shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

## Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule –

| Sr. No. | Name of the Examination | End Sem Examination | Supplementary Examination* |
|---|---|---|---|
| 1 | Semester-I, III, V and VII | Winter | Summer |
| 2 | Semester-II, IV, VI and VIII | Summer | Winter |

* The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination. The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
   a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
   b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
   c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be mutatis-mutandis applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

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# Additional Instructions to the Paper Setters
# BSc Zoology as per Scheme under NEP 2020

1. The duration of University theory examination shall be of Two hours or appropriate hours as prescribed in the syllabus/curriculum of the pertinent course
2. The Maximum Marks for the Question Paper shall be 30
3. The Question Paper shall consist of Short Answer type (60%) and Long Answer type (40%) questions.
4. Examiner shall set Long answer type Questions and Short Answer type Questions as specified in the following Table or as applicable as per the curriculum.
5. There shall be internal choice for Short-Answer type Question and Long Answer type Question for every Unit.
6. The Question paper should be set based on the Course Outcomes (COs) defined in the curriculum and setter shall ensure that all the outcomes are addressed through appropriate questions. Read and study the Course Outcomes of a paper/subject/course very carefully.
7. The Questions should help to measure attainment of their corresponding Course Outcomes as prescribed in the syllabus/curriculum. All questions must be mapped to their related Course Outcomes.
8. Questions paper should try to address the different levels of learning (Bloom's Taxonomy)
   i.e. Knowledge/Remembering, Understanding, Applying, Analysing, Evaluating and Creating
9. All Units mentioned in the course should be covered with equal weightage. The question paper shall be set so as to cover the entire syllabus of the respective course (paper).
10. The degree of difficulty of the question paper should be such that a student, who has engaged himself in the continuous learning process should be able to clear with ease. However, for scoring further his all-round knowledge and skills should be tested.
11. Model Solutions/answers to the short answer type questions and long answer type questions and scheme of marking for all question shall be submitted along with the question paper in a separate envelope.
12. Please ensure that the total marks for a course/subject/paper amounts to the prescribed total as notified in the scheme/curriculum. The total number of marks available for each question and each part of a question should be shown in the mark scheme and must tally with the marks shown on the question paper.
13. Avoid Questions like "Write short notes on …"
14. The question paper should be precise and should be designed such that the questions:
    a) are unambiguous
    b) are asked for appropriate marks
    c) The questions should be serially numbered as 01, 02, 03, 04, 05, 06 etc.
    d) Sub-questions, if any, shall be numbered as A,B,C,D,… continuously for all Units
    e) It must be ensured that all questions are from within the prescribed syllabus
    f) The paper setters should specify whether any Charts, Graphs, Tables, Codes, Books etc. are to be provided to the students. The use of which shall be permitted during the actual conduct of the examination.
15. For Short-Answer type Questions, ensure that:
    - The item calls for a single, brief answer
    - The item has been written as a direct question

- The desired response is related to the main point of the item
- Clues to the answer have been avoided (e.g. “a” or “an”, length of the blank)
- The units and degree of precision is indicated for numerical answers.

16.For Long Answer type questions, make sure that:

- Questions starting questions with “who”, “what”, “when”, “where”, “name”, “list” are avoided as these terms limit the response.
- Questions must follow Bloom’s taxonomy with inclusion of following levels:

**Distribution of Marks amongst Question paper**

<table>
<tr><th>Total marks of Theory Paper</th><th>Marks for Long + Short Answer</th><th>Distribution of Unit wise Long/Short Answer type Questions</th></tr>
<tr><td rowspan="2">30</td><td rowspan="2">12 + 18</td><td>1. Compulsory Question: Two One Sentance Questions Based on All Four Units, Total Eight Questions carrying 01 Mark Each out of with Compulsory 6 Questions to solve.<br><br>2. Questions with Internal Choice of All Four Units:<br><br>a. Long Answer: on any Two Units<br>Long Questions of Maximum Marks 6 with internal Choice on any Two Units as per the choice of Paper setter.<br><br>b. Short Answer: on any Two Units<br>Short Questions of Maximum 3 Marks with Internal Choice on any Two Units as per the choice of Paper setter.</td></tr>
<tr><td>Q1: 6 Marks Based on All Units (Two Questions on Each Unit)<br>Q2: 6 Marks Unit I<br>Q3: 6 Marks Unit II<br>Q4: 6 Marks Unit III<br>Q5: 6 Marks Unit IV</td></tr>
</table>

**Note:** For a unit, an identical pattern of long and short answer shall be adhered for internal choice, that is ‘either-or’ questions shall be in same pattern.

**Table 3: Model Question Paper Pattern**

| Sr. No of Questions | Questions | Marks allotted to each Question |
|---|---|---|
| | **B.Sc. (Zoology) Semester Examination NEP -2020**<br>**Paper Title As per Curriculum**<br>**Time: Two Hours** **Total marks: 30**<br>**N.B.:**<br>1. Question No 1 is compulsory<br>2. Draw well labelled diagrams whenever necessary.<br>3. Students may use various colors to signify answers. | |
| Q1: | **Write answers in One Sentance: (Solve any Six)**<br>[Set two questions on each unit (out of total Four units). Students should solve any six questions out of eight and each question carry one mark]<br>i. -------<br>ii. -------<br>iii. -------<br>iv. ---------<br>v. ---------<br>vi. ----------<br>vii. ----------<br>viii. ---------- | **Max. Marks**<br>(1x6) = **0 6** |
| Q 2: | **Answers in short (Any Two of the Following)**<br>[Paper Setter shall set Four Questions on Unit decided for Short Type Questions carrying 3 Marks Each. Students should solve any Two Questions out of Four]<br>**a)** ----------<br>**b)** ----------<br>**c)** ----------<br>**d)** ---------- | 06 Marks<br>(3x2)= 06 |
| Q 3: | **Explain in detail (Any One of the following)**<br>[Paper Setter shall set Two Questions on Unit decided for Long Type Questions carrying 6 Marks Each. Students should solve any One Questions out of Two]<br>**e)** ----------<br>**f)** ---------- | 6 Marks<br>(1x6) = 06 |
| Q 4: | **Answers in short (Any Two of the Following)**<br>[Paper Setter shall set Four Questions on Unit decided for Short Type Questions carrying 3 Marks Each. Students should solve any Two Questions out of Four]<br>**g)** ----------<br>**h)** ----------<br>**i)** ----------<br>**j)** ---------- | 06 Marks<br>(3x2)= 06 |
| Q 5: | **Explain in detail (Any One of the following)**<br>[Paper Setter shall set Two Questions on Unit decided for Long Type Questions carrying 6 Marks Each. Students should solve any One Questions out of Two]<br>**k)** ----------<br>**l)** ---------- | 6 Marks<br>(1x6) = 06 |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133212 | Cytology | 2 | 30 | 2 Hrs | 30 |

| | |
|---|---|
| **Course Objectives:** | **After this course, students will be able to**<br>• To understand structure of an animal cell and its organelles.<br>• To understand plasma membrane structure as explained by Fluid Mosaic Model, membrane dynamics and functions of cell membrane.<br>• To understand functions of different cell organelles.<br>• To understand structure of a typical eukaryotic chromosome.<br>• To understand cell cycle, types of cell division and cellular basis of cancer. |
| **Course Outcome:** | **After successful completion of this course, the students will be able to..**<br>1. Describe the structure of an animal cell, identify and describe various organelles and structures within an animal cell.<br>2. Describe Fluid Mosaic Model of plasma membrane, the mechanisms of transport across cellular membranes and the significance of membrane potential<br>3. Describe plasma membrane structure as explained by Fluid Mosaic Model, membrane dynamics and functions of cell membrane, including the processes of transport across membranes.<br>4. To describe the components of endomembrane system, how endomembrane system of a cell works; the structural model of ribosomes and their role as protein factories of the cell.<br>5. To explain the role of mitochondrion as the "Powerhouse of the Cell" and discuss how the structure of mitochondria allows harnessing of energy from oxidation of food stuff.<br>6. To describe the structure and functions of nucleus and discuss various roles of its components vis-a'-vis cell division.<br>7. To describe and identify stages of the cell cycle, including mitosis and meiosis; discuss the regulation of the cell cycle and cellular basis of cancer. |

| Unit | Contents | Workload Allotted | Weightage of Marks Allotted |
|---|---|---|---|
| **Unit I** | **Overview of an Animal Cell and Plasma membrane**<br>1.1 Structure of an Animal Cell and components<br>1.2 Characteristics of cell organelles in brief<br>1.3 Fluid-mosaic model of plasma membrane<br>1.4 Transport across membranes: active and passive transport, diffusion, osmosis, facilitated transport | 8 Hrs | 8 Marks |
| **Unit II** | **Nucleus, Chromatin Structure and Ribosomes**<br>2.1 Structure and functions of nucleus and nucleolus<br>2.2 Chromatin organization (Heterochromatin and euchromatin; Nucleosome and Solenoid structure)<br>2.3 General organization of a eukaryotic chromosome<br>2.4 Structure and Functions of Ribosome | 7 Hrs | 7 Marks |
| **Unit III** | **Endomembrane Systems**<br>3.1 Structure and Functions of Endoplasmic Reticulum (ER)<br>3.2 Structure and Functions of Golgi apparatus<br>3.3 Structure and Functions of Lysosomes<br>3.4 Structure and Functions of Mitochondria | 8 Hrs | 8 Marks |
| **Unit IV** | **Cell cycle, Cell Division and Cancer**<br>4.1 Cell cycle: Definition and Phases<br>4.2 Cell division: mitosis and meiosis<br>4.3 Cancer: Definition, Types of Cancer<br>4.4 Properties of cancer cells | 7 Hrs | 7 Marks |

| | |
|---|---|
| **References:** | 1. Molecular Cell Biology by Lodish, Berk, Kaiser, Krieger, Bretscher, Ploegh, Martin, Yaffe, Amon. W. H. Freeman<br>2. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by Verma P S and Agarwal V K. S. Chand Publications<br>3. The cell : A molecular approach by Geoffrey Cooper. Sunderland, MA : Sinauer Associates<br>4. Karp's Cell Biology by Iwasa, Marshall Wiley Publications<br>5. Cell Biology: C.B. Powar, Himalaya Pub. Co.<br>6. Cytology, Genetics and Evolution" by P K Gupta. Rastogi Publications,India<br>7. Alberts Molecular Biology Of The Cell 7th Edition. Alberts et al. W. W. Norton & Company<br>8. Becker's World of the Cell by Jeff Hardin. Pearson Publications |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. Continuous Assessment Test (Best 2 out of 3 tests) | ---------- | 10 Marks |
| 2. Report of Seminar / Field visit/ Case study/ Any innovative method | ----- | 10 Marks |
| Total ---------- | | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133213 | Developmental Biology of Vertebrates | 2 | 30 | 2 Hrs | 30 |

| | |
|---|---|
| **Course Objectives:** | **After this course, students will be able to**<br>• Understand the processes of gametogenesis, including spermatogenesis, oogenesis, and gamete differentiation.<br>• Analyze the chemical and metabolic conditions influencing gamete formation and classify the different types of eggs.<br>• Explain the mechanisms of fertilization, including gamete approximation, capacitation, acrosome reaction, formation of fertilization membrane, egg activation, and mechanisms preventing polyspermy.<br>• Study cleavage patterns and control, including chemical changes and totipotency, and perform a comparative analysis of blastulation and gastrulation in frogs and chicks.<br>• Interpret fate maps, understanding their formation and biological significance in embryonic development.<br>• Describe metamorphosis, especially retrogressive metamorphosis with examples, and understand the process of regeneration, focusing on limb regeneration in amphibians.<br>• Explain the structure and function of placentation in mammals.<br>• Understand the concept of embryonic induction and evaluate the role and significance of the primary organizer in development. |
| **Course Outcome:** | • Understand the fundamental processes of vertebrate development: Gametogenesis, Fertilization, Embryogenesis<br>• Learn about molecular and cellular mechanisms regulating development<br>• Study the formation of key organs and tissues<br>• Explore developmental disorders and their genetic basis |

| Unit | Contents | Workload Allotted | Weightage of Marks Allotted |
|---|---|---|---|
| **Unit I** | **Gametogenesis:**<br>1.1 Process of Spermatogenesis and Oogenesis<br>1.2 Differentiation of gametes<br>1.3 Chemical and Metabolic circumstances during gamete formation<br>1.4 Types of eggs | 8 Hrs | 8 Marks |
| **Unit II** | **Fertilization:**<br>2.1 Process of fertilization ( approximation and capacitation of gametes)<br>2.2 Acrosome reaction<br>2.3 Formation of fertilization membrane<br>2.4 Egg activation and Blockage to polyspermy | 7 Hrs | 7 Marks |
| **Unit III** | **Cleavage and Fate maps:**<br>3.1 Cleavage ( Pattern and Control)<br>3.2 Chemical changes during cleavage and totipotency<br>3.3 Blastulation and Gastrulation: A complete study in frog and chick<br>3.4 Fate maps ( Formation and Significance ) | 8 Hrs | 8 Marks |
| **Unit IV** | **Metamorphosis, Regeneration and Placentation:**<br>4.1 Retrogressive metamorphosis (example)<br>4.2 Process of regeneration ( Limb regeneration in Amphibia)<br>4.3 Placentation in mammals ( Structure and function)<br>4.4 Embryonic Induction and significance of primary organizer | 7 Hrs | 7 Marks |

| | |
|---|---|
| **References:** | 1. Gilbert, S.F. (2016) *Developmental Biology* (11th Edition)Sinauer Associates / Oxford University Press.– A widely acclaimed and comprehensive book on classical and molecular aspects of vertebrate development.<br>2. Balinsky, B.I. (2012) *An Introduction to Embryology* (5th Edition) Thomson Learning. – A foundational text focusing on comparative vertebrate embryology with clear explanations.<br>3. Verma, P.S. & Agarwal, V.K. (2020) *Chhatwal & Verma's Developmental Biology* S. Chand Publishing, New Delhi. – A student-friendly book widely used in Indian universities, covering both theoretical and practical aspects.<br>4. Carlson, B.M. (2019) *Human Embryology and Developmental Biology* (6th Edition) Elsevier. – Though focused on human development, it's excellent for understanding vertebrate developmental processes.<br>5. Saxena, R.K. & Saxena, S. (2010) *Developmental Biology* Himalaya Publishing House. – A concise textbook useful for quick revision and Indian syllabus-oriented study.<br>6. Wolpert, L., Tickle, C., & Arias, A.M. (2019) *Principles of Development* (6th Edition) Oxford University Press. – A clear, concept-driven book that balances molecular detail with broader developmental concepts.<br>7. Larsen, W.J. (2001) *Human Embryology* (3rd Edition) Churchill Livingstone. – Offers in-depth insight into vertebrate embryology with excellent illustrations. |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. Continuous Assessment Test (Best 2 out of 3 tests) | ---------- | 10 Marks |
| 2. Report of Seminar / Field visit/ Case study/ Any innovative method | ----- | 10 Marks |
| Total ---------- | | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133214 | Practical based on Theory 3 & 4 Major | 2 | 60 | 3 Hrs | 50 |

| | |
|---|---|
| **Lab/ Practical-8** | **I) Cell Biology:**<br>1. Use, care and maintenance of microscope.<br>2. Study of different cell types by permanent slides/ICT Tools/Charts (Endothelium, Neuronal, Epithelia, Connective Tissue)<br>3. Demonstration of mitochondria by using vital staining.<br>4. Preparation of Polytene chromosome in *Chironomus* or *Drosophila* larva.<br>5. Preparation of various stages of mitosis.<br>6. Preparation of various stages of meiosis from suitable material.<br>**II) Developmental Biology:**<br>1. Study of stages of gametogenesis in rat (Permanent Stained Slides).<br>2. Study of different of types of animal eggs.<br>3. Study of developmental stages (Life Cycle) of Cockroach, Housefly, Mosquito, Butterfly, Moth, Frog (Any Four).<br>4. Study of developmental stages of *Lymnaea*.<br>5. Developmental stages of frog: Cleavage, blastula, gastrula, and tadpoles through available resources.<br>6. Study of chick embryo at different hours of incubation by permanent slides.<br>7. Study of different types of placenta with suitable histological slides or visual diagrams. |

- **Distribution of Marks:**

| Practical External (25 Marks) | | Practical Internal (25 Marks) | |
|---|---|---|---|
| Identification and comments on spots (2 from Cytology, 2 from Developmental Biology) | 08 Marks | Student performance and Attendance during regular practical | 10 Marks |
| Cytological Preparation: 08 Marks | 08 Marks | Certified Practical Record | 05 Marks |
| Comment on given life cycle: | 04 Marks | Submission of Report | 05 Marks |
| Viva-voce | 05 Marks | Use of ICT | 05 Marks |
| **Total** | **25 Marks** | **Total** | **25 Marks** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133215 | IKS<br>Amazing World of Animals and Scope in Zoology | 2 | 30 | 2 Hrs | 30 |

| | |
|---|---|
| **Course Objectives:** | **After this course, students will be able to**<br>• This course aims to provide students with a comprehensive understanding of the animal kingdom, emphasizing the remarkable intelligence and unique adaptations of various species.<br>• Students will explore the rich zoological heritage of India, delving into ancient texts, ethical considerations, and traditional classifications.<br>• The curriculum also covers applied aspects of zoology, highlighting career opportunities in wildlife conservation, agriculture, and biotechnology.<br>• Additionally, students will gain insights into India's diverse fauna and the conservation efforts necessary to protect endangered species and ecosystems. |
| **Course Outcome:** | • Animal Intelligence and Adaptations: Students will understand the cognitive abilities and unique survival strategies of various species.<br>• Zoological Heritage of India: Students will explore India's rich zoological heritage, including ancient texts and ethical considerations.<br>• Applied Zoology Careers: Students will identify career opportunities in wildlife conservation, agriculture, and biotechnology.<br>• Faunal Diversity and Conservation: Students will gain insights into India's diverse fauna and the conservation efforts necessary to protect endangered species and ecosystems. |

| Unit | Contents | Workload Allotted | Weightage of Marks Allotted |
|---|---|---|---|
| **Unit I** | **Wonders of the Animal Kingdom**<br>1.1 Animal Intelligence in Nature – Examples like elephants' Memory and crow's problem-solving.<br>1.2 Unique Adaptations – Flying snakes, gliding frogs, and desert Survival tactics of camels.<br>1.3 Color and Camouflage – Chameleons, cuttlefish, and Mimicry in butterflies.<br>1.4 Social Behavior in Animals – Ant colonies, honeybee dances, and dolphin communication. | 8 Hrs | 8 Marks |
| **Unit II** | **Indian Contributions to Zoology (IKS)**<br>2.1 Ancient Texts on Animals –References to animals in Holy Literature : Ancients Scripture animals symbolically.<br>2.2 Ayurveda and Zoology – Use of animal products (like honey, milk, ghee) in treatments.<br>2.3 Animal Ethics in Indian Culture – Ahimsa, worship, and wildlife conservation.<br>2.4 Classifications in Ancient India – Jivajati (living beings) in Charaka and Sushruta Samhitas. | 7 Hrs | 7 Marks |
| **Unit III** | **Applied Zoology and Career Scope**<br>3.1 Wildlife Conservation & Forest Services – Careers in national Parks, biodiversity research.<br>3.2 Zoology in Agriculture & Pest Control – Role of biocontrol and Beneficial insects.<br>3.3 Medical and Pharmaceutical Fields – Use of animals in vaccine Testing and research.<br>3.4 Emerging Fields – Animal biotechnology, forensic zoology, and Environmental consultancy. | 8 Hrs | 8 Marks |

| | | | |
|---|---|---|---|
| **Unit IV** | **India's Faunal Diversity and Conservation**<br>4.1 Biodiversity Hotspots in India – Western Ghats, Himalayas, and Sundarbans.<br>4.2 Endemic and Endangered Species – Lion-tailed macaque, Great Indian bustard, gharial.<br>4.3 Conservation Efforts & Laws – Wildlife Protection Act, Project Tiger, Biosphere reserves.<br>4.4 Sacred Groves & Traditional Conservation – Role of local Communities and folk beliefs. | 7 Hrs | 7 Marks |
| **References:** | 1. Campbell, N. A., Reece, J. B., & Urry, L. A. (2017). *Biology* (11th ed.). Pearson. A comprehensive textbook that includes topics on the diversity of life, animal classification, anatomy, and behavior. It's a great foundational source for understanding the basic principles of zoology.<br>2. Hickman, C. P., et al. (2008). *Gastropoda: The Biology of Molluscs*. Academic Press. This book provides an in-depth look at gastropod molluscs, their physiology, behavior, and ecological importance. It's a good reference for specific animal groups in zoology.<br>3. Borror, D. J., et al. (1989). *An Introduction to the Study of Insects*. Saunders College Publishing. This is a staple in entomology and covers the diversity, behavior, and ecology of insects, which are an essential part of the animal kingdom.<br>4. Pough, F. H., Janis, C. M., & Heiser, J. B. (2012). *Vertebrate Life* (9th ed.). Pearson. This textbook focuses on vertebrates, exploring their anatomy, physiology, and evolutionary adaptations. | | |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. Continuous Assessment Test (Best 2 out of 3 tests) | ---------- | 10 Marks |
| 2. Report of Seminar / Field visit/ Case study/ Any innovative method | ----- | 10 Marks |
| Total | ---------- | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133216 | Minor-<br>Forensic Zoology | 2 | 30 | 2 Hrs | 30 |

| | |
|---|---|
| **Course Objectives:** | After studying this course, students will be able to<br>• The significance of biological evidence.<br>• How wildlife forensics aid in conserving natural resources.<br>• How forensic entomology assists in death investigations.<br>• Demonstration on various biological evidences handling and processing. |
| **Course Outcome:** | • Students will be able to apply zoological knowledge to solve crimes related to wildlife.<br>• Recognize diverse aspects of Forensic science.<br>• Techniques involved in collection, preservation and evaluation of evidences.<br>• Understanding animal behaviour.<br>• Identifying animal remains. |

| Unit | Contents | Workload Allotted | Weightage of Marks Allotted |
|---|---|---|---|
| **Unit I** | **Wildlife Forensics**<br>1.1 Fundamentals and Significance of wildlife forensic.<br>1.2 Protected and endangered species of animals.<br>1.3 Illegal trading in wildlife items (skin, fur, bone, horn, teeth)<br>1.4 Identification of pug marks of various animals.<br>1.5 Casting of Pug marks. | 8 Hrs | 8 Marks |
| **Unit II** | **Basics of Fingerprinting**<br>2.1 Biological basis of fingerprints.<br>2.2 Types of fingerprints.<br>2.3 Fingerprint patterns. Fingerprint characters.<br>2.4 Classification and cataloguing of fingerprint record.<br>2.5 Automated Fingerprint Identification System. | 7 Hrs | 7 Marks |
| **Unit III** | **Biological evidences**<br>3.1 Bite marks and Forensic significance of bite marks.<br>3.2 Significance of hair evidence.<br>3.3 Comparison of human and animal hair.<br>3.4 Collection and preservation of blood evidence.<br>3.5 Types and identification of microbial organisms of Forensic significance. | 8 Hrs | 8 Marks |
| **Unit IV** | **Forensic Entomology**<br>4.1 The fly life cycle (Blow fly and flesh fly)<br>4.2 Collection of entomological evidence during death investigations.<br>4.3 Significance of terrestrial and aquatic insects in forensic Investigations and their role in crime detection.<br>4.4 Sampling of insect stages at crime scene.<br>4.5 Insects to determine time since death. | 7 Hrs | 7 Marks |

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|---|---|
| **References:** | 1. Bisbing, Richard E., in Saferstein, Editor, Forensic Science Handbook, Vol. 1, 2nd Ed., Prentice Hall, 2002.<br>2. Saferstein, R.(1990) Criminalistics, Prentice Hall, New York.<br>3. David R. Ashbaugh (1999) Quantitative and Qualitative Friction Ridge Analysis, CRC Press.<br>4. E. Roland Menzel (1999) Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker, Inc. USA.<br>5. James F. Cowger (1993) Friction Ridge skin, CRC Press London.<br>6. Mehta, M.K (1980) Identification of Thumb Impression & Cross Examination of Finger Prints, N.M. Tripathi Pub. Bombay.<br>7. Moenssens (1975) Finger Prints Techniques, Chitton Book Co. Philadelphia, NY. 7. Chatterjee S.K. (1981) Speculation in Finger Print Identification, Jantralekha Printing Works, Kolkata.<br>8. Robertson (1999) : Forensic examination of Hair. Francis & Taylor, USA.<br>9. Gilblet, E. (1969) : Markers in Human Blood, Davis, Pensylvania<br>10. Culliford, B.E. (1971) The Examination and Typing of Blood Stains, US Deptt. of Justice, Washingron<br>11. Dunsford, I and Bowley, C. (1967) : Blood Grouping Techniques, Oliver & Boyd, London<br>12. Boorman KE, Dodd BE, Lincoln PJ. (1988) Blood group serology, 6th ed. Edinburgh : Churchill Livingstone.<br>13. Basin Et al. A laboratory Manual for Human Blood analysis. Kamla Raj Enterprises.<br>14. Li R. (2008) Forensic Biology, Taylor & Francis Group LLC.<br>15. Jason H. Byrd and James L. Castner (2001) Forensic entomology, CRC Press LLC.<br>16. Chowdhuri, S. (1971) : Forensic Biology, B P R & D Govt. of India.<br>17. Forensic Diatomology by M.S. Pollanen 8. Encyclopedia of Forensic Science. |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal - 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. Continuous Assessment Test (Best 2 out of 3 tests) | ---------- | 10 Marks |
| 2. Report of Seminar / Field visit/ Case study/ Any innovative method | ----- | 10 Marks |
| Total ---------- | | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| **5.0** | **III** | **133217** | **Practical based on Theory Minor- Forensic Zoology** | **2** | **60** | **3 Hrs** | **50** |

| | |
|---|---|
| **Course Objectives:** | **After studying this course, students will be able to**<br>• Apply Zoological principles to forensic investigations.<br>• Gaining skills in evidence analysis, identification and interpretation.<br>• Students will learn about the role of insects in forensic investigations, including their life cycles, decomposition patterns.<br>• Students will gain knowledge of the use of animal remains, including bones, teeth, and other biological samples, in forensic investigations.<br>• Practical experience in collecting, preserving, and analyzing biological evidence, including blood, hair, and other tissues |
| **Course Outcome:** | • Understand the fundamental principles of forensic zoology and its role in criminal investigations.<br>• Be able to identify and analyse animal remains and other biological evidence.<br>• Apply zoological knowledge to crime scene investigation and evidence interpretation.<br>• Understand the ethical considerations involved in forensic zoology. |
| **Lab/ Practical - 9** | **List of Practical's**<br>1. Microscopic comparison of animal and human hair.<br>2. To study different types of forensically important insect species.<br>3. To study the life cycle of forensically important insects (Blow fly/flesh fly)<br>4. To study the Human Skeleton.<br>5. To prepare and identify pugmarks of domestic animals.<br>6. Age determination from sutures.<br>7. To find the adulteration in the milk sample.<br>8. Analysis of bite mark.<br>9. Identification and comparison of Diatoms.<br>10. Photographic study of wild animals snare trap.<br>11. Different sampling methods for wild life material: mock study. |

- **Distribution of Marks:**

| **Practical External (25 Marks)** | | **Practical Internal (25 Marks)** | |
|---|---|---|---|
| Identification of hair sample / Age determination from sutures | 10 Marks | Student performance and Attendance during regular practical | 10 Marks |
| Identification of wild animals snare trap from given photographs. | 05 Marks | Certified Practical Record | 05 Marks |
| Identification of pugmarks from photographs/ analysis of bite marks/ analysis of milk adulteration | 05 Marks | Submission of case study | 05 Marks |
| Viva-voce | 05 Marks | Submission of collection (animals hairs/ pugmarks photographs) | 05 Marks |
| **Total** | **25 Marks** | **Total** | **25 Marks** |

**FOR BASKET (GOEC-5):**

**For Students of SEM-III of the program other than Science & TechnologyFaculty.**

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133218 | Ornithology Insights | 2 | 30 | 2 Hrs | 30 |

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|---|---|
| **Course Objectives:** | **After this course, students will be able to**<br>• Explore Cultural Significance of Birds: Students will examine how birds are represented in mythology, religion, and folklore across various cultures, understanding their symbolic meanings and roles.<br>• Analyze Artistic Representations: Students will investigate the symbolism of birds in literature, poetry, music, and art, exploring how they inspire creativity and convey deeper messages.<br>• Understand Traditional Uses of Birds: Students will learn about the traditional uses of birds, including the significance of feathers, domestication practices, and cultural beliefs associated with them.<br>• Study Iconic Birds in History: Students will study famous birds in history and storytelling, such as the peacock, eagle, and dove, and their impact on national identity and cultural narrative |
| **Course Outcomes:** | **By the end of this course, students will develop**<br>• Understand Birds and Their Ecological Role: Students will develop a foundational knowledge of bird species, their behaviors, and their significance in various ecosystems.<br>• Learn Bird Observation and Identification Techniques: Students will acquire practical skills in observing and identifying birds using tools like binoculars, field guides, and mobile applications.<br>• Appreciate Biodiversity and Conservation Efforts: Students will gain an appreciation for avian biodiversity and understand the importance of bird conservation in maintaining ecological balance.<br>• Engage in Citizen Science and Environmental Initiatives: Students will learn how to participate in citizen-led environmental projects, contributing to bird monitoring and conservation efforts. |

| Unit | Contents | Workload Allotted | Weightage of Marks Allotted |
|---|---|---|---|
| **Unit I** | **Birds in Human Culture and History**<br>1.1 Birds in mythology, religion, and folklore across different cultures<br>1.2 Symbolism of birds in literature, poetry, music, and art<br>1.3 Traditional uses of birds – feathers, domestication, and beliefs<br>1.4 Famous birds in history, storytelling, and national identity (e.g., peacock, eagle, dove) | 8 Hrs. | 8 Marks |
| **Unit II** | **Birds Around Us – Observation and Identification**<br>2.1 Common birds in urban, rural, and campus environments<br>2.2 Basics of bird watching – observation skills, note-taking, and ethics<br>2.3 Bird identification using color, sound, size, and behavior<br>2.4 Introduction to birding tools – mobile apps, field guides, and journals | 7 Hrs. | 7 Marks |
| **Unit III** | **Birds and the Environment**<br>3.1 Birds as part of nature – roles in ecosystem balance and food chains<br>3.2 How birds help humans – pest control, seed dispersal, and pollination<br>3.3 Urban birdlife and habitat changes due to cities and agriculture<br>3.4 Case studies of birds adapting to human environments (e.g., pigeons, crows, sparrows) | 8 Hrs. | 8 Marks |
| **Unit IV** | **Bird Conservation and Public Participation**<br>4.1 Major threats to birds – pollution, habitat destruction, hunting<br>4.2 Success stories in bird conservation – community and policy roles<br>4.3 Role of citizens in bird protection – bird festivals, bird counts, feeders<br>4.4 How to promote awareness – through social media, art, storytelling, and activism. | 7 Hrs. | 7 Marks |

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|---|---|
| **References:** | 1. **Ali, Salim (2002)** *The Book of Indian Birds,* Bombay Natural History Society / Oxford University Press – A classic and simple field guide with illustrations and notes on common Indian birds.<br>2. **Rasmussen, P.C. & Anderton, J.C. (2012)** *Birds of South Asia: The Ripley Guide* Smithsonian Institution and Lynx Edicions – Richly illustrated; great for bird identification and distribution.<br>3. **Sivakumar, K. & Venkatraman, C. (2013)** *A Photographic Guide to Birds of India* Zoological Survey of India – Beginner-friendly visual guide suitable for non-science readers.<br>4. **Zafar Futehally (1990)** *Birds: An Introduction to Ornithology* National Book Trust, India – A simple introduction to birds, their habits, and the joys of bird watching.<br>5. **Myneni, S.R. (2019)** *Environmental Studies* LexisNexis / Bharat Law House – Includes sections on birds, biodiversity, and environmental protection laws; suitable for arts and commerce students.<br>6. **Cornell Lab of Ornithology – Website** https://www.birds.cornell.edu – Free and interactive global platform with bird ID tools, citizen science programs (like eBird), and videos. |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. | Continuous Assessment Test (Best 2 out of 3 tests) ---------- | 10 Marks |
| 2. | Report of Seminar / Field visit/ Case study/ Any innovative method ----- | 10 Marks |
| | **Total ----------** | **20 Marks** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| **5.0** | **III** | **133219** | **VSC Advance Applications (Career oriented) / Practical based on Major-Microtechnique** | **2** | **30** | **2 Hrs** | **50** |

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|---|---|
| **Course Objectives:** | **After this course, students will be able to**<br>• To introduce students to the fundamental techniques of microtechnique used in histological studies.<br>• To train students in the preparation and application of fixatives and stains for tissue preservation and visualization.<br>• To develop hands-on skills in tissue processing, embedding, sectioning, and staining for microscopic examination.<br>• To ensure proper understanding and maintenance of laboratory equipment like microtomes, ovens, and knives. |
| **Course Outcomes:** | **After successful completion of the course, the students will be able to:**<br>• Students will be able to collect, fix, and process biological tissues using standard histological techniques.<br>• Students will demonstrate proficiency in preparing fixatives, stains, and alcoholic grades for tissue dehydration and clearing.<br>• Students will gain practical skills in embedding, section cutting, double staining, and mounting tissue sections.<br>• Students will effectively use and maintain microtomes and other laboratory instruments essential for histological work. |
| **Lab/ Practical-10** | **Laboratory Practical's:**<br>1. Microtechnique scope and importance.<br>2. Preparation of fixatives - Alcohol, Acetone, Formalin, Bouin's fluid, Cornoy fluid, Formal sublimate.<br>3. Collection of various tissues/organs from slaughter house for micro-technique<br>4. Preparation of Alcoholic grades, dehydration and clearing of tissues.<br>5. Preparation of Stains – Eosin. Borax carmine, Acetocarmin, Aceto-orcein, Haematoxylin.<br>6. Use and care of Oven<br>7. Embedding and block making, trimming of block.<br>8. Use and Care of different types of Microtome.<br>9. Honing and stropping Knives<br>10. Section cutting and spreading.<br>11. Staining of the sections, (Double Staining), mounting. |
| **Reference Books:** | **Gray P. (1952):** Handbook of Basic Microtechnique, The Blakiston Company, Toronto Philadelphia. |

**Note: Mode of Examination: Internal (There is no External Examination)**

| **Evaluation of Practical Marks** | **Marks** |
|---|---|
| a) Trimming and Section cutting of the Paraffin blocks<br>b) Spreading of ribbons | 20 |
| Staining of Given Slide | 10 |
| Submission of Stained Slides | 10 |
| Attendance | 05 |
| Overall Performance and Participation | 05 |
| **Total Marks-** | **50** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | III | 133220 | FP/ CEP in Zoology - I | 2 | 60 | NA | 50 |

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|---|---|
| **Course Objectives:** | **After this course, students will be able to**<br>• To develop an appreciation of rural culture, lifestyle and wisdom amongst students.<br>• To learn about the status of various development programmes.<br>• To understand the causes of distress and poverty faced by vulnerable households and explore solutions for the same.<br>• To apply classroom knowledge of courses to field realities and thereby improve the quality of learning. |
| **Course Outcomes:** | **After successful completion of the course, the students will be able to:**<br>• Gain an understanding of rural life, Indian culture and ethos and social realities<br>• Develop a sense of empathy and bonds of mutuality with the local community<br>• Appreciate significant contributions of local communities to Indian society and Economy<br>• Learn to value the local knowledge and wisdom of the community<br>• Identify opportunities for contributing to community's socio-economic improvements |
| **Guidelines/ SoP for FP/CEP** | For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf<br>**As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks. The guidelines regarding the field project are as follows:**<br>1. The total time allocation for the student to carry out field project is 60 hours.<br>2. Students should participate in field-based projects under the supervision of faculty.<br>3. Assignment of project topics to individual students or groups of students (max 4 students in one group) and one faculty member from the department will act as Guide for the student or group of students.<br>4. For a SURVEY based project related questionnaire (15 or more questions) should be prepared.<br>5. The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative.<br>6. If the project is related to work that does not involve survey work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection/ Experimental base etc).<br>7. The student should compile all the relevant data and carry out its analysis.<br>8. A project report should be written individually in the standard format (2 Copies): Index, Introduction, Materials, Methods, Result, Conclusion/output, References (Numeric citation type) etc.<br>9. The project report should be of minimum 6 pages (excluding Title page, Certificate, Index, Acknowledgement etc.). Submit the project report with the Guide's signature to the department.<br>10. The oral /poster presentation for all the projects should be arranged in the department. To evaluate the project, examiner should be appointed by HoD.<br>11. The total project work including preparation of questionnaire to presentation should be evaluated for 2 credits (50 Marks).<br>**Some suggested forms of FP/ CEP are:**<br>1. Comparative Study of Epithelial Tissues in Amphibians and Reptiles (ICT Tools)<br>2. Histological Analysis of Digestive Glands in Fishes.(ICT Tools)<br>3. Cytological Effects of Environmental Stress on Aquatic Invertebrates<br>4. Study of Blood Smear Preparations in Local Fauna |

| | |
|---|---|
| | 5. Study of Human Blood Smear for Cell Identification<br>6. Cytochemical Staining to Detect DNA (Feulgen Method)<br>7. Barr Body Detection in Human Buccal Cells.<br>8. Chick Embryo Development Analysis.<br>9. Developmental Stages of Drosophila melanogaster.<br>10. Metamorphosis in Amphibians.<br>11. DNA Barcoding for Species Identification in Wildlife Samples<br>12. Hair Morphology Analysis for Species Differentiation.<br>13. Entomological Evidence in Post-Mortem Interval Estimation.<br>14. Isotopic Analysis for Geographic Origin Determination.<br>15. Wildlife Poaching and Trade Awareness Campaign.<br>16. Influence of Bird Feeders on Bird Diversity<br>17. Study of Zooplanktons from different water bodies<br>18. Biodiversity of Insects from various areas nearby.<br>19. Diversity of Fish Fauna from local areas |

**Distribution of Marks and the scheme of FP/CEP Examination is as follows:**

- Students' performance 20 Marks
- Submission of duly certified FP/CEP report 20 Marks
- Presentation (PPT or Poster) 10 Marks

**Total** **50 Marks**

## SECOND YEAR: SEMESTER – IV

| Mode of Teaching | Vertical Number | The Vertical | Type of Course | Course Code | Course Name | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|---|---|---|---|---|---|---|---|---|
| Classroom Teaching / Lab Work (Practical) / Outdoor / Field | a. | Major (Zoology) | Theory 5 | 133221 | Fundamental of Genetics | 2 | 2 | **8** |
| | | | Theory 6 | 133222 | Advanced Genetics | 2 | 2 | |
| | | | Lab/Practical-11 | 133223 | Practical based on Theory 5 & 6 | 2 | 4 | |
| | b. | Minor (Other subject in combination with Zoology) | Theory 2 | 133224 | Fundamentals of Ecology | 2 | 2 | **6** |
| | | | Lab/Practical-12 | 133225 | Practical based on Minor Theory 2 | 2 | 4 | |
| | c. | Generic/ Open Elective (other than Science & Technology faculty) | Theory 6 | 133226 | From basket of open elective Ophidiology and Arachnology | 2 | 2 | **2** |
| | d. | VSC | Lab/Practical-13 | 133227 | Advance practical on Major (Zoology) Genetics | 2 | 4 | **8** |
| | | SEC | Lab/Practical-14 | 133228 | Skill Oriented practical on Major (Zoology) Ichthyology | 2 | 4 | |
| | e. | AEC English | Theory | - | | 1 | 1 | **2** |
| | | AEC –MIL | Theory | - | | 1 | 1 | |
| | f. | FP/CES | Project | 133229 | | 2 | 4 | **8** |
| | | CC | Outdoor | - | Course on health & wellness, yoga education, sports, fitness, cultural activities, NSS/NCC & Fine/ Applied/ Visual/ Performing Arts. | 2 | 4 | |
| | | **TOTAL** | | | | **22** | **34** | **34** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration |
|---|---|---|---|---|---|---|
| **5.0** | **IV** | **133221** | **Fundamental of Genetics (Major) Theory 5** | **2** | **30** | **2 Hrs** |
| **Course Objectives** | **After this course, students will be able to**<br>• To provide the background knowledge on the history of genetics and the importance of Mendelian principles.<br>• To provide the required knowledge on the gene interactions<br>• To provide knowledge of mutations and Human genetics. | | | | | |
| **Course Outcomes** | **On Completion of the course the students will be able:**<br>• To enable the students, understand history of Mendelian genetics and Mendelian inheritance.<br>• To learn the concepts of Linkage.<br>• To understand the concept of sex determination and sex linked inheritance.<br>• To understand Human Genetics | | | | | |

| Unit | Contents | Workload Allotted | Weightage of MarksAllotted |
|---|---|---|---|
| **Unit I** | **Mendelian Genetics I**<br>1.1 Development of Genetics: Mendel to modern genetics<br>1.2 Genetic Terminology: Gene, Alleles, Homozygous, Heterozygous<br>1.3 Monohybrid Crosses: Law of Dominance, Segregation<br>1.4 Dihybrid Crosses: Law of Independent Assortment<br>1.5 Multiple Alleles: ABO groups, Rh factor explained | 8 Hrs | 8 Marks |
| **Unit II** | **Mendelian Genetics II**<br>2.1 Dominance: Complete, Incomplete, Codominance types<br>2.2 Sex Linkage: X-linked (Drosophila, colour blindness), Y-linked (holandric traits)<br>2.3 Sex Determination: XX-XY, XX-X0, ZW-ZZ,Z0-ZZ systems, Genetic Balance Theory, Environmental mechanism of Sex determination.<br>2.4 Dosage Compensation: Lyon's hypothesis, X inactivation, hyperactivation | 8 Hrs | 8 Marks |
| **Unit III** | **Gene Mutation**<br>3.1 Gene Mutation: Point, frameshift, silent, missense<br>3.2 Mutation Types: Morphological, Nutritional, Lethal traits<br>3.3 Causes of Mutation: Radiation, chemicals, replication errors<br>3.4 Effect of Mutation: Structural, functional, lethal impacts | 7 Hrs | 7 Marks |
| **Unit IV** | **Human Genetics**<br>4.1 Human Chromosomes: Structure, shape, banding techniques<br>4.2 Karyotype: Chromosome charting, nomenclature system<br>4.3 Human Chromosomes: 22 autosomes, 1 sex pair<br>4.4 Sex Chromosome Anomalies: Turner's (XO), Klinefelter's (XXY)<br>4.5 Autosome Anomalies**:** Down's (21), Patau's (13), Edward's (18) | 7 Hrs | 7 Marks |

| | |
|---|---|
| **References** | 1. Strickberger: Genetics, Prentice hall.<br>2. Lodish-el al, Molecular Biology<br>3. P.K. GUPTA, Cell Biology and Genetics.<br>4. Principles of Genetics by B. D. Singh<br>5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.<br>6. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.<br>7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.<br>8. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.<br>9. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co. |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. | Continuous Assessment Test (Best 2 out of 3 tests) ---------- | 10 Marks |
| 2. | Report of Seminar / Field visit/ Case study/ Any innovative method ----- | 10 Marks |
| | Total ---------- | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration |
|---|---|---|---|---|---|---|
| 5.0 | IV | 133222 | Advanced Genetics (Major) Theory 6 | 2 | 30 | 2 Hrs |
| **Course Objectives** | **After this course, students will be able to**<br>• To provide the background knowledge on the Polygeneic traits<br>• To provide the required understanding on the population genetics.<br>• To understand the knowledge of clinical disorders in humans | | | | | |
| **Course Outcomes** | **On Completion of the course the students will be able:**<br>• To enable the students, understand Population and Evolutionary genetics.<br>• To describe the concepts of Linkage.<br>• To understand the importance of pre - natal diagnosis and learn about inherited disease<br>• To understand Genetic basis of Cancer | | | | | |

| Unit | Contents | Workload Allotted | Weightage of MarksAllotted |
|---|---|---|---|
| **Unit I** | **Polygenic Traits & Inheritance**<br>1.1 Analysis of Variation: Genetic vs Environmental<br>1.2 Heritability: Trait inheritance estimate<br>1.3 Inbreeding: Effects and consequences<br>1.4 Co-efficient of Inbreeding: Inbreeding, consanguinity measure<br>1.5 Linkage & Mapping: Linkage detection, diploid mapping | 8 Hrs | 8 Marks |
| **Unit II** | **Population & Evolutionary Genetics**<br>2.1 Genetic Polymorphism: Variation and selection strategies<br>2.2 Genetic Drift: Random allele changes<br>2.3 Genetics of Speciation: Classical and modern views<br>2.4 Population Genetics Concepts: Gene pool, gene frequency<br>2.5 Hardy-Weinberg Law: Genetic equilibrium principle | 8 Hrs | 8 Marks |
| **Unit III** | **Inherited Disorders & Clinical Genetics**<br>3.1 Genetic Disorders: Single gene, multifactorial, chromosomal<br>3.2 Somatic Cell Analysis: Genetic disorder testing<br>3.3 Metabolic Disorders: Nucleic acids, proteins, lipids<br>3.4 Diagnosis of Anomalies: Amniocentesis, chorionic sampling | 7 Hrs | 7 Marks |
| **Unit IV** | **Environment & Genome**<br>4.1 Imprinting & Epigenetics: Gene regulation changes<br>4.2 Genetics of Cancer: Oncogenes and mutations<br>4.3 Tumor Suppressor Genes: Cancer inhibition genes<br>4.4 Genetics of Ageing: Molecular ageing mechanisms | 7 Hrs | 7 Marks |

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|---|---|
| **References** | 1. Strickberger: Genetics, Prentice hall.<br>2. Lodish-el al, Molecular Biology<br>3. P.K. GUPTA, Cell Biology and Genetics.<br>4. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.<br>5. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.<br>6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.<br>7. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.<br>8. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.<br>9. James D. Watson, Nancy H. Hopkins 'Molecular Biology of the Gene' |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. | Continuous Assessment Test (Best 2 out of 3 tests) ---------- | 10 Marks |
| 2. | Report of Seminar / Field visit/ Case study/ Any innovative method ----- | 10 Marks |
| | Total ---------- | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | IV | 133223 | Practical's based on Theory 5 & 6 (Major) | 2 | 30 | 3 Hrs | 50 |
| **Learning Objectives** | | **After this course, students will be able to**<br>• To acquire practical knowledge on the importance of Mendelian principles by solving the problems.<br>• To provide the required knowledge on the Chromosomes.<br>• To acquaint the students on Human karyotype & pedigree analysis basics<br>• To understand the various genetic concepts through Virtual labs | | | | | |
| **Lab/ Practical - 11** | | **List of Practicals**<br>1. Preparation of pre-treating / fixing agents/ stains for cytological studies.<br>2. Study of Mitosis using root tips<br>3. Preparation of salivary gland chromosomes in Chironomus larvae<br>4. Preparation of salivary gland chromosomes in Drosophila larvae<br>5. Blood typing in humans for multiple alleles and Rh factor<br>6. Genetic Problems on Monohybrid cross,<br>7. Genetic Problems on Dihybrid cross<br>8. Genetic Problems Non-Mendelian Interactions.<br>9. Construction of pedigree( for the given data /analyse the given pedigree )<br>10. Human karyotyping (study by photograph /ICT).<br>11. Human Traits (Earloab, Dimples, Rolling tounge,colorblindness, Hairline shape ,PTC taste) | | | | |

- **Distribution of Marks:**

| Practical External (25 Marks) | | Practical Internal (25 Marks) | |
|---|---|---|---|
| Experiment on salivary gland chromosome / Blood typing /Mitosis | 10 Marks | Practical Record Book | 05 Marks |
| Spotting ( spot 1 to 5 ) | 05 Marks | Submission Tour / Field visit/ Check list | 10 Marks |
| Problem On Genetics | 05 Marks | Permanent slide submission | 05 Marks |
| Viva voce | 05 Marks | Student Attendance and performance | 05 Marks |
| **Total** | **25 Marks** | **Total** | **25 Marks** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration |
|---|---|---|---|---|---|---|
| 5.0 | IV | 133224 | Fundamentals of Ecology (Minor) | 2 | 30 | 2 Hrs |
| Course Objectives | | After this course, students will be able to<br>• To develop skills in identifying aquatic and terrestrial organisms and understanding their ecological adaptations.<br>• To encourage observation and analysis of trophic relationships and ecosystem dynamics through food chains and food webs.<br>• To raise awareness of environmental pollution by identifying harmful waste in soil and water samples.<br>• To engage students in real-world ecological problems through field visits and report writing on natural ecosystems and waste management practices. | | | | |
| Course Outcomes | | By the end of this course, students will understand<br>• Key ecological concepts, including ecosystems, energy flow, and biodiversity.<br>• They will be able to analyze ecological interactions and the impact of human activities on the environment.<br>• Students will also gain skills in ecological research methods and conservation strategies, applying this knowledge to real-world environmental challenges. | | | | |

| Unit | Contents | Workload Allotted | Weightage of MarksAllotted |
|---|---|---|---|
| Unit I | **Fundamental of Ecology and Ecosystem functioning**<br>1.1 Introduction to Ecology<br>1.2 Principles and Scope of Ecology<br>1.3 Structure and Function of Ecosystem<br>1.4 Abiotic and Biotic components<br>1.5 Case Studies of the following Ecosystem: Forest, Grassland, Desert and Aquatic | 8 Hrs | 8 Marks |
| Unit II | **Ecosystem Dynamics and the Biosphere**<br>2.1 Food Chain( grazing and detritus )<br>2.2 Trophic levels and Food web<br>2.3 Pyramids of number, biomass and energy<br>2.4 Energy Flow in an Ecosystem<br>2.5 Biosphere : Hydrosphere, Lithosphere and Atmosphere | 8 Hrs | 8 Marks |
| Unit III | **Environmental cycles Resources and Adaptation**<br>3.1 Biogeochemical cycles : Carbon and Nitrogen cycles<br>3.2 Natural resources: Renewable and Non-renewable resources<br>3.3 Deforestation: Causes and impacts<br>3.4 Energy resources<br>3.5 Ecological adaptations of the plant and animal (suitable examples) | 7 Hrs | 7 Marks |
| Unit IV | **Ecological Interactions and Environmental issues**<br>4.1 Populations and communities: density, growth and migration<br>4.2 Intraspecific interactions, Parasitism, Prey-predator relationships<br>4.3 Interspecific interactions: Commensalism, mutualism<br>4.4 Alterations of ecosystem function: Acid rain, Ozone layer and their effects<br>4.5 Global warming and climate change | 7 Hrs | 7 Marks |

| | |
|---|---|
| **References** | 1. **Odum, E.P. & Barrett, G.W. (2005)** *Fundamentals of Ecology* (5th Edition) Brooks/Cole, USA. – A foundational and classic text covering core ecological principles and systems ecology.<br>2. **Smith, R.L. & Smith, T.M. (2012)** *Elements of Ecology* (8th Edition) Pearson Education. – A well-illustrated and updated book focusing on ecosystem dynamics, biodiversity, and applied ecology.<br>3. **Dash, M.C. (2001)** *Fundamentals of Ecology* Tata McGraw-Hill, New Delhi. – Simplified for Indian students; covers ecosystem concepts, energy flow, and environmental issues.<br>4. **Kumar, H.D. (2000)** *Modern Concepts of Ecology* Vikas Publishing House Pvt. Ltd. – Offers insights into modern ecological theories and applications in environmental management.<br>5. **Kormondy, E.J. (1996)** *Concepts of Ecology* Prentice-Hall of India, New Delhi. – Suitable for both introductory and intermediate learners; discusses population, community, and ecosystem ecology.<br>6. **Sharma, P.D. (2020)** *Ecology and Environment* Rastogi Publications, Meerut. – Useful for understanding ecology in the Indian context, with updated environmental case studies.<br>7. **Singh, J.S., Singh, S.P., & Gupta, S.R. (2014)** *Ecology, Environmental Science and Conservation* S. Chand Publishing, New Delhi. – A multidisciplinary approach covering ecological concepts and conservation strategies. |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. | Continuous Assessment Test (Best 2 out of 3 tests) ---------- | 10 Marks |
| 2. | Report of Seminar / Field visit/ Case study/ Any innovative method ----- | 10 Marks |
| | Total ---------- | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| **5.0** | **IV** | **133225** | **Practical's based on Minor- Fundamentals of Ecology** | **2** | **30** | **3 Hrs** | **50** |
| **Course Objectives** | | **After this course, students will be able to**<br>• To develop skills in identifying aquatic and terrestrial organisms and understanding their ecological adaptations.<br>• To encourage observation and analysis of trophic relationships and ecosystem dynamics through food chains and food webs.<br>• To raise awareness of environmental pollution by identifying harmful waste in soil and water samples.<br>• To engage students in real-world ecological problems through field visits and report writing on natural ecosystems and waste management practices. | | | | | |
| **Course Outcomes** | | • Students will be able to assess water quality by measuring parameters such as pH, dissolved oxygen, salinity, $CO_2$, and hardness.<br>• They will identify and describe ecological adaptations of various organisms using museum specimens.<br>• Students will construct food chains and food webs based on actual field data and understand energy flow in ecosystems.<br>• They will gain hands-on experience in identifying zooplankton and harmful pollutants in environmental samples.<br>• Students will develop reporting skills through the documentation of ecosystem visits and analysis of local waste management systems. | | | | | |
| **Lab/ Practical- 12** | | **List of Practicals:**<br>1. Estimation of pH in water.<br>2. Estimation of Dissolved oxygen, salinity, free $CO_2$, total hardness in water sample.<br>3. Adaptations of aquatic and terrestrial animals based on study of museum specimens such as rocky, sandy, muddy-shore, flying and burrowing animals.<br>4. Preparation of checklist of producers and consumers of local ecosystems and construction of a food web diagram based on field visit.<br>5. Mounting and identification of zooplankton.<br>6. To prepare charts of local terrestrial food chain and food web.<br>7. To identify harmful wastes in any given water or soil samples.<br>8. Studies on biological and other waste disposal mechanism of any nearby Health center or hospital and submit report.<br>9. Study of a natural ecosystem and field report of the visit. | | | | | |

- **Distribution of Marks:**

| **Practical External (25 Marks)** | | **Practical Internal (25 Marks)** | |
|---|---|---|---|
| Estimation | 08 Marks | Practical Record Book | 05 Marks |
| Mounting and identification of zooplankton | 08 Marks | Submission Tour / Field visit/ Check list | 10 Marks |
| Spottings based on adaptation | 04 Marks | Permanent slide submission | 05 Marks |
| Viva voce | 05 Marks | Student Attendance and performance | 05 Marks |
| **Total** | **25 Marks** | **Total** | **25 Marks** |

**FOR BASKET GOEC-6:**

**For the students of SEM-IV of the program of other than Science & technologyfaculty.**

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | IV | 133226 | Ophidiology and Arachnology | 2 | 30 | 2 Hrs | 30 |
| **Course Objectives** | • After completing the course, students will understand the ecological roles and biological characteristics of snakes and arachnids. | | | | | | |
| **Course Outcomes** | **After this course, students will be able to**<br>• Distinguish venomous from non-venomous snake species and their physiological differences.<br>• They will grasp the mechanics of snake locomotion, hunting techniques, and reproductive strategies.<br>• Students will identify key morphological features and silk production methods in spiders.<br>• They will explore the venom apparatus in arachnids and its ecological functions.<br>• Students will gain insight into spider mating behavior, reproductive cycles, and parental care.<br>• They will apply theoretical knowledge of Ophidiology and arachnology in practical fieldwork. | | | | | | |

| Unit | Contents | Workload Allotted | Weightage of Marks Allotted |
|---|---|---|---|
| **Unit I** | **Introduction to Ophidiology**<br>1.1 Study of Snake Life<br>1.2 Venomous and Non-venomous Species<br>1.3 Scales, Limblessness, Specialized Senses<br>1.4 Role in Food Web | 8 Hrs | 8 Marks |
| **Unit II** | **Snake Physiology and Habits**<br>2.1 Unique Snake Body Design<br>2.2 Locomotion: Slithering, Sidewinding<br>2.3 Hunting: Venomous vs. Constricting<br>2.4 Reproductive Methods: Eggs and Birth | 7 Hrs | 7 Marks |
| **Unit III** | **Introduction to Arachnology**<br>3.1 Definition and scope of arachnology<br>3.2 Classification of spiders and related arachnids<br>3.3 General characteristics of spiders<br>3.4 Ecological significance of spiders | 8 Hrs | 8 Marks |
| **Unit IV** | **Spider Morphology and Behavior**<br>4.1 External and internal morphology of a typical spider<br>4.2 Silk production and web-building<br>4.3 Venom apparatus and types of venom<br>4.4 Mode of Reproduction, mating behavior, and parental care | 7 Hrs | 7 Marks |

| | |
|---|---|
| **References** | 1. "Herpetology: An Introductory Biology of Amphibians and Reptiles" Authors: Laurie J. Vitt & Janalee P. Caldwell Publisher: Academic Press<br>2. "Snakes: Ecology and Behavior" Editor: Richard A. Seigel & Joseph T. Collins Publisher: Blackburn Press<br>3. "The Book of Indian Reptiles and Amphibians" Author: J.C. Daniel Publisher: Bombay Natural History Society (BNHS).<br>4. "Venomous Reptiles of the World" Author: Scott Shupe Publisher: Skyhorse Publishing<br>5. "Biology of Spiders"Author: Rainer F. Foelix, Publisher: Oxford University Press<br>6. "The World of Spiders" Author: W.S. Bristowe Publisher: Collins<br>7. "Spiders of India" Authors: P.A. Sebastian & K.V. Peter Publisher: Universities Press<br>8. "The Spider Book" Author: John Henry Comstock Publisher: Cornell University Library |

**Examination, Evaluation and Assessment Scheme**

1. External Theory -- 30 Marks
2. Internal- 20 Marks

**Distribution of Internal Marks**

| | | |
|---|---|---|
| 1. Continuous Assessment Test (Best 2 out of 3 tests) | ---------- | 10 Marks |
| 2. Report of Seminar / Field visit/ Case study/ Any innovative method | ----- | 10 Marks |
| Total ---------- | | 20 Marks |

| Level | Semester | Course Code | Course Name | Credits | TeachingHours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| **5.0** | **IV** | **133227** | **Advance Applications (Career oriented) / Practical based on Major- Genetics (VSC)** | **2** | **30** | **2 Hrs** | **30** |

| | |
|---|---|
| **Course Objectives:** | After this course, students will be able to<br>• To develop hands-on skills in genetic techniques and problem-solving.<br>• To analyze cytogenetic preparations and understand chromosomal behavior<br>• To introduce basic molecular genetics tools. |
| **Course Outcomes:** | At the end of this course, students should be able to…<br>• Differentiate between wild type and mutant *Drosophila* and sexes of the *Drosophila.*<br>• Identify chromosomal abnormalities using printed photomicrographs<br>• Identify various components and steps of PCR<br>• Identify Barr body |
| **Lab/ Practical -13** | **Laboratory Practical's:**<br>1. **Study of *Drosophila* (Fruit Fly)**: Identification of wild and mutant types (eye color, wing shape, body color), Sexing and mounting of Drosophila using ICT tools.<br>2. **Pedigree Analysis**: Drawing and interpretation of human pedigree charts for autosomal dominant, recessive, and X-linked traits<br>3. **Karyotyping**: Preparation and analysis of human karyotypes using printed photomicrographs, Identification of chromosomal abnormalities (Down's, Turner's, Klinefelter's syndrome)<br>4. **Barr Body Demonstration:** Buccal smear preparation and observation of sex chromatin<br>5. **DNA Extraction:** Isolation of DNA from plant (onion or spinach) or animal sources (saliva/cheek cells)<br>6. **PCR and Gel Electrophoresis (Demo or Virtual):** Introduction to PCR setup, Visualization of DNA fragments using gel electrophoresis (demo or simulation-based)<br>7. **Gene Interaction (Epistasis) Problems:** Solving problems on complementary, duplicate, and dominant epistasis. |
| **References:** | 1. **Verma, P.S. & Agarwal, V.K.** – *Genetics. S. Chand Pub.*<br>2. **Goswami, H.K, Goswami, R.**- Practical Cytology- Applied Genetics and Biostatistics. Himalaya Publishing House<br>3. **Worku Negash Mhiret**. Laboratory Manual for Principles of Genetics. LAP LAMBERT Academic Publishing<br>4. S. C. Lakhotia and H. A. Ranganath- Experiments with Drosophila for Biology Courses. Published by the Indian Academy of Sciences<br>*5.* **Ashburner, M.** – *Drosophila: A Laboratory Handbook. Cold Spring Harbor, N.Y. : Cold Spring Harbor Laboratory Press*<br>6. **Russell, P.J.** – *iGenetics. Pearson/Benjamin Cummings*<br>7. **Brooker, R.J.** – *Genetics: Analysis and Principles. McGraw Hill Pub.* |

8. **Kumar, H.D.** – *A Laboratory Manual of Genetics*
9. Gregore Koliantz, Daniel B. Szymanski- Genetics: A Laboratory Manual. J. Wiley Pub.
10. **Jorde, L.B., Carey, J.C., & Bamshad, M.J.** – *Medical Genetics. Mosby/Elsevier Pub.*
11. **Guyton, A.C. & Hall, J.E.** – *Textbook of Medical Physiology*
12. **Practical Hematology** – *Dacie and Lewis. Churchill Livingstone Pub.*
13. **Sarma, P.** – *Laboratory Techniques in Hematology*
14. **Gardner, R.J.M. & Sutherland, G.R.** – *Chromosome Abnormalities and Genetic Counseling*
15. **Turnpenny, P. & Ellard, S.** – *Emery's Elements of Medical Genetics*
16. **Sambrook, J. & Russell, D.** – *Molecular Cloning: A Laboratory Manual*
17. **Gupta, P.K.** – *Genetics*
18. **Sharma, A.K. & Sharma, A.** – *Chromosome Techniques: Theory and Practice*
19. **Darlington, C.D. & La Cour, L.F.** – *The Handling of Chromosomes*


**Note: Mode of Examination: Internal (There is no External Examination)**

| Evaluation of Practical Marks | Marks |
|---|---|
| DNA Extraction | 10 Marks |
| Preparation and analysis of human karyotypes | 10 Marks |
| Barr Body Demonstration | 10 Marks |
| Attendance | 10 Marks |
| Overall Performance and Participation | 10 Marks |
| **Total** | **50 Marks** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| **5.0** | **IV** | **133228** | **(SEC) Skill based practical on Major- Ichthyology** | **2** | **30** | **2 Hrs** | **50** |
| **Course Objectives:** | | | **After this course, students will be able to**<br>• To provide students with foundational knowledge of fish morphology, anatomy, and taxonomy through hands-on and ICT-based observations.<br>• To develop practical skills in identifying, classifying, and analyzing fish species using morphometric, meristic, and taxonomic methods.<br>• To introduce students to the physiological adaptations of fishes, including their reproductive systems, gills, scales, swim bladder, and lateral line systems.<br>• To expose students to economically important fish species and preservation techniques relevant to fishery science.<br>• To encourage understanding of fish ecology and behavior through water quality testing and field visits to fish markets or hatcheries. | | | | |
| **Course Outcomes:** | | | **By the end of the Skill-Oriented Practical's in Ichthyology, students will gain**<br>• Hands-on experience in fish anatomy, identification, and classification.<br>• They will develop practical skills in morphometric and meristic analysis, dissection, and specimen preservation.<br>• The course enhances understanding of fish physiology, adaptations, and ecological roles.<br>• Students will also learn basic water quality testing and gain exposure to fishery-related practices through field visits. | | | | |
| **Lab/ Practical - 14** | | | **Laboratory Practical's:**<br>1. **External Morphology of Fishes**-Study of body shapes, Fins, Scales, and Coloration in various fish species.<br>2. **Dissection of Fish (By using ICT tools only)** -Observation of internal anatomy: Digestive, Respiratory, Circulatory, and Reproductive systems.<br>3. **Identification and Classification of Local Fishes**-Using taxonomic keys for identification up to genus/species level.<br>4. **Study of Fish Scales**-Types (cycloid, ctenoid, placoid, glenoid) and their role in identification and age determination.<br>5. **Gill Structure and Function**-Mounting and examination of gill lamellae under microscope.<br>6. **Study of Swim Bladder and Lateral Line System ( By using ICT tools only -** Functional and structural adaptations in different species.<br>7. **Morphometric and Meristic Measurements**-Collection and analysis of fish body measurements and counts (fin rays, scales, etc.)..<br>8. **Fish Reproduction and Development** -Study of gonads and observation of developmental stages (if available).<br>9. **Identification of Commercially Important Fishes**- Study of economically significant freshwater and marine fishes.<br>10. **Fish Behavior and Adaptation-** Observation of feeding, schooling, and habitat-based adaptations.<br>11. **Preservation Techniques of Fish Specimens**-Wet and dry preservation methods and labeling practices.<br>12. **Field Visit to Fish Market/Hatchery-** Exposure to practical aspects of fish handling, marketing, or breeding.<br>13. **Water Quality Analysis (Basic Parameters)-** Testing pH, temperature, dissolved oxygen – relevant to fish habitat. | | | | |

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|---|---|
| **Reference Books:** | 1. Jhingran, V.G. (1991) *Fish and Fisheries of India* Hindustan Publishing Corporation, New Delhi. – A comprehensive text on Indian fish species, morphology, and fisheries.<br>2. Lagler, K.F., Bardach, J.E., Miller, R.R., & May Passino, D.R. (1977) *Ichthyology* John Wiley & Sons. – A classic text covering anatomy, classification, and ecology of fishes.<br>3. Jayaram, K.C. (2010) *The Freshwater Fishes of the Indian Region* Narendra Publishing House, Delhi. – Essential for identification and classification of Indian freshwater fishes.<br>4. Khanna, S.S. & Singh, H.R. (2003) *A Textbook of Fish Biology and Fisheries* Narendra Publishing House. – Suitable for understanding fish biology, behavior, and applied aspects.<br>5. Bal, D.V. & Rao, K.V. (1984) *Marine Fisheries* Tata McGraw Hill, New Delhi. – Useful for understanding marine ichthyology and fishery science.<br>6. Nikolsky, G.V. (1963) *The Ecology of Fishes* Academic Press. – Good reference for ecological and behavioral studies of fishes.<br>7. Practical Zoology Manuals (University-prescribed or authored by faculty) – Often tailored for specific syllabi and provide step-by-step dissection and observation guides.<br>8. Pandey, K. & Shukla, J. P. *Fish and Fisheries*<br>9. S.S. Khanna & H.R. Singh *A Textbook of Fish Biology and Fisheries*<br>10. Arora, M.P. *Fish and Fisheries*<br>11. Srivastava, C.B.L. *A Textbook of Fishery Science and Indian Fisheries*<br>12. Verma, P.S. & Agarwal, V.K. *Chordate Zoology*<br>13. APHA (American Public Health Association) *Standard Methods for the Examination of Water and Wastewater* |

**Note: Mode of Examination: Internal (There is no External Examination)**

| Evaluation of Practical Marks | Marks |
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| Field Visit Report | 25 Marks |
| Mounting and examination of any given materials | 10 Marks |
| Report on Identification and Classification of Local Fishes | 05 Marks |
| Attendance | 05 Marks |
| Overall Performance and Participation | 05 Marks |
| **Total** | **50 Marks** |

| Level | Semester | Course Code | Course Name | Credits | Teaching Hours | Exam Duration | Max Marks |
|---|---|---|---|---|---|---|---|
| 5.0 | IV | 133229 | FP/ CEP in Zoology - II | 2 | 60 | NA | 50 |

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| **Course Objectives:** | **After this course, students will be able to**<br>• To develop an appreciation of rural culture, lifestyle and wisdom amongst students.<br>• To learn about the status of various development programmes.<br>• To understand the causes of distress and poverty faced by vulnerable households and explore solutions for the same.<br>• To apply classroom knowledge of courses to field realities and thereby improve the quality of learning. |
| **Course Outcomes:** | **After successful completion of the course, the students will be able to:**<br>• Gain an understanding of rural life, Indian culture and ethos and social realities<br>• Develop a sense of empathy and bonds of mutuality with the local community<br>• Appreciate significant contributions of local communities to Indian society and Economy<br>• Learn to value the local knowledge and wisdom of the community<br>• Identify opportunities for contributing to community's socio-economic improvements |
| **Guidelines/ SoP for FP/CEP** | For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf<br>**As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks. The guidelines regarding the field project are as follows:**<br>1. The total time allocation for the student to carry out field project is 60 hours.<br>2. Students should participate in field-based projects under the supervision of faculty.<br>3. Assignment of project topics to individual students or groups of students (max 4 students in one group) and one faculty member from the department will act as Guide for the student or group of students.<br>4. For a SURVEY based project related questionnaire (15 or more questions) should be prepared.<br>5. The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative.<br>6. If the project is related to work that does not involve survey work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection/ Experimental base etc).<br>7. The student should compile all the relevant data and carry out its analysis.<br>8. A project report should be written individually in the standard format (2 Copies): Index, Introduction, Materials, Methods, Result, Conclusion/output, References (Numeric citation type) etc.<br>9. The project report should be of minimum 6 pages (excluding Title page, Certificate, Index, Acknowledgement etc.). Submit the project report with the Guide's signature to the department.<br>10. The oral /poster presentation for all the projects should be arranged in the department. To evaluate the project, examiner should be appointed by HoD.<br>11. The total project work including preparation of questionnaire to presentation should be evaluated for 2 credits (50 Marks).<br>**Some suggested forms of FP/ CEP are:**<br>1. Habitat Preference and Microhabitat Use by Snakes.<br>2. Human-Snake Conflict in Rural Areas.<br>3. Venomous vs. Non-Venomous Snakes: Identification and Awareness Program.<br>4. Effect of Urbanization on Snake Population. |

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| | 5. Diversity and Distribution of Spiders in Different Habitats.<br>6. Web Architecture and Its Ecological Role.<br>7. Role of Spiders in Agricultural Pest Control.<br>8. Spiders as Bioindicators of Environmental Health<br>9. Snake and Spider Myths and Cultural Beliefs: Ethnozoology Study<br>10. Study of Inherited Traits in Human Populations<br>11. Pedigree Analysis of Hereditary Traits in Families.<br>12. Variation in Fingerprint Patterns,<br>13. Study of Gene-Environment Interaction Using Observable Traits.<br>14. Survey of Genetically Inherited Disorders in a Population.<br>15. Awareness Campaign on Genetic Counseling and Testing.<br>16. Food Web Construction in a Local Habitat |

**Distribution of Marks and the scheme of FP/CEP Examination is as follows:**

- Students' performance 20 Marks
- Submission of duly certified FP/CEP report 20 Marks
- Presentation (PPT or Poster) 10 Marks

**Total** **50 Marks**