Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL(AUTONOMOUS)

Re-accredited 'A++' Grade by NAAC
'College with Potential for Excellence' Status Awarded by UGC
'Best College Award' by University of Mumbai

Program: Bachelor's in Science (B. Sc.)

SYLLABUS FOR

B.Sc. IN ZOOLOGY

DEPARTMENT OF ZOOLOGY
BACHELOR'S IN SCIENCE (B. Sc.)
PROGRAMME OUTCOMES

Sr. No.	After completion of B.Sc. program students will acquire	Graduate Attribute
PO1	The knowledge of the disciplines and in-depth and extensive knowledge, understanding and skills in a specific field of interest.	Disciplinary knowledge
PO2	An ability to develop and conduct experiments, analyze, and interpret data and use scientific judgment to draw conclusions	Scientific reasoning
PO3	An ability to use current technology, and modern tools necessary for creation, analysis, dissemination of information.	Digital literacy
PO4	Innovative, professional, and entrepreneurial skills needed in various disciplines of science.	Life-long learning
PO5	An ability to achieve high order communication skills.	Communication skills
PO6	An ability to collect, analyse and evaluate information and ideas and apply them in problem solving using conventional as well as modern approaches	Problem solving
PO7	A sense of social responsibility; intellectual and practical skills and demonstration of ability to apply it in real world settings.	Reflective thinking
PO8	An ability to engage in independent and life-long learning through openness, curiosity, and a desire to meet new challenges.	Life-long learning
PO9	A capacity to relate, collaborate, and lead others, and to exchange views and ideas to work in a team to achieve desired outcomes	Teamwork
PO10	An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	Leadership
PO11	An ability to understanding values, ethics, and morality in a multidisciplinary context.	Moral and ethical awareness

B.Sc. in Zoology

PROGRAMME SPECIFIC OUTCOMES

PSO1	Gain the comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Zoology and its different subfields
PSO2	Learn a wide range of approaches, from genetics to molecular and cellular biology, as well as physiological processes and anatomy, and diseases
PSO3	Spread awareness about wildlife and ecology as well as the environment and its conservation in the society
PSO4	Gain knowledge of Agro based Small-Scale industries like sericulture, aquaculture and vermicomposting.
PSO5	Develop the interest and employability, program includes learning experiences which offer opportunities for higher studies and research at reputed laboratories
PSO6	Understand the concept of research and its type along with basic knowledge of qualitative research techniques, data collection and process of scientific documentation.
PSO7	Analyze the ethical aspects of research and evaluate the different methods of scientific writing and reporting by appropriate documentations and presentations.

Scheme of Examination (Amended)

First Year UG: Faculty of Science

Sr. No.	Type of Course	Credits	Internal Evaluation (Marks)	External Evaluation (Marks)	Practical	Total
1	Discipline Specific Course 1	04(3+1)	40	60	50	150
2	Discipline Specific Course 2	04(3+1)	40	60	50	150
3	Discipline Specific Course 3	04(3+1)	40	60	50	150
4	SEC	02	---	---	50	50
5	IKS/OE	02	20	30	---	50
6	AEC	02	20	30	---	50
7	VEC	02	20	30	---	50
8	CC	02	20	30	---	50
	Total	**22**				**700**

Second Year UG: Faculty of Science

Sr. No.	Type of Course	Credits	Internal Evaluation (Marks)	External Evaluation (Marks)	Practical	Total
1	Major Course 1	03(2+1)	20	30	50	100
2	Major Course 2	03(2+1)	20	30	50	100
3	Major Course 3 / IKS	02	20	30	---	50
4	Minor	04(2+2)	20	30	50	100
5	OE	04	40	60	---	100
6	AEC	02	20	30	---	50
7	CC	02	20	30	---	50
8	SEC (Sem. III)	02	---	---	50	50
8	CEP (Sem. IV)	02	---	---	50	50
	Total	**22**				**600**

Third Year UG : Faculty of Science

Sr. No.	Type of Course	Credits	Internal Evaluation (Marks)	External Evaluation (Marks)	Practical	Total
1	Major Course 1	04	40	60	---	100
2	Major Course 2	04	40	60	---	100

3	Major Course 3	02	---	---	100	100
4	Elective	04 (3+1)	40	60	50	150
5	Minor	04(2+2)	20	30	50	100
6	VSC (Sem. V)	04	---	---	100	100
6	OJT (Sem. VI)	04	---	---	100	100
	Total	**22**				**650**

Scheme of Examination (Amended)

Faculty of Science

(Under-graduate Programmes)

Choice Based Credit System (CBCS)

- **Revised Scheme of Examination**

1. For 4 or 3 Credits Courses (Discipline Specific Courses (DSC)/Major/Elective Courses)

(100 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 40 Marks

Sr. No.	Particular	Marks
01	One periodical class test / online examination to be conducted in the given semester	20 Marks
02	Test on Practical Skills/ Case studies /Group/ Individual Survey Project/Presentation and write up on the selected topics of the subjects/ Book Review / Open Book Test	15 Marks
03	Active participation in routine class instructional deliveries and overall conduct as a responsible learner, mannerism and articulation and exhibition of leadership qualities in organizing related academic activities	05 Marks

Question Paper Pattern

(Periodical Class Test)

Maximum Marks: 20 Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/True or False/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

Question Paper Pattern

(Periodical Class Test T.Y. Classes Traditional Programme)

Maximum Marks: 20 Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

Question No.		Particular	Marks
		Section I	
Q-1	A	Match the Column / Fill in the Blanks / Multiple Choice Questions/True or False/ Answer in One or Two Lines (Concept based Questions) (1 Marks each)	05 Marks
	B	Answer in Brief (Attempt any one of the Two) (5 Marks each)	05 Marks
		Section II	
Q-2	A	Match the Column / Fill in the Blanks / Multiple Choice Questions/True or False/ Answer in One or Two Lines (Concept based Questions) (1 Marks each)	05 Marks
	B	Answer in Brief (Attempt any one of the Two) (5 Marks each)	05 Marks

B) Semester End Examination (SEE): 60 % 60 Marks

- Duration: The examination shall be of 2 hours duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be three/four questions each of 20/15 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

- **Practical Examination (PE) for Discipline Specific Courses (DSC) /Elective/ Minor Courses: 50 Marks**

  The Practical Examination (PE) shall be of 50 marks for Discipline Specific Courses (DSC)/Elective/Minor Courses.

Journal & Viva Voce	10 Marks
Practical Examination (PE)	40 Marks

- **Practical Examination (PE) for Major Courses (Semester III, IV, V & VI) 100 Marks**

  The Practical Examination (PE) shall be of 100 marks for Major Courses of Semester III, IV, V & VI.

Journal & Viva Voce	20 Marks
Practical Examination (PE)	80 Marks

2. For 2 Credits Courses (VEC/AEC/IKS /Major /Minor Courses) (50 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations (SEE) are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 20 Marks

Sr. No.	Particular	Marks
01	One periodical class test / online examination to be conducted in the given semester	20 Marks

Question Paper Pattern

(Periodical Class Test)

Maximum Marks: 20 Duration: 40 Minutes

Questions to be set: 02

All Questions are Compulsory

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 1 hour's duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

3. For 2 Credits Skill Enhancement Courses (SEC)

- **Practical Examination (PE) (50 Marks)**

The Practical Examination (PE) shall be of 50 marks for Skill Enhancement Courses (SEC)

Journal & Viva Voce	10 Marks
Practical Examination (PE)	40 Marks

4. For 4 Credits Vocational Skill Courses (VSC)

- **Practical Examination (PE) (100 Marks)**

The Practical Examination (PE) shall be of 100 marks for Vocational Skill Courses (VSC)

Journal & Viva Voce	20 Marks
Practical Examination (PE)	80 Marks

5. For 2 Credits Courses (Open Elective (OE) /CC Courses) (50 Marks)

The performance of the learners shall be evaluated into two components. The allocation of marks are as shown below:

A) Projects/Case Studies/Portfolio/Survey/Model/Presentation/Workbook:40% 20 Marks

B) Semester End Examination (SEE): 60 % 30 Marks

- Duration: The examination shall be of 1 hour duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be two/three questions each of 15/10 marks. 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

6. For 4 Credits Open Elective Courses (OE) (100 Marks)

The performance of the learners shall be evaluated into two components, as the first component by 'Continuous Internal Assessment (CIA)' with 40% marks and as the second component by conducting the 'Semester End Examinations (SEE)' with 60% marks. The allocation of marks for the Continuous Internal Assessment (CIA) and Semester End Examinations are as shown below:

A) Continuous Internal Assessment (CIA): 40 % 40 Marks

Sr. No.	Particular	Marks
01	One periodical class test / online examination to be conducted in the given semester	20 Marks
02	Projects / Case Studies / Portfolio / Survey / Model / Presentation / Workbook	20 Marks

Question Paper Pattern

(Periodical Class Test)

Maximum Marks: 20 Duration: 40 Minutes
Questions to be set: 02
All Questions are Compulsory

Question No.	Particular	Marks
Q-1	Match the Column / Fill in the Blanks / Multiple Choice Questions/True or False/ Answer in One or Two Lines (Concept based Questions) (1 Marks / 2 Marks each)	10 Marks
Q-2	Answer in Brief (Attempt any Two of the Three) (5 Marks each)	10 Marks

B) Semester End Examination (SEE): 60 % 60 Marks

- Duration: The examination shall be of 2 hours duration.

Question Paper Pattern

Theory question paper pattern
1. There shall be four/five questions each of 15/12 marks (with internal options). 2. All questions shall be compulsory with internal options. 3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depends on the weightage of the unit.

7. For 2 Credits Community Engagement Project (CEP) (50 Marks)

- The performance of the learners shall be evaluated 50 Marks.

The Community Engagement & Service Programme must involve the student for minimum 30 hours of total engagement with a significant portion dedicated to outreach activity beneficial to community. The whole exercise is marked out of 50 marks. The marks distribution will be as follows-

- **Project proposal 10 marks,**
- **Participation/attendance (Log book entry) 10 marks,**
- **Summary report 20 marks and**
- **Presentation/ Viva-voce 10 marks.**

N.B.: For details, refer the guidelines given by the College.

8. For 2 Credits Field Project (FP) (50 Marks)

- **Research Proposal (10 Marks):** Evaluated on clarity, feasibility, and ethical considerations.
- **Fieldwork and Data Collection (15 Marks):** Assessed based on completion of research activities, adherence to timelines, and data quality.
- **Data Analysis and Interpretation (10 Marks):** Evaluated on the application of appropriate analysis techniques and meaningful interpretation of findings.
- **Written Report (10 Marks):** Assessed on clarity, structure, organization, and adherence to scientific writing conventions.
- **Presentation (05 Marks):** Evaluated on delivery, clarity, effectiveness in communicating research findings.

N.B.: For details, refer the guidelines given by the College.

9. For 4 Credits On Job Training (OJT) / Internship Program (100 Marks)

Evaluation Pattern

The Internship/OJT program has the two examinable units that the students are supposed to undertake and be examined in. The whole exercise is marked out of 100 marks. Evaluation will be done by Examiner and Mentor. The marks distribution will be as follows:

- **OJT/Internship performance: 50 marks,**

  Marks will be given based on

  - Remark by the supervisor

- OJT/Internship completion certificate

➢ **Institute supervisor 50 marks with following break up**

- Internship/OJT Report: 20 marks
- Log Book 10 marks and
- Presentation/Viva-Voce: 20 marks

N.B.: For details, refer the guidelines given by the College.

Passing Standard

➢ **For 4 or 3 Credits Courses (Discipline Specific Courses (DSC) /Major /Elective /OE Courses):** The learners shall obtain minimum of 40% marks (i.e. 16 out of 40) in the Continuous Internal Assessment (CIA) and 40% marks in Semester End Examination (SEE) (i.e. 24 out of 60) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Continuous Internal Assessment (CIA) and Semester End Examination (SEE).

➢ **For 2 or 1 Credits Courses (Discipline Specific Courses (DSC)/Major):** The learners shall obtain minimum of 40% marks (i.e. 8 out of 20) in the Continuous Internal Assessment (CIA) and 40% marks in Semester End Examination (SEE) (i.e. 12 out of 30) separately, to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Continuous Internal Assessment (CIA) and Semester End Examination (SEE).

➢ **For 2 Credits Courses AEC, VEC, Minor, IKS, OE, FP, CEP and CC courses:** Learners should remain present for Continuous Internal Assessment (CIA) and Semester End Examination (SEE)/ Practical Examination (PE). A learner will be said to have passed the course if the learner obtains minimum of 40% marks in the Continuous Internal Assessment (CIA) and Semester End Examination (SEE)/ Practical Examination together and obtain minimum 10 marks out of 30 marks in Semester End Examination (SEE).

➢ **For Practical Examinations (PE):** The learners shall obtain minimum of 40% marks (i.e. 20 out of 50 or 40 out of 100) in Practical Examination (PE), to pass the course and minimum of Grade D, wherever applicable, to pass a particular semester.

Note: As per previous ordinance there will not be any internal examination for practical.

- **Rules of A.T.K.T. for Revised NEP 2020 structure of Academic Year 2025-26**

1. A learner shall be allowed to keep term for Semester II irrespective of the number of courses of failure in the Semester I.
2. A learner shall be allowed to take admission to Semester III if he/she passes both Semester I and Semester II.

OR

A learner shall be allowed to keep term for Semester III, if he/she fails in not more than four Discipline Specific Courses (DSC) and not more than six other courses of Semester I and Semester II taken together with not more than two Discipline Specific Courses (DSC) and not more than three other courses each in Semester I and Semester II.

3. A learner shall be allowed to keep term for Semester IV irrespective of the number of courses of failure in the Semester III.
4. A learner shall be allowed to take Admission to Semester-V and Keep Terms if he/she Passes in both Semester-I and Semester-II and failed in not more than four Discipline Specific Courses (DSC)/Major and not more than six other courses of Semester – III and Semester – IV taken together with not more than two Discipline Specific Courses (DSC)/Major and not more than three other courses each in Semester – III and Semester – IV

   OR

   Passes in both Semester-III and Semester-IV and failed in not more than four Discipline Specific Courses (DSC) and not more than six other courses of Semester – I and Semester – II taken together with not more than two Discipline Specific Courses (DSC) and not more than three other courses each in Semester – I and Semester – II.
5. A learner shall be allowed to keep term for Semester VI irrespective of the number of courses of failure in the Semester V.
6. The result of Semester-VI shall be withheld by the College till the learner passes all the Semesters from I – V.
7. A Learner is allowed to take admission in semester VII (UG Hon. /PG Part I) only if he passed all courses of semesters I to VI (132 Credits).

- **Eligibility Condition to appear for Additional Examination of any Semester (Applicable only for Regular Semester End Examinations)**

A learner who remains absent in some or all the subjects on medical grounds or for representing the College or University in NSS, NCC, Sports, Cultural Activities or co-curricular/extracurricular/extension activities with prior permission of the Principal or Head of the institute reported to the examination section, by producing necessary documents and testimonials, will be allowed to appear for the Additional Semester End Examination (ASEE). This is not applicable for any A.T.K.T. / Supplementary Examinations.

- **Supplementary Examination (SE)**

  The college will conduct supplementary examinations for semester II, IV, and VI after the declaration of their respective results.

Note:

1) It is noted that the concerned regulation of the College is amended and implemented to Semester I to Semester VI of undergraduate programmes, under faculty of Arts, Commerce and Science with effect from the academic year 2025 - 2026.
2) All these rules maybe amended as and when required with authorisation of Academic bodies.

B.O.S. DATE: 24th April 2024

B.O.S. ITEM NO.: 2 & 3

ACADEMIC COUNCIL DATE: 13th June 2024

ACADEMIC COUNCIL ITEM NO.: 2

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR

ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL
(AUTONOMOUS)

Re-accredited 'A++' Grade by NAAC
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'Best College Award' by University of Mumbai

Program: Bachelor's in Science (B. Sc.)

SYLLABUS

(Approved in the Academic council meeting held on 13th June 2024)

F. Y. B. Sc. Zoology

NEW ACADEMIC POLICY 2020

w. e. f. Academic Year 2024-25

To be implemented from the Academic year 2024-2025
Zoology Major

SEMESTER I

COURSE I: Diversity in Non- Chordates

COURSE	COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES/WEEK
MAJOR	USC1ZO1	I	Diversity in non-chordates	3	1
		II	Animal Diversity- Non chordates		1
		III	Type study- Earthworm		1
	USC1ZOP	Practical based on major course		1	2
SEC	USEC1OFB	Ornamental Fish Breeding		2	04

SEMESTER II

Course II: Diversity in Chordates

COURSE	COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES/WEEK
MAJOR	USC2ZO2	I	Animal Diversity in chordates	3	1
		II	Group Eurochordata		1
		III	Type study- Shark		1
	USC2ZOP	Practical based on major course		1	2
SEC	USEC2SER	Sericulture		2	04

Syllabus for F.Y.B.Sc.
Program B.Sc.

Course: ZOOLOGY

Semester I
Paper I and Practical I

F.Y.B.Sc. ZOOLOGY (THEORY)
Course Code: USC1ZO1

SEMESTER I

Diversity in Non-chordates

Course Objectives:

- *To nurture interest in the students for the subject of Zoology.*
- *To understand animal diversity.*
- *To study detailed morphology of invertebrates.*

Course Outcomes

- *Learners will be able to comprehend the diversity of animals.*
- *Learners will be able to understand the importance of classification.*
- *Learners develop insight of group and type study.*

Unit	Title	Lectures	Credits
Unit I: Diversity of animal Kingdom I	**1.1: Levels of organization** **1.1.1 :** Unicellularity Vs multicellularity, Colonization and organization of germ layers (diploblastic and triploblastic condition) **1.1.2 :** Division of labour and organization of tissues (Brief fate of ectoderm, mesoderm and endoderm) **1.1.3 :** Development of coelom: Acoelomate, pseudocoelomate and coelomate organization **1.1.4 :** Radial and bilateral symmetry **1.1.5 :** Metamerism	**12 lectures**	**01**
	1.2: Unicellular and multicellular organization **1.2.1:** Unicellular organization: Phylum Protozoa **1.2.2:** Multicellular organization: Colonization level- Phylum Porifera **1.2.3:** Multicellular organization: Division of labour (Cell differentiation)- Phylum Coelenterata		
	1.3 Triploblastic acoelomate and pseudocoelomate organization **1.3.1 :** Acoelomate organization - Phylum Platyhelminthes **1.3.2 :** Pseudocoelomate organization – Phylum Nemathelminths		

	1.4: Triploblastic coelomate organization		
	1.4.1 : Animals with metameric segmentation- Phylum Annelida **1.4.2 :** Animals with jointed appendages- Phylum Arthropoda		
Unit II: Animal Diversity- Non chordates	**2.1 Non–Chordates:** General characters and classification of the following up to classes with examples showing distinctive / adaptive features of the following phyla:	**12 lectures**	**01**
	2.1.1: Kingdom Protista: Protozoa (Amoeba, Paramecium, Euglena, Plasmodium)		
	2.2: Kingdom Animalia		
	2.2.1 : Porifera (Leucosolenia, Euplactella, Hyalonema, Euspongia) **2.2.2 :** Coelenterata (Cnidaria) (Physalia, Obelia, Aurelia, sea Anemone) **2.2.3 :** Ctenophora (Comb jelly) **2.2.4 :** Platyhelminthes (Fasciola, Planaria, Liverfluke, Tapeworm) **2.2.5** : Nematohelminthes (*Ascaris, Ancyclostoma, Enterobius*) **2.2.6** : Annelida (Nereis, Earthworm, Leech) **2.2.7 :** Arthropoda (Crab,Lobster, Beetle, Dragonfly, Butterfly, Moth, Spider, Centipede, Millipede) **2.2.8 :** Mollusca (Chiton, Dentalium, Pila, Unio, Sepia and Nautilus) **2.2.9 :** Echinodermata (Starfish, Brittle star, Sea urchin, Sea cucumber, Feather star)		
	2.2. General topics: Economic importance of Protozoa		
Unit III: Type study- Earthworm:	Systematic position, Habits and habitat, External characters, Body wall, Digestive system, Blood Vascular System, Excretory system, Nervous system and sense organs. Reproductive system, Economic importance.	**12 lectures**	**01**
	SEMESTER I **Practical Code: USC1ZOP** **PRACTICAL – I**	**30 lectures**	**01**
	1. Study of levels of organization in Animal kingdom A) Symmetry: i) Asymmetric organization: Amoeba ii) Radial symmetry: Sea anemone, Aurelia		

	iii) Bilateral symmetry: Planaria / liver fluke B) Acoelomate: T.S. of Planaria / liver fluke C) Pseudocoelomate: T.S. of Ascaris D) Coelomate: T.S. of Earthworm E) Segmentation i) Pseudosegmentation: Tapeworm ii) Metamerism: Earthworm F) Specialization of body parts for division of labour: Head, thorax and abdomen - Insect G) Cephalization i) Cockroach – Head ii) Prawn/ crab – Cephalothorax **2.** Study of animal diversity with reference to- i) Protozoa: Amoeba, Paramecium, Euglena, Plasmodium ii) Porifera: Leucosolenia, bath sponge iii) Coelenterate: Hydra, obelia colony, Aurelia, sea anemone and any one coral iv) Platyhelminthes: Planaria, liver fluke and tapeworm v) Nemathelminths: Ascaris- male and female vi) Annelida: Nereis, earthworm and leech vii) Arthropoda: Crab, lobster, Lepisma, beetle, dragonfly, butterfly, moth, spider, centipede, millipede **3.** Preparation and observation of Paramecium. **4.** Determination of the rate of heart beat in Daphnia **5.** Study of animal interaction: ➢ Commensalism: Echinus and shark ➢ Mutualism: Termite and Trichonympha ➢ Antibiosis: Effect of antibiotic on bacterial growth on a petri plate		

	➢ Parasitism: Ectoparasite – head louse and bed bug ➢ Endoparasite: *Trichinella spiralis* ➢ Predation: Praying mantis and spider **6.** Mounting of foraminiferan shells from sand **7.** Demonstration of systems/ organs in Earthworm: Digestive system, Excretory system, Reproductive system and Nervous system (Use of permanent slide, model or photographs) **8.** Study of life cycle and pathogenicity of *Entamoeba, Leishmania*, liver fluke and Tapeworm **9.** Study of any 5 invertebrates available in nearby area (Submit the project)		

References:

1. Invertebrate Zoology Volume II- Jordan andVerma , S. Chand and Co.
2. Invertebrate Zoology- T. C. Majupuria , S. Nagin and Co.
3. Invertebrate Zoology- P. S. Dhami and J. K. Dhami , R. Chand and Co.
4. Zoology- S. A. Miller and J. B. Harley, Tata McGraw Hill
5. Modern Textbook of Zoology, Invertebrates, R. L. Kotpal
6. Biodiversity- S.V.S Rana- Prentice Hall Publications
7. Modern Biology- V. B. Rastogi
8. Biology of Mollusca- D. R. Khanna
9. A Textbook of Zoology, Vol. II- T. Jeffery Parker and William. A. Haswell- Low Price Publications.
10. Manuals of Laboratory Specimens Invertebrates Gurudarshan Singh

Syllabus for F.Y.B.Sc.
Program B.Sc.

Course: ZOOLOGY

Semester I
SKILL ENHANCEMENT COURSE 1
Theory and Practical

Skill Enhancement Course	CREDITS -2
ORNAMENTAL FISH BREEDING USEC1OFB	
Course Objectives: • *Understand the basic concepts and significance of ornamental fishery.* • *Learn the techniques and best practices for breeding ornamental fish and managing fish farms.* • *Acquire practical skills in constructing and maintaining aquariums for ornamental fish.*	
Course outcomes • *Students will be able to define ornamental fishery, explain its economic and ecological importance, and identify various types of ornamental fish.* • *Students will demonstrate knowledge of breeding techniques, including spawning methods and larval rearing, and apply management practices for maintaining healthy fish populations and optimizing farm productivity.* • *Students will gain hands-on experience in designing, building, and maintaining aquariums, including knowledge of water quality management, filtration systems, and the selection of suitable aquatic plants and decorations.*	

PRACTICALS	
1.	Identify classify and describe an aquarium fish (any five
2.	Study of breeding in live bearer
3.	Study of typical behaviors of different aquarium fish species and how they interact with each other, their environment, and potential mate.
4.	Identify and describe the aquarium accessories with their use and maintains.
5.	Identify and describe hybrid aquarium fishes
6.	Identify and describe food and its Types
7.	Identify and describe an aquarium plant (any five).
8.	Preparation of an aquarium tank of suitable size
9.	Setting of aquarium
10.	Maintenance of an aquarium.
11.	Explain the role of pH, hardness, ammonia, nitrates, and nitrites in maintaining a healthy aquarium environment
12.	Cultivation of some common live food
13.	Aquarium fish diseases
14.	Report on Field visit

ANNEXURE -I Suggested Field Visits

Field visits are to be organized to facilitate students to have first-hand experience and exposure to technology / production / functioning of an organization / unit or witness a relevant activity. Each student must make at least 02 (Two) such visits to the units/markets/public aquarium out of 2 to 3 such visits organized by the college.

i) Visit to one of the units with one or multiple activities such as • Ornamental fish farm / Nursery/ Hatchery.

ii) Visit any production units such as Ornamental fish Food industry Ornamental articles

iii) Govt. Offices such as • Fishery Department. • MPEDA, Mumbai • NFDB, Hyderabad • CIFI, Mumbai iv) Visit to National Laboratories, National Research Labs & Training Institutes such as NIO, Goa; CIFE, Mumbai; Fishery College, Ratnagiri; (Field visit is desirable to know the organization; however guest lecturers could also be helpful in understanding functioning).

ANNEXURE –II Suggested

Topics for Entrepreneurial Skill Development

1. Setting and Maintenance of fresh water aquarium.
2. Setting and Maintenance of marine aquarium.
3. Breeding of various aquarium fishes.
4. Preparation of aquarium fish feed.
5. Breeding of aquarium fishes.
6. Rearing of aquarium fishes.
7. Propagation of aquatic plants.

ANNEXURE -III Suggested Topics for Individual Project

1. Feasibility report of the maintenance of aquarium fishes in high profile residences.
2. Probability report of maintenance of a culture of Chaetoceros & Artemia by the fish farmers.
4. Project report for the establishment of small / medium / large ornamental fish farming unit
5. Feasibility report of various packaging materials in freezing / canning industry.
6. Feasibility report for establishing an aquarium shop.
7. Feasibility report for establishing a fish feed industry.
8. Setting up of marine aquarium with various accessories and its costing.
9. Finding herbal medicines for ornamental fish diseases

10 Propagation of aquarium plants and tissue culturing methods

References:

1. Hawlins, A.D. (Ed). Aquarium Systems. Academic Press.
2. Hunnam, P. Ward Lock, Living Aquarium.
3. Ratjak, K. and Zukal, R., Aquarium Fishes and Plants.
4. Spotte and John Wiley, S., Seawater Aquariums.
5. Straughan, R.P.L. and Thomas Yoseloff. Salt water Aquarium in the Home.
6. Dick Mills, 1987. Illustrated Guide to Aquarium Fishes. Published by Galley and Price, an imprint of W.H. Smith and Sons Limited, England.
7. Stephen Spotte. Marine Aquarium Keeping. A Wiley-Interscience Publication.
8. Dick Mills and Gwynne Vevere. Tropical Aquarium Fishes. Published by Salamander Books Limited. London.
9. Carcacson, R.H. A field guide to the Coral Reef Fishes of the Indian and West Pacific Oceans.
10. Vincent B. Hargreaves. The Tropical Marine Aquarium. Mc-Graw-Hill Book Company. New York.
11. Guy N. Smith. Profitable Fish Keeping.
12. Maurice Melzak. Marine Aquarium Manual. B.T. Balsford Ltd., London.
13. Ornamental aquarium fishes of India- 1999- K.L.Tekrival and A.A. Rao.- TFH United Kingdom.
14. Marine Ornamental species (collection, culture and conservation) – J.C.Cato and C.L.Brown. – Blackwell Science

Syllabus for F.Y.B.Sc.
Program B.Sc.

Course: ZOOLOGY

Semester II
Paper I and Practical I

F.Y.B.Sc. ZOOLOGY (THEORY)
Course Code: USC2ZO2

SEMESTER II

Title: Diversity in Chordates **Credit: 3+1**

Course Objectives:

- *To nurture interest in the students for the subject of Zoology.*
- *To understand animal diversity.*
- *To study detailed morphology of chordates*

Course Outcomes:

- *Learners will be able to comprehend the diversity of animals.*
- *Learners will be able to understand the importance of classification.*
- *Learners develop insight of group and type study*

Unit	Title	Lectures	Credits
Unit I: Animal Diversity in chordates	**1.1:** Phylum Chordata: **1.1.1.** General characters and classification of Chordata. **1.1.2.** Difference between Chordates and non-chordates. **1.1.3.** Affinities of Balanoglossus **1.2:** Group Protochordata: **1.2.1.** Subphylum Hemichordata e.g., Balanoglossus **1.2.2 :** Subphylum Urochordata e.g., Herdmania **1.2.3 :** General characters of Ascidian **1.2.4 :** Retrogressive Metamorphosis in Ascidian **1.2.5 :**Subphylum Cephalochordata e.g., Amphioxus	**12 lectures**	**01**
Unit II: Group Eurochordata	**2.1 :** Division: Agnatha **2.1.1 :** Class Ostracodermi **2.1.2** : Class Cyclostomata **2.1.3 :** Division: Gnathostomata **2.1.3.1 :** Superclass Pisces (Cartilaginous and bony fish) • Class Chondrichthyes • Class Osteichthyes **2.1.3.2:** Superclass Tetrapoda	**12 lectures**	**01**

	➢ Class Amphibia ➢ Class Reptilia ➢ Class Aves ➢ Class Mammalia		
Unit III: Type study- Shark:	**3.1.** Systematic position, Habits and habitat **3.2.** External characters **3.3.** Digestive system **3.4.** Circulatory system **3.5.** Excretory system **3.6.** Reproductive system **3.7.** Nervous system and sense organs	**12 lectures**	**01**
	SEMESTER II **Practical code: USC2ZOP** **Practical II**	**30 lectures**	**01**
	1. Study of museum specimen of Herdmania, *Petromyzon* (Sea lamprey) and *Myxine* (Hagfish) **2.** Study of permanent slide of Amphioxus and Balanoglossus. **3.** Study of classification and morphological characteristics of vertebrates i. Superclass Pisces: Shark (Scoliodon), Skate (Rhinobatys), Sting ray (Dasiatias), Electric ray, Sciena, Flying fish, Tilapia ii. Class Amphibia: Frog, toad iii. Class Reptilia: Chameleon, Calotes, Turtle, Cobra iv. Class Aves: Duck, Kingfisher, Parakeet v. Class Mammalia: Bat, Shrew **4.** Study of External morphology of Scoliodon (Demonstration). **5.** Study of Digestive system of Scoliodon (Demonstration). **6.** Study of Circulatory system of Scoliodon (Demonstration).		

	7. Study of Reproductive system of Scoliodon (Demonstration). **8.** Study of Nervous system (Brain and Cranial Nerves) of Scoliodon (Demonstration). **9.** Mounting of scales of fish (Placoid, Cycloid, Ctenoid) **10.** Visit to forest/ wildlife sanctuary/ biodiversity park/ museum and preparation of field visit report.		

Syllabus for F.Y.B.Sc.
Program B.Sc.
Course: ZOOLOGY
Semester II
SKILL ENHANCEMENT COURSE II
Theory and Practical

Skill Enhancement Course (THEORY)

SERICULTURE (USC2ZOSEC2)

CREDITS -2 (1 Theory + 1 Practical)

Course objectives:

- *Define sericulture, trace its historical development, and explain its status globally and within India.*
- *Understand and analyze the entire process of silkworm rearing, focusing on selecting appropriate mulberry varieties and establishing productive mulberry gardens.*
- *Perform hands-on practical examinations of non-mulberry plants, silkworm anatomy, and various rearing appliances, supplemented by field visits to sericulture centers.*

Course outcomes

- *Students will be able to articulate the definition and history of sericulture, describe significant milestones in its development, and evaluate its current global and national status, including economic and cultural impacts.*
- *Students will demonstrate the ability to select suitable mulberry varieties, plan and establish efficient mulberry gardens, and manage the rearing process to optimize silk production.*
- *Students will gain practical skills by examining non-mulberry plants, understanding the anatomy of silkworms, using rearing appliances, and applying their knowledge in real-world settings through field visits to sericulture centers.*

PRACTICALS

	1. Introduction to Sericulture **2.** Life Cycle of Bombyx mori L. **3.** Morphology of egg, larva, pupa and adult of silkworm Bombyx mori L. **4.** Types of silkworms **5.** Anatomy of Silkworm **6.** Study of Digestive system of Bombyx mori L. **7.** Study of respiratory system of Bombyx mori L. **8.** Mounting of larval mouth parts and spiracle **9.** Study of Silk gland **10.** Nervous system of silkworm larva **11.** Reproductive system of male and female silkworm moth **12.** Bacterial diseases of silkworm **13.** Viral diseases of silkworm **14.** Fungal diseases of silkworm **15.** Rearing appliances used in rearing **16.** Pests of silkworm	30	2 credit

	17. Entrepreneurship in Sericulture **18.** Visit to sericulture center		

References:

1. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
2. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
3. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
4. Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
5. Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
6. A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
7. Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

B.O.S. DATE: 15th February 2025 & 12th April 2025

B.O.S. ITEM NO.: 2 & 3

ACADEMIC COUNCIL DATE: 28th April 2025

ACADEMIC COUNCIL ITEM NO.: 2

Janardan Bhagat Shikshan Prasarak Sanstha's

CHANGU KANA THAKUR ARTS, COMMERCE & SCIENCE COLLEGE, NEW PANVEL (AUTONOMOUS)

Re-accredited 'A++' Grade by NAAC (4th Cycle)

'College with Potential for Excellence' Status Awarded by UGC

'Best College Award' by University of Mumbai

DEPARTMENT OF ZOOLOGY

SYLLABUS FOR

Second Year Bachelor of Science

(S.Y.B.Sc.)

SEMESTER – III & IV

w.e.f. Academic Year 2025-2026

SEMESTER – III

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	GENETICS	USC3ZO3	THEORY :02
2	ANIMAL PHYSIOLOGY	USC3ZO4	THEORY :02
3	PRACTICALS BASED ON MAJOR1& 2)	USC3ZOP	PRACTICAL :02
4	IKS: INDIAN PERSPECTIVE ON HEALTH AND LIFESTYLE MANAGEMENT	UIKS1IPHLM	THEORY :02

B. DISCIPLINE SPECIFIC COURSE (MINOR)

(Students will select 1 in continuation of Sem. 2 minor)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FOOD NUTRITION AND HEALTH	USC3ZOM	THEORY :02
	PRACTICALS BASED ON FOOD NUTRITION AND HEALTH	USC3ZOMP	PRACTICAL :02

C. OPEN ELECTIVES (ANY ONE FROM THE OE LIST FOR OTHER FACULTY)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	BIOMIMICRY: INNOVATION INSPIRING INDUSTRIES	UOE3BM	THEORY :04

D. SKILL ENHANCEMENT COURSE

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	PRACTICAL APPROCHES TO BIODIVERSITY CONSERVATION AND SUSTAINABLE DEVELOPMENT	USEC3BCSD	PRACTICAL: 02

E. ABILITY ENHANCEMENT COURSE

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	COMMUNICATION SKILLENGLISH	UAEC1CSE	THEORY: 02

F. FOUNDATION COURSE IN NSS/NCC/PE/PA

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FOUNDATION COURSE IN NSS/NCC/PE/PA	UCC3NSS/ UCC3NCC/ UCC3PE/ UCC3PA	THEORY: 02

G. OJT/FP/CEP/RP

No. of Courses	TITLE OF THE COURSES	CREDITS
1	==========	==========

SEMESTER – IV

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FOUNDATION OF EVOLUTIONARY BIOLOGY AND RESEARCH ETHICS	USC4ZO5	THEORY :02
2	DEVELOPMENTAL BIOLOGY	USC4ZO6	THEORY :02
3	PRACTICALS BASED ON MAJOR1& 2)	USC4ZOP	PRACTICAL :02
4	ECOTOURISM	USC4ZO7	THEORY :02

B. DISCIPLINE SPECIFIC COURSE (MINOR)

(Students will select 1 in continuation of Sem. 2 minor)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	ECONOMIC ZOOLOGY	USC4ZOM	THEORY :02+ PRACTICAL :02

C. OPEN ELECTIVES (ANY ONE FROM THE OE LIST)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	WILDLIFE TOURISM AND ECOENTREPRENEURSHIP	UOE4WTEE	THEORY :04

SKILL ENHANCEMENT COURSE

No. of Courses	TITLE OF THE COURSES	CREDITS
1	**----------**	**----------**

D. ABILITY ENHANCEMENT COURSE

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	COMMUNICATION SKILL IN ENGLISH	UAEC2CSE	THEORY: 02

E. FOUNDATION COURSE IN NSS/NCC/PE/PA (SELECT ANY ONE)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FOUNDATION COURSE IN NSS/NCC/PE/PA	UCC3NSS/ UCC3NCC/ UCC3PE/ UCC3PA	THEORY: 02

F. OJT/FP/CEP/RP

No. of Courses	TITLE OF THE COURSES	CREDITS
1	COMMUNITY ENGAGEMENT PROJECT	2 CREDITS

SYLLABUS FOR

Second Year Bachelor of Science

(S.Y.B.Sc.)

SEMESTER – III

SEMESTER – III

DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
DISCIPLINE SPECIFIC COURSE (MAJOR)			
1	GENETICS	USC3ZO3	THEORY :02
2	ANIMAL PHYSIOLOGY	USC3ZO4	THEORY :02
3	PRACTICALS BASED ON MAJOR1& 2)	USC3ZOP	PRACTICAL :02
4	IKS: INDIAN PERSPECTIVE ON HEALTH AND LIFESTYLE MANAGEMENT	UIKS1IPHLM	THEORY :02

A. DISCIPLINE SPECIFIC COURSE (MAJOR: 1)

COURSE TITLE: GENETICS

COURSE CODE: USC3ZO3 **(CREDIT: THEORY- 02)**

Course Objectives:

- To introduce the fundamental concepts of genetics and heredity.
- To understand the principles of gene interaction, linkage, and chromosomal mapping.
- To explore molecular genetics and the role of DNA and RNA in inheritance.

Course Outcomes:

- Understand basic principles, including Mendelian inheritance, gene interaction, and linkage.
- Explain chromosome structure, function, aberrations, and their genetic significance.
- Able to describe DNA/RNA structure, gene expression, and regulation in prokaryotes and eukaryotes.

Unit I: Basic Concepts in Genetics **(15 Lectures)**

1. **Introduction to Genetics:**
   - **a)** Historical perspectives and scope.
   - **b)** Mendelian laws of inheritance and exceptions.
2. **Chromosome Structure and Function:**
   - **a)** Chromosomal theory of inheritance.
   - **b)** Structure and types of chromosomes.
   - **c)** Chromosomal aberrations and their significance.
3. **Gene Interaction and Linkage:**
   - **a)** Concept of alleles, dominance, and epistasis.

b) Linkage and crossing over.

c) Chromosome mapping and recombination frequency.

Unit II: Molecular Genetics and Applications (15 Lectures)

1. **DNA and RNA Structure and Functions:**
   - **a)** Double helix model, replication, and mutations.
   - **b)** Types and functions of RNA.
2. **Gene Expression and Regulation:**
   - **a)** Transcription and translation mechanisms.
   - **b)** Gene regulation in prokaryotes and eukaryotes.
3. **Applications of Genetics:**
   - **a)** Genetic engineering and CRISPR technology.
   - **b)** Role of genetics in conservation biology and human health.
   - **c)** Genetic basis of inherited diseases and genetic counseling.

SUGGESTED READINGS:

1. Benjamin Cummings. Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. 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.
4. Fletcher H. and Hickey I. (2015). Genetics. IV Edition. GS, Taylor and Francis Group, New York and London.

A. DISCIPLINE SPECIFIC COURSE (MAJOR: 2)

COURSE TITLE: ANIMAL PHYSIOLOGY

COURSE CODE: USC3ZO24 **(CREDIT: THEORY- 02)**

Course Objectives:

- To introduce fundamental concepts of animal physiology.
- To understand the structure and functions of different organ systems.
- To explore physiological mechanisms and their adaptations.

Course Outcomes:

- Comprehend the fundamental principles of animal physiology, including homeostasis and the functions of major organ systems.
- Explain the structure and functioning of the digestive, respiratory, circulatory, nervous, endocrine, and excretory systems.
- Perform basic physiological experiments and interpret the results to understand body functions and regulatory mechanisms

Unit I: Physiological Systems and Functions **(15 Lectures)**

1. **Introduction to Animal Physiology:**
   - **a)** Scope and importance of physiology.
   - **b)** Levels of organization and homeostasis.
2. **Digestive System:**
   - **a)** Structure and function of digestive organs in Invertebrates and Vertebrates
   - **b)** Physiology of digestion in human
3. **Respiratory System:**
   a) Respiratory structures and adaptations in invertebrates and vertebrates
   b) Physiology of respiration in human
4. **Circulatory System:**
   - **a)** Types of circulatory systems in animals.
   - **b)** Structure and function of the heart and blood vessels vertebrates
   - **c)** Physiology of circulation in human

Unit II: Regulation and Coordination **(15 Lectures)**

1. **Nervous System:**
   a) Structure and function of neurons.
   b) Nerve impulse transmission and synaptic coordination.
2. **Endocrine System:**
   a) Hormonal regulation and feedback mechanisms.
   b) Major endocrine glands and their functions.

3. **Excretory System:**
    a) Comparative study of excretory organs and its mechanism (Protonephridia, metanephridia, Malpighian tubules and Nephron)
    b) Structure and function of kidney in human
    c) Mechanism of urine formation and osmoregulation.
4. **Reproductive system:**
    a) Reproductive organs
    b) Gametogenesis
    c) Types of reproduction
    d) Reproductive strategies (Oviparity, viviparity and ovo-viviparity)

SUGGESTED READINGS:

1. Marieb E.N. and Hoehn K.N. (2009) Human Physiology. Pearson Education Publication, 9th edition
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI
3. Edition John Wiley & sons.
4. Guyton & Hall, (2016) Textbook of Medical Physiology. Elsevier, 12th edition,
5. Victor P. Eroschenko. (2008). DiFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
6. Vander A Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills.
7. Moyes C.D., Schulte PM (2016), Principles of physiology, 2nd edition, Pearson education, 3rd.
8. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.

DISCIPLINE SPECIFIC PRACTICAL COURSE
PRACTICALS BASED ON DISCIPLINE SPECIFIC COURSE MAJOR: 1 & 2

COURSE CODE: USC3ZOP **(CREDIT: 02)**

Course Objectives:

- Develop practical skills in cytogenetics, physiology, and animal morphology.
- Understand genetics, inheritance, enzymatic activity, and physiological processes.
- Enhance analytical skills through genetic problem-solving and project work.

Course Outcomes:

- Gain proficiency in cytogenetic techniques and blood group detection.
- Acquire hands-on experience in enzyme activity, excretion, and respiration.
- Build a strong foundation in animal morphology, reproduction, and adaptation.

PRACTICALS

1. Mounting of Barr bodies
2. Study of polytene chromosome from the Drosophila Larvae
3. Study of mitosis- temporary squash preparation from tip of fish tail
4. Detection of blood groups and Rh factor
5. Problems in Genetics based on Monohybrid
6. Problems in Genetics based on Dihybrid Cross
7. Problems in Genetics based on X- linked inheritance
8. Problems in Genetics based on Multiple Alleles
9. Chromosome morphology: (photograph to be provided)
10. Pedigree analysis
11. Study of effect on activity of salivary amylase enzyme on Substrate Concentration
12. Study of effect on activity of salivary amylase enzyme on pH
13. Study of effect on activity of salivary amylase enzyme on Temperature
14. Study of nutritional apparatus (Amoeba, Hydra, Earthworm, Pigeon, Ruminant stomach)
15. Study of respiratory structures: a. Gills of bony fish and cartilaginous fish b. Lungs of frog c. Lungs of mammal d. Accessory respiratory structure in Anabas / Clarius e. Air sacs of Pigeon.
16. Study of different types of hearts (Cockroach, Shark, Frog, Garden lizard, Crocodile and Mammal) by using charts /models.
17. Demonstration of osmotic pressure in RBC using isotonic, hypotonic and hypertonic solution.
18. Comparative study of brain structure (Insect, fish, frog and mammalian brain by using charts and models).
19. Study of major endocrine glands and their functions.
20. Detection of ammonia excreted by fish from aquarium water.

21. Urine analysis- Normal constituents.

22. Urine analysis- Abnormal constituents.

23. Estimation of urea and creatinine in urine.

24. Microscopic study of reproductive organ ovaries and testes sections in fish, amphibia, reptiles and mammals.

25. Submission of project based on Genetics.

26. Field visit.

REFERENCE BOOKS:

1. Experimental Genetics – R.C. Dubey, S. Chand & Company, 2018.

2. Practical Zoology: Vertebrate – S.S. Lal, Rastogi Publications, 2010.

3. Animal Physiology and Biochemistry – M. N. Sastry & R. S. Shrivastava, S. Chand Publishing, 2016.

4. Laboratory Manual in Genetics – D.P. Singh & N.S. Shekhawat, Pointer Publishers, 2017.

5. Practical Zoology: Invertebrate – P.S. Verma, S. Chand Publishing, 2018.

6. Vertebrate Zoology – Jordan & Verma, S. Chand Publishing, 2016.

A. COURSE: INDIAN KNOWLEDGE SYSTEM

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	INDIAN PERSPECTIVE ON HEALTH AND LIFESTYLE MANAGEMENT	UIKS1IPHLM	THEORY :02

Course Objectives:

- Understand traditional Indian health systems like Ayurveda, Yoga, and Naturopathy.
- Learn holistic lifestyle practices for physical, mental, and spiritual well-being.
- Explore diet, daily routines, and stress management techniques from an Indian perspective

Course Outcomes:

- Understand the holistic approach to health as described in Indian traditions.
- Gain knowledge about the Tridosha system and how it influences individual health.
- Gain practical insights into the Ayurvedic lifestyle management practices such as daily and seasonal routines.
- Understand how the principles of Ayurveda can be applied to modern lifestyle choices for maintaining health and preventing diseases.

Unit 1: Understanding Health from an Indian Perspective (15 lectures)

1. **Concept of health:**
   - **a)** Defining health according to Indian traditions.
   - **b)** The holistic concept of health: physical, mental, and spiritual well-being.
   - **c)** Understanding "Swasthya" (health) in the context of balance between body, mind, and soul.
   - **d)** The role of harmony in maintaining health: Ayurveda's view of balance between internal and external environments.
   - **e)** The significance of self-awareness, balance, and prevention in maintaining health.

2. **Introduction to Tridosha (Three Doshas):**
   - **a)** The concept of the Tridosha (Vata, Pitta, and Kapha) and its role in health and disease.
   - **b)** Characteristics of the three doshas and their effects on the body and mind.
   - **c)** How imbalances in the doshas lead to various physical and mental conditions.
   - **d)** The concept of "Prakriti" (individual constitution) and "Vikriti" (imbalance) in Ayurveda.
   - **e)** Identifying and understanding one's dosha for personalized health management.

Unit 2: Lifestyle Management for Well-being (15 lectures)

1. **Epidemic in Indian Context:**
   - **a)** Different types of food intake.
   - **b)** Understanding the food balance between "Sattva" (mental clarity), "Rajas" (activity), and "Tamas" (inertia) in maintaining health.

c) The role of immunity (Ojas) in resisting epidemics and diseases.

d) Ayurvedic remedies for enhancing immunity and preventing diseases.

2. **Concept of our Daily and Seasonal Routine:**
    a) The significance of daily and seasonal routines (Dinacharya and Ritucharya) for maintaining balance.
    b) The Ayurvedic principles of waking up early, personal hygiene, exercise, and proper diet as part of a daily regimen.
    c) Seasonal adjustments in diet, behavior, and lifestyle for optimal health.
3. **Understand Your Sleep:**
    a) The importance of sleep in maintaining overall health according to Ayurveda.
    b) The concept of "Nidra" (sleep) and its impact on the body, mind, and emotions.
    c) Ayurvedic recommendations for good sleep hygiene: ideal sleep timings, sleep environment, and sleep rituals.
    d) Understanding the link between quality sleep and mental clarity, mood, and immune function.
    e) How sleep imbalances (insomnia, disturbed sleep) are related to dosha imbalances and methods to address them.
4. **Drink Water, Stay Healthy:**
    a) The Ayurvedic perspective on hydration and the importance of drinking water in maintaining bodily functions.
    b) The role of water in detoxification, digestion, and circulation.
    c) Guidelines for drinking water: when, how, and how much.
    d) The significance of drinking water at the right temperature and in the right manner for balancing the doshas.
    e) The role of herbal waters and teas in Ayurvedic wellness practices.
5. **Food Intake Methods:**
    a) The role of food in health: Ayurveda's perspective on food as medicine.
    b) Food as per your dosha: Understanding which foods balance each dosha and promote health.
    c) Importance of mindful eating: the concept of "Ahara" (diet) in Ayurveda.
    d) Ideal food combinations, proper meal timings, and portion control.
    e) Eating for digestion: the importance of Agni (digestive fire) in maintaining health.
    f) Ayurvedic guidelines for food preparation, presentation, and consumption for optimal digestion and health.

Reference books:

1. "Ayurveda: Life, Health, and Longevity" by Robert E. Svoboda - An introduction to Ayurvedic principles and lifestyle practices.
2. "Charaka Samhita" by Acharya Charaka (Translated by P.V. Sharma) - A foundational text on Ayurveda and holistic health.
3. "Sushruta Samhita" by Acharya Sushruta (Translated by K.R. Srikantha Murthy) - Classical text on surgery and health practices.
4. "Yoga Sutras of Patanjali" by Swami Satchidananda - Insights into yogic practices for lifestyle and mental well-being.
5. "The Complete Book of Ayurvedic Home Remedies" by Vasant Lad - Practical applications of Ayurveda for lifestyle management.
6. "Science of Yoga" by Ann Swanson - Blending traditional yoga practices with scientific perspectives.
7. "Indian Systems of Medicine" by T. V. Sairam - An overview of various Indian health systems.
8. "Prakriti: Your Ayurvedic Constitution" by Dr. Robert E. Svoboda - Understanding individual health profiles in Ayurveda.
9. "The Art and Science of Raja Yoga" by Swami Kriyananda - Comprehensive guide on yoga as a holistic lifestyle practice.
10. "The Textbook of Ayurveda" (Vol. I, II, III) by Vasant Lad - Detailed explanations of Ayurvedic concepts and applications.

B. DISCIPLINE SPECIFIC COURSE (MINOR) (Students will select 1 in continuation of Sem. 2 minor)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FOOD NUTRITION AND HEALTH	USC3ZOM	THEORY :02+ PRACTICAL :02

Course Objectives:

- Understand nutrition fundamentals and the role of nutrients in health.
- Learn about balanced diets, dietary guidelines, and disease prevention.
- Explore Indian traditional diets and their health benefits.

Course Outcomes:

- Gain knowledge of nutrients, dietary sources, and balanced diet principles.
- Identify nutritional deficiencies and their health impacts.
- Understand Indian dietary traditions and nutrition-based lifestyle management.

Unit 1: Fundamentals of Food and Nutrition (15 lectures)

1. **Introduction to Food and Nutrition:**
   - **a)** Definition, scope, and importance of nutrition.
   - **b)** Classification of nutrients: Macronutrients (Carbohydrates, Proteins, Fats) and Micronutrients (Vitamins, Minerals).
   - **c)** Dietary sources and functions of essential nutrients.
2. **Balanced Diet and Dietary Guidelines:**
   - **a)** Components of a balanced diet.
   - **b)** Food groups and their nutritional significance.
   - **c)** Recommended Dietary Allowances (RDA) and Nutritional Guidelines.
   - **d)** Concept of Nutrient Density and Food Pyramid.
3. **Nutritional Deficiencies and Health Issues:**
   - **a)** Malnutrition: Under-nutrition and Over-nutrition.
   - **b)** Common nutritional disorders: Protein-Energy Malnutrition (PEM), Micronutrient Deficiencies (Iron, Vitamin A, Iodine).
   - **c)** Lifestyle-related disorders: Obesity, Diabetes, Hypertension.

Unit 2: Food, Health, and Indian Perspectives (15 lectures)

1. **Traditional Indian Diets and Health:**
   - **a)** Ayurveda and nutrition: Concepts of Sattvic, Rajasic, and Tamasic foods.
   - **b)** Regional and cultural diversity in Indian diets.
   - **c)** Health benefits of traditional Indian foods and spices.

2. **Nutrition and Disease Prevention:**
    - **a)** Role of antioxidants, dietary fiber, and probiotics.
    - **b)** Functional foods and nutraceuticals in promoting health.
    - **c)** Importance of immunity-boosting foods.
3. **Nutrition and Lifestyle Management:**
    - **a)** Dietary modifications for lifestyle diseases.
    - **b)** Role of nutrition in mental well-being and stress management.
    - **c)** Nutrition for special populations: Children, Adolescents, Pregnant Women, and the Elderly.

Reference books:

1. Understanding Nutrition – Ellie Whitney & Sharon Rady Rolfes, Cengage Learning, 2020. **2.** Food and Nutrition – M. Swaminathan, The Bangalore Printing & Publishing Co. Ltd., 2019.

3. Human Nutrition and Dietetics – J.S. Garrow, W.P.T. James & A. Ralph, Churchill Livingstone, 2018.

4. Essentials of Food and Nutrition – S. R. Mudambi & M. V. Rajagopal, New Age International, 2021.

5. Nutrition Science – B. Srilakshmi, New Age International, 2020.

6. Fundamentals of Foods and Nutrition – Sumati R. Mudambi & M.V. Rajagopal, New Age International, 2019.

7. Ayurvedic Nutrition – Sandhya L. Dave, Notion Press, 2021.

8. Functional Foods and Nutraceuticals – Rotimi E. Aluko, Springer, 2019.

9. Modern Nutrition in Health and Disease – A. Catharine Ross, Lippincott Williams & Wilkins, 2020.

10. The Indian Cuisine Diabetes Cookbook – May Abraham Fridel, American Diabetes Association, 2019.

B. DISCIPLINE SPECIFIC COURSE PRACTICAL (MINOR)

(Students will select 1 in continuation of Sem. 2 minor)

COURSE TITLE: FOOD NUTRITION AND HEALTH

COURSE CODE: USC3ZOM **CREDITS: 02**

Course Objectives

- To develop practical skills in food quality testing by detecting adulterants and assessing food purity.
- To understand nutrient estimation techniques for fats, proteins, vitamins, and minerals in food samples.
- To study stored grain pests, their impact on food security, and control measures.

Course Outcomes

- Students will gain hands-on experience in food adulteration detection and milk quality assessment.
- Students will learn nutrient analysis methods for evaluating food composition.
- Students will develop awareness of food safety, nutrition labeling, and pest management.

PRACTICALS

1. Classification of food based on origin chemical composition and nutritive value
2. To determine Nutritive value of different food groups
3. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
4. Testing of adulteration of milk
5. Estimation of total fat in milk
6. Estimation of total cholesterol in milk
7. To determine the specific gravity of milk to know its purity by lactometer
8. Detection of starch, sucrose, formalin, boric acid, and urea in milk.
9. Ascorbic acid estimation in food
10. Estimation of Calcium in foods.
11. Study of the stored grain pests from slides/photographs *(Sitophilus oryzae, Trogoderma granarium, Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control.
12. Preparation of temporary mounts of the above stored grain pests.
13. Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price
14. Study of nutrition facts on selected foods

15. Colorimetric estimation of protein in egg

16. Calculation of Basal Metabolic Rate

17. Calculation of Body Mass Index

18. Diet of specific Health Condition (Diabetic)

19. Diet of specific Health Condition (Obesity)

20. Nutritional labelling of food products.

21. Preparation of Balanced diet and RDA of Nutrients

22. Computation of energy requirements based on various activity

23. Project based on food and nutrition

24. Visit to food testing lab /or any agency of food standards and submit report of it.

Reference Books:

1. Food Adulteration and Safety – H.D. Sharma & B. Sharma, Agrobios (India), 2018.
2. Handbook of Food Analysis – Leo M.L. Nollet, CRC Press, 2020.
3. Food Chemistry – H.D. Belitz, W. Grosch, & P. Schieberle, Springer, 2019.
4. Food Quality and Safety – Charis M. Galanakis, Academic Press, 2021.
5. A Handbook on Food Analysis and Quality Control – S. Ranganna, Tata McGraw Hill, 2018.
6. Milk and Dairy Products in Human Nutrition – Young W. Park, Wiley-Blackwell, 2017.
7. Essentials of Food Science – Vickie A. Vaclavik & Elizabeth W. Christian, Springer, 2020.
8. Stored-Grain Pests and Their Management – D. S. Jayas, N.D.G. White & W.E. Muir, CRC Press, 2019.
9. Techniques in Food Analysis – Nielson S., Springer, 2018.
10. Food Standards and Labeling Compliance – Stanley Sacharow, CRC Press, 2019.

C. OPEN ELECTIVES COURSE FOR OTHER FACULTY STUDENTS (SELELCT ANY ONE FROM THE OE LIST)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	BIOMIMICRY: INNOVATION INSPIRING INDUSTRIES	UOE3BM	THEORY :04

Course Objectives:

- Introduce students to the concept, history, and foundational principles of biomimicry.
- Equip students with insights into various biological systems, adaptations, and natural strategies that can inspire innovative applications across industries.
- Enable students to analyze and relate biomimetic concepts to real-world solutions.

Course Outcomes:

- Students will be able to define biomimicry, understand its historical context, and discuss its principles and applications in sustainable innovation.
- Students will gain the ability to identify biological strategies in nature and understand how these adaptations can solve industrial challenges.
- Students will be able to recognize and explain biomimetic solutions in daily life.

Unit 1: Introduction to Biomimicry (15 lectures)

1. Introduction
2. Definition and historical background
3. Principles of biomimicry
4. Importance of Biomimicry in Sustainable Design and Innovation
5. Biological Inspiration-
   - **a)** Understanding biological systems
   - **b)** Adaptations and strategies in nature
   - **c)** Biomimicry in organismal structures and functions

Unit 2: Biomimicry Examples in Daily Life (15 lectures)

1. Needles
2. Swim Suits
3. Velcro
4. Camouflage
5. Air Crafts
6. Self-Filling Water Bottles
7. Air Conditioning
8. Shock Absorbers
9. Modern Turbine Blades
10. Bullet Trains

Unit 3 A) Biomimicry in Fashion **(15 lectures)**

1. Lotus Effect
2. Spider Silk
3. Butterfly Wing Patterns.
4. Sharkskin-Inspired Swimwear.
5. Production Methods

B) Biomimicry in Architecture and Building Design

Unit 4 A) Biomimicry in Medicine and Healthcare

1. Nature-inspired medical technologies
2. Drug discovery and bio-mimetic drug delivery systems
3. Biomimetic prosthetics and implants

B) Biomimicry for Sustainability

1. Ecological design and systems thinking
2. Biomimetic solutions for environmental challenges

Reference books:

1. "Biomimicry: Innovation Inspired by Nature" by Janine M. Benyus
2. "Biomimicry for Designers: Applying Nature's Processes & Materials in the Real World" by Veronika Kapsali
3. "Biomimicry Resource Handbook: A Seed Bank of Knowledge and Best Practices" by Dayna Baumeister, Bryony Schwan, and Janine Benyus
4. "Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life" by Stephen R. Kellert, Judith Heerwagen, and Martin Mador
5. "Biomimetics: Nature-Based Innovation" by Yoseph Bar-Cohen
6. "Biomimicry in Architecture" by Michael Pawlyn
7. "Biomimetics: Nature-Inspired Design and Innovation" by Paolo S. Coelho
8. "The Shark's Paintbrush: Biomimicry and How Nature is Inspiring Innovation" by Jay Harman

D. SKILL ENHANCEMENT COURSE

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	PRACTICAL APPROCHES TO BIODIVERSITY CONSERVATION AND SUSTAINABLE DEVELOPMENT	USEC3BCSD	PRACTICAL :02

Course Objectives:

- To develop hands-on skills in biodiversity assessment and conservation strategies.
- To understand the integration of sustainable development principles in conservation practices.
- To encourage field-based learning and real-world application of conservation techniques.

Course Outcomes:

- Conduct biodiversity assessments using field and lab techniques.
- Implement conservation strategies and evaluate their effectiveness.
- Analyze the impact of human activities on biodiversity

PRACTICALS

1. Quadrat Sampling for Vegetation Analysis.

2. Point Count Method for Bird Diversity.

3. Line Transect Method for Terrestrial Fauna.

4. Estimation of COD from the given water sample.

5. Estimation of BOD from the given water sample.

6. Estimation of Hardness of given water sample.

5. Estimation of phosphate from the given water sample.

6. Estimation of nitrate from the given water sample.

7. Types of Cameras used in Camera Trapping for Mammal Diversity.

8. Water Quality Assessment of nearby water body.

9. Study of pH of different types of Soil.

10. Study of Environmental Impact Assessment Report

11. Case studies on successful community-driven conservation initiatives.

12. Field visits to wildlife sanctuaries, national parks, or biodiversity hotspots.

Reference Books:

1. Biodiversity and Conservation: A Practical Approach: Malcolm L. Hunter, Publisher: Cambridge University Press 1996
2. Measuring Biological Diversity: Anne E. Magurran, Publisher: Blackwell Publishing, 2004 **3.** Conservation Biology: Foundations, Concepts, Applications, Fred Van Dyke, Publisher: Springer, 2008
4. Practical Ecology for Conservation and Management: John S. Fairweather, Judith S. Weis, Publisher: Oxford University Press, 2005
5. Field and Laboratory Methods for General Ecology, James E. Brower, Jerrold H. Zar, Publisher: McGraw-Hill, 1998
6. Remote Sensing and GIS for Ecologists: Using Open-Source Software: Martin Wegmann et al. Publisher: Pelagic Publishing, 2016
7. Wildlife Techniques Manual: Research and Management: Nova J. Silvy, Publisher: Johns Hopkins University Press, 2012
8. Camera Trapping for Wildlife Research: Francesco Rovero, Fridolin Zimmermann Publisher: Pelagic Publishing, 2016
9. Soil Microbiology, Ecology, and Biochemistry: Eldor A. Paul, Publisher: Academic Press, 2014
10. Handbook of Molecular Markers in Ecology: Anurag A. Agrawal Publisher: Wiley-Blackwell, 2008
11. Statistical Methods for Environmental and Biological Monitoring: Bryan F. J. Manly Publisher: Chapman and Hall/CRC, 2008
12. Introduction to R for Conservation and Development Projects: Nathan Whitmore, Publisher: Pelagic Publishing, 2020

SYLLABUS FOR

Second Year Bachelor of Science

(S.Y.B.Sc.)

SEMESTER – IV

SEMESTER – IV

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FOUNDATION OF EVOLUTIONARY BIOLOGY AND RESEARCH ETHICS	USC4ZO5	THEORY :02
2	DEVELOPMENTAL BIOLOGY	USC4ZO6	THEORY :02
3	PRACTICALS BASED ON MAJOR1& 2)	USC4ZOP	PRACTICAL :02
4	ECOTOURISM	USC4ZO7	THEORY :02

DISCIPLINE SPECIFIC COURSE (MAJOR: 1)

COURSE TITLE: FOUNDATION OF EVOLUTIONARY BIOLOGY AND RESEARCH ETHICS

COURSE CODE: USC4ZO5 CREDITS: 02

Unit 1: Foundations of Evolutionary Biology (15 lectures)

1. Introduction to Evolutionary Biology:

- **a)** Definition and Scope of Evolutionary Biology
- **b)** Historical Perspectives: Pre-Darwinian to Modern Synthesis
- **c)** Natural Selection: Concepts and Types (Directional, Stabilizing, Disruptive)
- **d)** Speciation: Allopatric, Sympatric, Peripatric, and Parapatric

2. Mechanisms of Evolution:

- **a)** Genetic Drift, Gene Flow, and Mutation
- **b)** Adaptive Radiation and Convergent Evolution
- **c)** Microevolution Vs Macroevolution
- **d)** Coevolution

3. Human Evolution and Adaptation:

- **a)** Hominin Evolution and Fossil Records
- **b)** Genetic Evidence of Human Ancestry
- **c)** Evolution of Human Traits: Bipedalism, Brain Size
- **d)** Case studies: Evolution of limbs and wings

Unit 2: Research Methodology (15 lectures)

1: Process of science:

- **a)** A dynamic approach to investigation: The Scientific method, Deductive reasoning and inductive reasoning, Critical thinking, Role of chance in scientific discovery (serendipity)

b) Scientific research: Definition, difference between method and methodology, characteristics, types

c) Dissemination of data: Reporting results to scientific community (publication in peer- reviewed journals, thesis, dissertation, reports, oral presentation, poster presentation)

d) Application of knowledge: Basic research, Applied research and Translational research

2: Scientific writing:

a) Structure and components of a research paper: preparation of manuscript for publication of research paper

b) Writing a review of research paper: Structure and components of review article

c) Report writing and types of report

3: Ethics:

a) Ethics in animal research: The ethical and sensitive care and use of animals in research, teaching and testing, approval from Dissection Monitoring Committee (DMC)

b) Ethics in clinical research: Approval from clinical research ethics committee or/and informed consent

4: Plagiarism

Reference books

1. Evolution: Douglas J. Futuyma and Mark Kirkpatrick,Publisher: Sinauer Associates 2017 (4th Edition)
2. Principles of Evolutionary Genetics: James F. Crow and Motoo Kimura, Publisher: Columbia University Press, 1970
3. Molecular Evolution: Wen-Hsiung Li Publisher: Sinauer Associates, 1997
4. Evolutionary Analysis: Scott Freeman and Jon C. Herron, Publisher: Pearson: 2013 (5th Edition)
5. Evolutionary Biology: A Conceptual Approach: Eric Svensson and Ryan Calsbeek, Publisher: Oxford University Press, 2012
6. Evolution and Genetics: Concepts and Challenges: Francisco J. Ayala, Publisher: Springer 2014
7. Phylogenetics: Theory and Practice of Phylogenetic Systematics: E.O. Wiley and Bruce S. Lieberman, Publisher: Wiley-Blackwell 2011
8. Research Ethics: A Reader, Editors: Deni Elliott and Judy E. Stern Publisher: University Press of New England, 1997
9. Scientific Integrity: Text and Cases in Responsible Conduct of Research: Francis L. Macrina Publisher: ASM Press, 2014 (4th Edition)

10. Ethics and the Practice of Science : Kristin Shrader-Frechette Publisher: Cambridge University Press, 1994
11. Responsible Conduct of Research: Adil E. Shamoo and David B. Resnik Publisher: Oxford University Press, 2015 (3rd Edition)
12. The Ethics of Scientific Research: Frank Wells Publisher: Cambridge University Press: 2003
13. On Being a Scientist: A Guide to Responsible Conduct in Research , Publisher: National Academy of Sciences, 2009
14. Ethics in Science: Ethical Misconduct in Scientific Research: John M. Braxton, Publisher: Routledge, 2014

DISCIPLINE SPECIFIC COURSE (MAJOR: 2)
COURSE TITLE: DEVELOPMENTAL BIOLOGY

COURSE CODE: USC4ZO6 **CREDITS: 02**

Course Objectives:

- Understand key concepts and historical perspectives of developmental biology.
- Learn cellular and molecular mechanisms of development and organ formation.
- Explore applications like stem cell therapy and impacts of environmental factors.

Course Outcomes:

- Explain concepts of gametogenesis, fertilization, and early development.
- Describe molecular mechanisms in organogenesis and growth.
- Apply developmental biology knowledge to stem cell therapy and teratology.

Unit 1: Foundations of Developmental Biology (15 Lectures)

1. **Introduction to Developmental Biology**
   - **a)** Historical perspectives and significance
   - **b)** Key concepts: differentiation, morphogenesis, growth, reproduction, regeneration, and evolution
   - **c)** Types of eggs and sperm
   - **d)** Fertilization
2. **Early Embryonic Development**
   - **a)** Patterns of Cleavage
   - **b)** Types of blastula
   - **c)** Gastrulation: Germ layer formation and fate mapping

Unit 2: Embryonic development (15 Lectures)

1. **Late embryonic development**
   - **a)** Fate of germ layer
   - **b)** Extra embryonic membrane
   - **c)** Implantation of embryo in human
   - **d)** Placenta (Structure, type and function)
2. **Post embryonic development and implications of developmental biology**
   - **a)** Metamorphosis
   - **b)** Regeneration
   - **c)** In-vitro fertilization
   - **d)** Amniocentesis

Reference Books :

1. Principles of Development – Lewis Wolpert & Cheryll Tickle, Oxford University Press, 2019.

2. Essentials of Developmental Biology – Jonathan Slack, Wiley-Blackwell, 2021.
3. Foundations of Developmental Biology – Sally A. Moody, Academic Press, 2018.
4. Genetic Control of Embryonic Development – Richard Twyman, Taylor & Francis, 2018.
5. Stem Cells and Regenerative Medicine – Nagwa El-Badri, Springer, 2021.
6. Molecular Biology of the Cell – Alberts et al., Garland Science, 2021.
7. Introduction to Embryology – B.I. Balinsky, Saunders, 2019.
8. Developmental Biology – P.C. Jaiswal, Himalaya Publishing House, 2020.
9. Textbook of Developmental Biology – R.M. Twati, Sonali Publications, 2019.
10. Cell and Developmental Biology – Dr. Veer Bala Rastogi, Kedar Nath Ram Nath, 2020.
11. A Textbook of Embryology – Arora M.P., Himalaya Publishing House, 2018.
12. Introduction to Embryology – B.I. Balinsky & Sudhir Bhaskar, CBS Publishers, 2019.
13. Developmental Biology and Regeneration – R. S. Verma, S. Chand Publishing, 2021.

DISCIPLINE SPECIFIC PRACTICAL COURSE (MAJOR)

PRACTICALS BASED ON DISCIPLINE SPECIFIC COURSE MAJOR: 1 & 2

COURSE CODE: USC4ZOP **CREDITS: 02**

Course Objectives

- Understand evolutionary biology through fossils, homology, and population genetics.
- Study developmental biology focusing on gametogenesis, embryonic stages, and organogenesis.
- Develop research ethics and analytical skills in evolutionary and developmental studies.

Course Outcomes

- Gain practical skills in fossil identification, genetic analysis, and selection simulations.
- Learn embryological techniques, karyotyping, and organogenesis studies.
- Apply research ethics and analytical methods in biological studies**.**

PRACTICALS

1. Identification of speciation (allopatric, Sympatric, Peripatric & Parapatric) (2 hrs)
2. Identification and study of fossils: Arthropoda, Mollusca, Aves (2 hrs)
3. Study of homology and analogy from suitable specimens. (2 hrs)
4. Study and verification of Hardy-Weinberg Law by chi square analysis. (2 hrs)
5. Preparation of Review/ Bibliography / Abstract writing. (12 hrs)
6. Preparation of Power Point Presentation based on research paper. (12hrs)
7. Review writing based on programmes telecast by Doordarshan, Gyandarshan, UGC programmes or other media sources (6 hrs)
8. Preparation of bibliography and abstract writing (6 hrs)
9. Study of Gamete Structure (Sperm and Egg) Using Permanent Slides/Models (2 hrs)
10. Types of eggs and sperm using chart and permanent slides (2 hrs)
11. Observation of Cleavage and Blastula Stages in Chick Embryo (Slides/Images) (2 hrs)
12. Study of Gastrulation and Germ Layer Formation in Early Embryos (2hrs)
13. Observation of Placental Structure and Function in Mammals (Slides/Models) (2hrs)
14. Temporary mounting of chick blastoderm (2 hrs)
15. Karyotyping Analysis from print material (3hrs)
16. Demonstration of Regeneration in Planaria (V-LAB) (1 hr)

Reference Books:

1. Molecular Evolution: A Phylogenetic Approach: Roderick D.M. Page and Edward C. Holmes Publisher: Blackwell Science, 1998
2. Evolutionary Analysis: Scott Freeman and Jon C. Herron, Publisher: Pearson, 2013 (5th Edition)
3. Molecular Evolution: Wen-Hsiung Li, Publisher: Sinauer Associates, 1997
4. Phylogenetics: Theory and Practice of Phylogenetic Systematics, E.O. Wiley and Bruce S. Lieberman, Publisher: Wiley-Blackwell, 2011
5. Research Ethics: A Reader: Deni Elliott and Judy E. Stern, Publisher: University Press of New England: 1997
6. Scientific Integrity: Text and Cases in Responsible Conduct of Research: Francis L. Macrina Publisher: ASM Press, 2014 (4th Edition)
7. On Being a Scientist: A Guide to Responsible Conduct in Research, Publisher: National Academy of Sciences, 2009
8. Ethics in Science: Ethical Misconduct in Scientific Research: John M. Braxton Publisher: Routledge, 2014
9. Responsible Conduct of Research: Adil E. Shamoo and David B. Resnik, Publisher: Oxford University Press, 2015 (3rd Edition)

2. DISCIPLINE SPECIFIC COURSE (MAJOR 3)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	ECOTOURISM	USC4ZO7	THEORY :02

Course Objectives:

- To introduce the concept and principles of ecotourism and its role in conservation.
- To understand the ecological, economic, and social impacts of ecotourism.
- To develop skills for planning and managing sustainable ecotourism initiatives.

Course Outcomes:

- Demonstrate understanding of ecotourism principles and its significance in biodiversity conservation.
- Analyze the socio-economic and environmental impacts of ecotourism.
- Apply sustainable practices to develop and manage ecotourism ventures.

UNIT 1: Introduction to Ecotourism (15 lectures)

1. **Concept and Principles of Ecotourism:**
   - **a)** Definition and scope
   - **b)** Key principles of sustainable and responsible tourism
2. **Historical Perspectives and Evolution of Ecotourism:**
   - a) Early initiatives and case studies
   - b) Global and Indian contexts
3. **Types of Ecotourism:**
   - **a)** Wildlife-based, Adventure-based, Community-based, and Cultural Ecotourism
4. **Benefits and Challenges of Ecotourism:**
   - **a)** Economic, social, and environmental impacts
   - **b)** Conflict resolution and stakeholder involvement

UNIT 2: Ecotourism Planning and Management (15 lectures)

1. **Ecotourism Planning and Development:**
   - **a)** Site selection and assessment
   - **b)** Community involvement and participation
   - **c)** Infrastructure and resource management
2. **Sustainable Practices in Ecotourism:**
   - **a)** Waste management and eco-friendly practices
   - **b)** Conservation initiatives and habitat preservation
3. **Community Engagement and Capacity Building:**
   - **a)** Role of local communities in ecotourism
   - **b)** Skills development and employment generation
4. **Case Studies and Success Stories:**

a) Global and Indian ecotourism models (e.g., Kaziranga, Sundarbans, and Periyar)

b) Lessons learned and best practices

Reference Books:

1. Ecotourism: Principles and Practices: David A. Fennell, Publisher: Routledge: 2014 (3rd Edition)
2. Ecotourism and Sustainable Development: Who Owns Paradise?: Martha Honey Publisher: Island Press: 2008 (2nd Edition)
3. The Business of Ecotourism: Putting Practice into Theory: Carol Patterson
4. Publisher: Trafford Publishing: 2007
5. Sustainable Tourism: Theory and Practice: David Weaver Publisher: Routledge: 2006

DISCIPLINE SPECIFIC COURSE (MINOR)

(Students will select 1 in continuation of Sem. 2 minor)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	ECONOMIC ZOOLOGY	USC4ZOM	THEORY :02+ PRACTICAL :02

THEORY COURSE: ECONOMIC ZOOLOGY CREDITS: 2

Course Objectives:

- To understand the economic importance of various animal groups.
- To explore the role of animals in agriculture, industry, and human welfare.
- To develop skills to utilize economically important animals sustainably.

Course Outcomes:

- Identify economically significant animals and their contributions to human welfare.
- Explain the economic value of animal products and services.
- Apply knowledge for sustainable management and conservation of economically important species.

UNIT 1: Introduction to Economic Zoology (15 lectures)

1. **Fundamentals of Economic Zoology:**
   - **a)** Definition and scope of economic zoology
   - **b)** Historical perspective and significance
2. **Economically Important Invertebrates:**
   - **a)** Apiculture: Honey bees and their economic value
   - **b)** Sericulture: Silk production and its economic importance
   - **c)** Aquaculture: Edible molluscs, crustaceans, and their commercial significance
3. **Economically Important Vertebrates:**
   - **a)** Pisciculture: Fish farming and its economic impact
   - **b)** Poultry farming: Breeds, management, and productivity
   - **c)** Dairy farming: Cattle breeds, milk production, and by-products

UNIT 2: Applications and Emerging Trends (15 lectures)

1. **Animal Husbandry and Sustainable Practices:**
   - **a)** Breeding techniques and hybridization
   - **b)** Disease management and animal welfare **2. Wildlife Utilization and Conservation:**
   - **a)** Sustainable harvesting of wildlife resources

b) Role of wildlife tourism in economic development **3. Bioresources and By-products:**

a) Use of animal products and by-products in industries

b) Pharmaceutical and cosmetic applications of animal derivatives **4. Emerging Trends in Economic Zoology:**

a) Biotechnology in animal husbandry

b) Genetic improvement for enhanced productivity

Reference Books:

1. Ganga, G. & Chetty, J. – An Introduction to Sericulture (Oxford & IBH Publishing, 2010)
2. Vasantharaj David, B. & Kumaraswami, T. – Elements of Economic Entomology (Popular Book Depot, 2016)
3. Shukla, G.S. & Upadhyay, V.B. – Economic Zoology (Rastogi Publications, 2019)
4. Rathore, H.S. & Mathur, S. – Animal Husbandry and Dairy Science (Jain Brothers, 2017)
5. Jhingran, V.G. – Fish and Fisheries of India (Hindustan Publishing, 2006)
6. Banerjee, G.C. – A Textbook of Animal Husbandry (Oxford & IBH Publishing, 2018)
7. Pandey, B.N. & Shukla, J.P. – Applied and Economic Zoology (S. Chand Publishing, 2016)
8. Yadav, D.N. – Economic Zoology (CBS Publishers, 2020)
9. Sinha, R.K. & Sinha, K. – Aquaculture and Fisheries (Daya Publishing House, 2013)
10. Swarup, D. & Varshney, J.P. – Veterinary Clinical Diagnosis (International Book Distributing Co., 2015)

DISCIPLINE SPECIFIC COURSE PRACTICAL (MINOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	ECONOMIC ZOOLOGY	USC4ZOMP	PRACTICAL :02

Course Objectives

- Understand the economic importance of apiculture, sericulture, aquaculture, and poultry.
- Learn practical techniques in honey extraction, silk production, and fish disease management.
- Develop skills in analyzing animal-derived products and animal husbandry practices.

Course Outcomes

- Gain hands-on experience in beekeeping, silk production, and fish farming.
- Identify fish diseases, edible mollusks, crustaceans, and poultry breeds.
- Assess milk quality and analyze community perceptions of animal husbandry.

PRACTICALS **CREDITS: 2**

1. Identification of common honey bee species
2. Life history of honeybee and lac insect.
3. Quality analysis of different brands of honey
4. Study of Life history of silk worm *Bombyx mori*
5. Demonstration of Silk Production and Cocoon Processing
6. Demonstrate silk reeling
7. Different types of important edible fishes of India.
8. Study of Edible Molluscs and Crustaceans
9. Identify common fish diseases and its management practices
10. Observe symptoms in infected fish (fin rot, white spots, etc.).
11. To assess the quality of milk samples and Record density, pH,
12. Estimate the fat content of milk samples.
13. To study different poultry breeds and their productivity.
14. To identify and analyze animal-derived products.
15. Survey Project on Community Perception of Animal Husbandry

Reference Books:

1. Economic Zoology by Shukla and Upadhyay Publisher: Rastogi Publications, 2010
2. Animal Husbandry and Dairy Science by R. S. Chauhan, Publisher: CBS Publishers & Distributors, 2013
3. Applied and Economic Zoology by P. V. Jabde, Publisher: Discovery Publishing House, 2005
4. Economic Zoology by G. S. Shukla and V. B. Upadhyay, Publisher: Rastogi Publications, 2009
5. Aquaculture: Farming Aquatic Animals and Plants by John S. Lucas and Paul C. Southgate Publisher: Wiley-Blackwell, 2012

OPEN ELECTIVES COURSE FOR OTHER FACULTY STUDENTS
(SELELCT ANY ONE FROM THE OE LIST)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	WILDLIFE TOURISM AND ECO-ENTREPRENEURSHIP	UOE4WTEE	THEORY: 04

Course Objectives:

- To understand the principles and practices of wildlife tourism and its role in conservation.
- To develop entrepreneurial skills for promoting eco-friendly tourism ventures.
- To explore sustainable business models that balance tourism and conservation.

Course Outcomes:

- Demonstrate knowledge of wildlife tourism and its socio-economic and environmental impacts.
- Develop innovative strategies for eco-entrepreneurship in the wildlife tourism sector.
- Apply practical skills in planning, managing, and marketing sustainable tourism ventures.

Unit 1: Fundamentals of Wildlife Tourism **(15 lectures)**

1. Introduction to Wildlife Tourism:
   - **a)** Definition, scope, and significance.
   - **b)** Evolution and growth of wildlife tourism in India and globally.
   - **c)** Role of wildlife tourism in conservation and community welfare.
2. Types of Wildlife Tourism:
   - **a)** Safari tourism, birdwatching, marine tourism, and nature trails.
   - **b)** Adventure-based wildlife tourism and community-based tourism.
3. Wildlife Tourism Planning and Management:
   - **a)** Site selection, carrying capacity assessment, and visitor management.
   - **b)** Environmental impact analysis and mitigation strategies.
   - **c)** Case studies: Successful wildlife tourism models in India and abroad.

Unit 2: Legal, Policy, and Ethical Aspects **(15 lectures)**

1. **Legal and Policy Framework:**
   - **a)** Wildlife Protection Act (1972) and its amendments.
   - **b)** Guidelines and regulations for responsible wildlife tourism.
   - **c)** International conventions and protocols (CITES, CBD).
2. **Ethics in Wildlife Tourism:**
   - **a)** Ethical wildlife viewing practices.
   - **b)** Human- Animal conflicts
   - **c)** Addressing human-wildlife conflicts in tourism zones.
3. **Community Involvement and Benefits:**
   - **a)** Strategies for integrating local communities in tourism activities.
   - **b)** Revenue sharing models and community-driven conservation.

Unit 3: Eco-Entrepreneurship and Sustainable Tourism (15 lectures)

1. **Introduction to Eco-Entrepreneurship:**
   - **a)** Concept and importance of eco-friendly tourism ventures.
   - **b)** Role of eco-entrepreneurs in wildlife conservation.
   - **c)** Socio-economic and environmental benefits.
2. **Business Models and Strategies:**
   - a) Community-driven eco-tourism initiatives.
   - b) Developing sustainable business plans and feasibility studies.
   - c) Marketing and branding of wildlife tourism ventures.
3. **Emerging Trends and Challenges:**
   - a) Digital eco-tourism and virtual wildlife experiences.
   - b) Balancing tourism growth and biodiversity conservation.
   - c) Challenges in managing wildlife tourism in protected areas.

Unit 4: CASE STUDY (WILD LIFE TOURISM IN INDIA) (15 lectures)

Reference Books:

1. Wildlife Tourism: Impacts, Management, and Planning: David Newsome, Susan A. Moore, Ross K. Dowling *Publisher:* Channel View Publications, 2012
2. Eco-Entrepreneurship: Creating and Growing Green Businesses: Kristin Joos, *Publisher:* ABC-CLIO , 2011
3. Sustainable Tourism: Theory and Practice: David Weaver, *Publisher:* Routledge, 2006 **4.** Wildlife Tourism: A Strategic Destination Management Approach: Ralf Buckley, Publisher*:* CAB International, 2010
5. Community-based Tourism: Principles and Practices: Gianna Moscardo *Publisher:* CAB International, 2008
6. Tourism and Sustainability: Development, Globalisation and New Tourism in the Third World: Martin Mowforth, Ian Munt *Publisher:* Routledge, 2016
7. Ecotourism and Sustainable Development: Who Owns Paradise? Martha Honey, *Publisher:* Island Press, 2008
8. Wildlife Tourism and Conservation: Conflicts and Solutions *Editors:* Ronda L. Green, Peter J. S. Jones *Publisher:* CAB International, 2010
9. Nature-Based Tourism, Environment and Land Management: Ralf Buckley *Publisher:* CAB International, 2004
10. Tourism and Conservation: Sustainable Frameworks and Practices: Ralf Buckley, Anna Spenceley, *Publisher:* CAB International, 2011

Note – The practicals may be conducted by using specimens authorized by the wild life and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/simulations/ models etc. as recommended by the UGC and as envisaged in

the regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practical mentioned here-in above.

N.B:

I. It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II. Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

1. A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
2. A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)

ii) Two Senior Faculty Members of the concerned Department

iii) One Faculty of related department from the same College

iv) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

B.O.S. DATE: 15th February 2025 & 12th April 2025

B.O.S. ITEM NO.: 4

ACADEMIC COUNCIL DATE: 28th April 2025

ACADEMIC COUNCIL ITEM NO.: 3

Janardan Bhagat Shikshan Prasarak Sanstha's

Changu Kana Thakur Arts, Commerce and Science College,

New Panvel (Autonomous)

Re-accredited 'A++' Grade by NAAC (Fourth Cycle - 3.52 CGPA)

'College with Potential for Excellence' Status Awarded by University Grants Commission

'Best College Award' by University of Mumbai

DEPARTMENT OF ZOOLOGY

SYLLABUS FOR

Third Year Bachelor of Science

(T.Y.B.Sc.)

SEMESTER – V & VI

w.e.f. Academic Year 2025-2026

T.Y.B.Sc. ZOOLOGY SEMESTER – V

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	HAEMATOLOGY AND IMMUNOLOGY	USC5ZO1	THEORY :04
2	TOXICOLOGY AND ENZYMOLOGY	USC5ZO2	THEORY :04
3	PRACTICALS BASED ON MAJOR1& 2	USC5ZOP	PRACTICAL :02

B. DISCIPLINE SPECIFIC COURSE (ELECTIVES)

(Students will select any 1 out of 2)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	MEDICAL ZOOLOGY	USC5MP	THEORY: 03+ PRACTICAL: 01
2	NEUROSCIENCE	USC5NS	THEORY: 03+ PRACTICAL: 01

C. DISCIPLINE SPECIFIC COURSE (MINOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	PHARMACOLOGICAL ASPECT OF ZOOLOGY	USC5ZOM	THEORY :02+ PRACTICAL :02

D. VOCATIONAL SKILL COURSE

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	VALUE ADDED PRODUCTS OF ANIMAL	UVSC2VAP	PRACTICAL: 04

E. OJT/FP/CEP/RP

No. of Courses	TITLE OF THE COURSES	CREDITS
1	----------	----------

SEMESTER – VI

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	MOLECULAR BIOLOGY	USC6ZO1	THEORY :04
2	WILDLIFE CONSERVATION AND MANAGEMENT	USC6ZO2	THEORY :04
3	PRACTICALS BASED ON MAJOR 1 & 2	USC6ZOP	PRACTICAL :02

B. DISCIPLINE SPECIFIC COURSE (ELECTIVES)

(Students will select any 1 out of 2)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FORENSIC ZOOLOGY	USC6ZOFZ	THEORY :03+ PRACTICAL :01
2	NANOBIOLOGY	USC6ZONB	THEORY :03+ PRACTICAL :01

C. DISCIPLINE SPECIFIC COURSE (MINOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	BIOCHEMICAL BASIS OF ANIMAL PHYSIOLOGY	USC6ZOM	THEORY :02+ PRACTICAL :02

D. VOCATIONAL SKILL COURSE

No. of Courses	TITLE OF THE COURSES	CREDITS
D. VOCATIONAL SKILL COURSE		
1	--------	--------

E. OJT/FP/CEP/RP

No. of Courses	TITLE OF THE COURSES	CREDITS
E. ON JOB TRAINING		
1	ON JOB TRAINING	4 CREDITS

SYLLABUS FOR

Third Year Bachelor of Science

(T.Y.B.Sc.)

SEMESTER – V

SEMESTER – V

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

No. of Courses	TITLE OF THE COURSES	COURSE CREDIT	CREDITS
1	HAEMATOLOGY AND IMMUNOLOGY	USC5ZO1	THEORY :04

Course Objectives:

- To provide an in-depth understanding of blood components, their functions, and disorders.
- To explore the principles of immunology, immune responses, and immune-related diseases.
- To integrate theoretical knowledge with clinical and applied aspects of haematology and immunology.

Course Outcomes:

- Understand the structure, function, and formation of blood components.
- Comprehend key immunological principles, immune responses, and disease mechanisms.
- Apply immunological concepts to disease management, including autoimmune and immunodeficiency disorders.
- Gain insights into modern immunotherapies and vaccine development

Unit 1: Hematopoiesis and Blood Components (15 Lectures)

1. Structure and function of blood cells: Erythrocytes, leukocytes, and platelets.
2. Haematopoiesis: Stem cells, bone marrow, and differentiation pathways.
3. Plasma and serum: Composition and functions.
4. Haemoglobin: Structure, synthesis, and function.
5. Blood groups and transfusion biology: ABO and Rh system, compatibility testing.

Unit 2: Disorders of Blood and Hematological Techniques (15 Lectures)

1. Anaemia: Types, causes, and diagnosis.
2. Leukaemia and lymphoma: Pathophysiology and classification.
3. Coagulation disorders: Haemophilia, thrombosis, and anticoagulant therapy.
4. Laboratory techniques: Complete Blood Count (CBC), blood smear examination, and coagulation tests.

Unit 3: Fundamentals of Immunology (15 Lectures)

1. Innate and adaptive immunity: Components and mechanisms.
2. Antigens, antibodies, and antigen-antibody interactions.
3. Lymphoid organs: Bone marrow, thymus, spleen, and lymph nodes.

4. Major Histocompatibility Complex (MHC) and antigen presentation.
5. Immunological techniques: ELISA, flow cytometry, immunofluorescence.

Unit 4: Immune System in Health and Disease (15 Lectures)

1. Hypersensitivity reactions: Types I-IV and clinical relevance.
2. Autoimmune diseases: Mechanisms and examples (Rheumatoid arthritis, SLE).
3. Immunodeficiency disorders: Primary and secondary (AIDS, SCID).
4. Vaccines and immunotherapy: Types, development, and applications.
5. Cancer immunology: Tumor antigens and immunosurveillance.

Reference Books:

Haematology:

1. Hoffbrand, A. V., Moss, P. A. H., & Pettit, J. E. (2019). *Essential Haematology* (7th ed.). Wiley-Blackwell.
2. Rodak, B. F., Fritsma, G. A., & Doig, K. (2020). *Hematology: Clinical Principles and Applications* (5th ed.). Elsevier.
3. Wintrobe, M. M., Greer, J. P., & Arber, D. A. (2018). *Wintrobe's Clinical Hematology* (14th ed.). Wolters Kluwer.
4. Turgeon, M. L. (2017). *Clinical Hematology: Theory and Procedures* (6th ed.). Wolters Kluwer.
5. Bain, B. J. (2021). *Blood Cells: A Practical Guide* (6th ed.). Wiley-Blackwell.

Immunology:

1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2022). *Basic Immunology: Functions and Disorders of the Immune System* (6th ed.). Elsevier.
2. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2017). *Janeway's Immunobiology* (9th ed.). Garland Science.
3. Roitt, I. M., Brostoff, J., & Male, D. K. (2017). *Roitt's Essential Immunology* (13th ed.). Wiley-Blackwell.
4. Kindt, T. J., Goldsby, R. A., & Osborne, B. A. (2019). *Kuby Immunology* (8th ed.). W. H. Freeman.
5. Murphy, K., Weaver, C., & Berg, L. (2022). *Immunobiology* (10th ed.). Garland Science.

A. DISCIPLINE SPECIFIC COURSE (MAJOR-2)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
2	TOXICOLOGY AND ENZYMOLOGY	USC5ZO1	THEORY :04

Course Objectives:

- To provide fundamental knowledge of toxicology and its significance in environmental and human health.
- To understand the biochemical and molecular aspects of enzyme function.
- To explore the mechanisms of toxicity, detoxification pathways, and enzyme kinetics. ***Course Outcomes:***
- Know the fundamental principles of toxicology and its relevance to human and environmental health.
- Identify different types of toxicants and understand their effects on biological systems.
- Describe the biochemical pathways of xenobiotic metabolism and detoxification.

Unit 1: Fundamentals of Toxicology (15 Lectures)

1. Introduction to toxicology: Scope and historical perspectives.
2. Types of toxicants: Chemical, biological, and environmental toxins.
3. Dose-response relationship and toxicity testing.
4. Absorption, distribution, metabolism, and excretion (ADME) of toxicants.
5. Toxic effects on major organ systems (liver, kidney, nervous system).

Unit 2: Mechanisms of Toxicity and Detoxification (15 Lectures)

1. Mechanisms of toxic action: Oxidative stress, enzyme inhibition, and receptormediated toxicity.
2. Biotransformation of xenobiotics: Phase I (oxidation, reduction, hydrolysis) and Phase II (conjugation) reactions.
3. Role of cytochrome P450 in detoxification.
4. Carcinogenicity and mutagenicity of toxicants.
5. Ecotoxicology: Impact of pollutants on ecosystems.

Unit 3: Basics of Enzymology (15 Lectures)

1. Introduction to enzymes: Classification, structure, and function.
2. Enzyme kinetics: Michaelis-Menten equation and Lineweaver-Burk plot.
3. Factors affecting enzyme activity: pH, temperature, substrate concentration.

4. Enzyme inhibition: Competitive, non-competitive, and uncompetitive inhibition.
5. Coenzymes and cofactors in enzymatic reactions.

Unit 4: Applied Enzymology and Toxicology (15 Lectures)

1 Industrial and medical applications of enzymes.
2 Enzymes in drug metabolism and toxicity assessment.
3 Biomarkers of toxicity: Enzymatic and non-enzymatic indicators.
4 Antidotes and therapeutic approaches in toxicology.
5 Biotechnological advancements in enzymology and toxicology

REFERENCE BOOKS:

Toxicology

1. Casarett, L. J., Klaassen, C. D., & Amdur, M. O. (2019). Casarett & Doull's Toxicology: The Basic Science of Poisons (9th ed.). McGraw-Hill.
2. Timbrell, J. (2020). Principles of Biochemical Toxicology (5th ed.). Taylor & Francis.
3. Hayes, A. W. (2019). Principles and Methods of Toxicology (6th ed.). CRC Press.
4. Hodgson, E. (2012). A Textbook of Modern Toxicology (4th ed.). Wiley-Blackwell.
5. Wright, J. (2017). Environmental Toxicology (3rd ed.). Cambridge University Press.

Enzymology

1. Palmer, T., & Bonner, P. L. (2011). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2nd ed.). Woodhead Publishing.
2. Price, N. C., & Stevens, L. (2013). Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins (3rd ed.). Oxford University Press.
3. Copeland, R. A. (2000). Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis (2nd ed.). Wiley-VCH.
4. Voet, D., Voet, J. G., & Pratt, C. W. (2018). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.
5. Fersht, A. (2017). Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding (2nd ed.). W. H. Freeman.

DISCIPLINE SPECIFIC PRACTICAL COURSE (MAJOR)			
No. of Courses	**TITLE OF THE COURSES**	**COURSE CODE**	**CREDITS**
3	**PRACTICALS BASED ON MAJOR1& 2)**	**USC5ZOP**	**PRACTICAL :02**

PRACTICALS BASED ON HAEMATOLOGY, IMMUNOLOGY, TOXICOLOGY AND ENZYMOLOGY

PRACTICALS

1. Preparation of Blood Smear and Identification of Blood Cells
2. To determine the total number of red blood cells using a haemocytometer.
3. To estimate the total number of white blood cells in blood samples.
4. To identify different types of WBCs using stained blood smears.
5. To measure the rate of RBC sedimentation as an indicator of inflammation. (Erythrocyte Sedimentation Rate (ESR))
6. To estimate the hemoglobin concentration in human blood using Sahli's method.
7. To identify ABO and Rh blood groups using antigen-antibody interactions.
8. Demonstration – To detect antigen or antibody presence using enzyme-substrate reactions-ELISA (Enzyme-Linked Immunosorbent Assay)
9. Study of LC50 Using Daphnia/Fish.
10. To study the inhibition of enzymes like catalase or cholinesterase by toxicants.
11. To evaluate acute toxicity of pollutants using brine shrimp larvae.
12. Histopathological observation of permanent slides/ Microphotograph: Study of Liver/Kidney /gills damage due to Toxicants.
13. Study of Salivary amylase activity at different pH values using buffer solutions.
14. Determination of optimum temperature and thermal stability of an enzyme.
15. To quantify the protein concentration in a given sample using colorimetric assays
16. Demonstration of enzyme immobilization using alginate beads and assessment of activity.

Reference books:

Haematology:

1. Practical Haematology by Sir John V. Dacie and S.M. Lewis, *Publisher:* Churchill Livingstone, 2016
2. Clinical Hematology: Theory and Procedures by Mary Louise Turgeon*Publisher:* Wolters Kluwer Health, 2017
3. Textbook of Medical Laboratory Technology by Praful B. Godkar,*Publisher:* Bhalani Publishing House, 2014

Immunology:

1. Kuby Immunology by Judith A. Owen, Jenni Punt, and Sharon A. Stranford *Publisher:* W.H. Freeman, 2018
2. Essential Immunology by Ivan M. Roitt and Peter J. Delves, *Publisher:* Wiley-Blackwell

Toxicology:

1. Casarett and Doull's Toxicology: The Basic Science of Poisons by Curtis Klaassen, *Publisher:* McGraw-Hill Education, 2019
2. Principles of Toxicology: Environmental and Industrial Applications by Stephen M. Roberts and Phillip L. Williams *Publisher:* Wiley, 2015
3. A Textbook of Modern Toxicology by Ernest Hodgson, *Publisher:* Wiley, 2010

Enzymology:

1. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins by Nicholas C. Price and Lewis Stevens *Publisher:* Oxford University Press, 1999
2. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer, *Publisher:* Woodhead Publishing, 2001
3. Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems by Irwin H. Segel, *Publisher:* Wiley Classics Library, 1993

B. DISCIPLINE SPECIFIC COURSE (ELECTIVES 1) (Students will select any 1 out of 2)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	MEDICAL ZOOLOGY	USC5MZ	THEORY :03+ PRACTICAL :01

Course Objectives:

- To understand the biology, morphology, and life cycles of medically important parasites and vectors.
- To study the epidemiology and pathogenesis of zoonotic and vector-borne diseases.
- To explore diagnostic, preventive, and control measures for parasitic and vector-borne infections.

Course Outcomes:

- Demonstrate knowledge of the biology and classification of medically significant parasites.
- Analyze the impact of parasitic and vector-borne diseases on public health.
- Apply knowledge of control strategies for disease prevention and management.

Unit 1: Introduction to Medical Zoology and Parasitology (15 Lectures)

a) Introduction to Medical Zoology: Scope, significance, and applications.
b) Parasites and Host-Parasite Relationships: Definitions, types, and examples.
c) Classification of Parasites: Protozoa, helminths, and arthropods.
d) Life Cycles and Transmission: Malaria, Filariasis, Leishmaniasis, and Schistosomiasis.

Unit 2: Vector Biology and Disease Transmission (15 Lectures)

a) Introduction to Medical Entomology: Role of vectors in disease transmission.
b) Major Vector Groups: Mosquitoes, ticks, fleas, lice, and sandflies.
c) Vector-Borne Diseases: Dengue, Chikungunya, Zika, Japanese Encephalitis, COVID and GBV.
d) Vector Control Strategies: Biological, chemical, and environmental management.
e) Emerging and Re-emerging Vector-Borne Diseases: Climate change and disease dynamics.

Unit 3: Diagnostic Techniques and Control Measures (15 Lectures)

a) Diagnosis of Parasitic Infections: Microscopic, serological, and molecular techniques.
b) Principles of Disease Control: Integrated vector management (IVM) and mass drug administration (MDA).
c) Vaccines and Chemotherapy: Recent advancements and challenges.
d) Zoonotic Infections and One Health Approach: Bridging human, animal, and environmental health.
e) Epidemiology and Public Health Impact: Prevalence, distribution, and socioeconomic implications.

Reference Books:

1. "Parasitology: Protozoology and Helminthology" by K.D. Chatterjee, 13th Edition, published in 2017 by CBS Publishers & Distributors Pvt Ltd, India.
2. "Textbook of Medical Parasitology" by P. Chakraborty, 3rd Edition, published in 2016 by NCBA.
3. "Medical Entomology for Students" by Mike Service, 5th Edition, published in 2012 by Cambridge University Press.
4. "Paniker's Textbook of Medical Parasitology" by Sougata Ghosh, 8th Edition, published in 2017 by Jaypee Brothers Medical Publishers.
5. "Park's Textbook of Preventive and Social Medicine" by K. Park, 26th Edition, published in 2021 by Banarsidas Bhanot Publishers.
6. "Medical Parasitology" by D.R. Arora and B. Arora, 2nd Edition, published in 2007 by CBS Publishers & Distributors

PRACTICALS BASED ON DISCIPLINE SPECIFIC COURSE (ELECTIVES 1)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	MEDICAL ZOOLOGY	USC5MZP	PRACTICAL :01

Course Objectives:

- To develop skills in identifying and studying the morphology, life cycles, and pathogenic effects of medically important parasites and their vectors.
- To train students in microscopic diagnostic techniques and histopathological observations of parasite-induced infections.
- To promote field-based learning and data interpretation related to vector prevalence, distribution, and disease management strategies.

Course Outcomes:

Upon successful completion of the practical course, students will be able to:

- Accurately identify parasites and vectors of medical importance through slide observation and morphological features.
- Demonstrate basic diagnostic techniques, such as blood smear examination, and analyze histopathological changes caused by parasitic infections.
- Conduct field surveys, analyze epidemiological data, and interpret the spread and control strategies for vector-borne diseases.

PRACTICALS

1. To identify and study the morphology of medically significant parasites using permanent slides. (Plasmodium, Trypanosoma, Leishmania, and Schistosoma.)
2. To study the morphological characteristics of important vectors like mosquitoes, ticks, and lice.
3. To study the life cycle patterns of parasites like Plasmodium and Wuchereria
4. To detect parasitic infections (e.g., malaria) in blood smears.
5. To study histopathological changes in tissues caused by parasitic infections through microscopic observation of stained tissue sections.
6. To prepare charts for the prevalence and distribution of vector-borne diseases.
7. To conduct a field survey to record vector prevalence and habitat characteristics.
8. Case Study Analysis on Vector-Borne Diseases: To analyze the epidemiological data and management strategies for a specific disease (e.g., Dengue).

REFERENCE BOOKS:

1. "Foundations of Parasitology" by Larry S. Roberts and John Janovy Jr. *Publisher:* McGrawHill Education, 2012
2. "Medical Entomology for Students" by Mike Service, *Publisher:* Cambridge University Press, 2012

3. "Diagnostic Parasitology for Veterinary Technicians" by Charles M. Hendrix and Ed Robinson, *Publisher:* Elsevier Health Sciences, 2016.
4. "Essentials of Medical Parasitology" by Apurba Sankar Sastry and Sandhya Bhat Pu*blisher:* Jaypee Brothers Medical Publishers, 2021
5. "Vector-Borne Diseases: Understanding the Environmental, Human Health, and Ecological Connections" by Institute of Medicine, *Publisher:* National Academies Press, 2008
6. "Atlas of Human Parasitology" by Lawrence R. Ash and Thomas C. Orihel, *Publisher:* American Society of Clinical Pathology, 2007
7. "Medical Parasitology: A Practical Approach" by R. Paniker *Publisher:* Jaypee Brothers Medical Publishers, 2017

B. DISCIPLINE SPECIFIC COURSE (ELECTIVES) (Students will select any 1 out of 2)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
2	NEUROSCIENCE	USC5ZOP	THEORY :03+ PRACTICAL :01

Course objectives:

- Understand the nervous system and its functions.
- Develop treatments for neurological disorders.
- Enhance cognitive health and neurotechnology.

Course outcomes:

- Understand the structure of brain and improved methods to study it.
- Understand the neurodegenerative diseases (such as Alzheimer's and Parkinson's diseases) and mental illnesses.
- Understand the structure of different lobes of the brain and their corresponding functions.

Unit 1: Introduction to Neuroscience and Neural Structure (15 Lectures)

1. History and scope of neuroscience
2. Organization of the nervous system: Central Nervous System (CNS) and Peripheral Nervous System (PNS)
3. Types of neurons and glial cells
4. Structure of a neuron: axons, dendrites, synapses
5. Resting membrane potential and the action potential
6. Neurotransmitters and synaptic transmission

Unit 2: Brain and Spinal Cord – Diversity in Animals (15 Lectures)

1. General organization of the nervous system
2. Invertebrate nervous system: Neuronal organization in brain and ganglia (Hydra, Starfish, Earthworm)
3. Functional organization of the human CNS: Spinal cord, medulla, pons, cerebellum, midbrain, diencephalon, and cerebral hemispheres
4. Brain lobes: Forebrain, midbrain, and hindbrain with their functional significance

Unit 3: Higher Brain Functions and Neural Disorders (15 Lectures)

1. Brain regions involved in learning and memory
2. Introduction to neuroplasticity and neural circuits
3. Basics of emotion and behavior – the limbic system
4. Neurological and psychiatric disorders: Alzheimer's disease, Parkinson's disease, depression, schizophrenia

Reference Books:

1. "Textbook of Neuroanatomy" by Inderbir Singh Publisher: Jaypee Brothers Medical Publishers, 2014 (9th Edition)
2. "Essentials of Medical Physiology" by K. Sembulingam & Prema Sembulingam Publisher: Jaypee Brothers Medical Publishers, 2021 (9th Edition)
3. "Textbook of Medical Physiology" by A.K. Jain, Publisher: Avichal Publishing Company, 2019
4. "Neuroanatomy for Medical Students" by Pritha S Bhuiyan, Publisher: CBS Publishers & Distributors, 2022
5. "Neurophysiology "by M.S. Vishnu Madhav, Publisher: Paras Medical Publishers, 2017
6. "Principles of Neural Science" Editors: Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, Steven A. Siegelbaum, and A.J. Hudspeth, Publisher: McGraw-Hill Publication, 2012 (5th Edition)
7. "Neurobiology": Gordon M. Shepherd Publisher: Oxford University Press, 1994
8. Developmental Neurobiology": Mahendra S. Rao and Marcus Jacobson Publisher: Kluwer Academic/Plenum Publishers, 2005 (4th Edition)

A. DISCIPLINE SPECIFIC PRACTICAL COURSE (ELECTIVES 2)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
2	NEUROSCIENCE	USC5ZOP	THEORY :03+ PRACTICAL :01

Course Objectives:

- To introduce the fundamental structure and functions of the nervous system, with emphasis on neurons, synapses, and neurotransmission.
- To explore the diversity of nervous systems across animal phyla and understand the functional anatomy of the human brain and spinal cord.
- To develop foundational knowledge of higher brain functions, neuroplasticity, and neurological disorders through theoretical and practical exposure.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Describe the organization and working of the nervous system at the cellular and systemic levels.
- Compare neural structures across species and identify major regions of the human central nervous system with their functions.
- Demonstrate understanding of basic neurological processes, recognize common brain disorders, and interpret their functional implications.

PRACTICAL

1. Demonstration of Human Brain and Spinal Cord Models
2. Study of Neuron Structure (Permanent Slides/Charts/Models/Virtual Lab)
3. Microscopic Study of Nervous Tissue
4. Study of Nervous Systems in Invertebrates (Charts/Models/Virtual Labs):
    - **a)** Hydra,
    - **b)** Starfish
    - **c)** Earthworm
    - **d)** Cockroach
5. Study of Nervous Systems in Vertebrates (Charts/Models/Virtual Labs):
    - **a)** Fish
    - **b)** Frog
    - **c)** Human
6. Observation of Brain Lobes and Functions through Simulations(V- LAB)
7. Case Studies/Video Analysis of Neurological Disorders
    - Alzheimer's, Parkinson's, Schizophrenia – symptoms, causes, treatments
8. Presentation: Students present short reports on any one brain disorder or neuroscience discovery

C. DISCIPLINE SPECIFIC COURSE (MINOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	PHARMACOLOGICAL ASPECT OF ZOOLOGY	USC5ZOM	THEORY:02 + PRACTICAL: 02

Course Objectives:

- To understand the fundamental principles of pharmacology, including drug action, metabolism, and administration.
- To explore the role of pharmacology in zoology, including drug effects on different species, wildlife management, and environmental impact.

Course Outcomes:

- Students will gain knowledge of pharmacokinetics, pharmacodynamics, and factors affecting drug action across species.
- Students will develop an understanding of zoological models in drug testing, the therapeutic potential of animal-derived compounds, and ethical considerations in pharmacology.

Unit 1: Basics of Pharmacology (15 Lectures)

a) Introduction to Pharmacology: Definition, scope, and historical background

b) Pharmacokinetics: Absorption, distribution, metabolism, and excretion (ADME)

c) Pharmacodynamics: Mechanism of drug action, receptors, and signal transduction

d) Dose-Response Relationship: Therapeutic index, potency, and efficacy

e) Routes of Drug Administration: Oral, intravenous, intramuscular, and topical

f) Factors Affecting Drug Action: Species differences, age, sex, genetics, and environmental factors

Unit 2: Pharmacology with Reference to Zoology (15 Lectures)

1. **Comparative Pharmacology:** Differences in drug action among invertebrates and vertebrates
2. **Zoological Models in Pharmacology:** Use of animals like mice, rats, rabbits, and zebrafish in drug testing
3. **Pharmacological Agents from Zoological Sources:**
   - **a.** Animal toxins and venoms as potential therapeutic agents
   - **b.** Bioactive compounds derived from marine and terrestrial animals
4. **Wildlife Pharmacology:**
   - **a.** Anesthesia and tranquilization in wildlife management
   - **b.** Drug use in conservation and rehabilitation practices
5. **Environmental Pharmacology:**
   - **a.** Impact of pharmaceuticals and pesticides on wildlife
   - **b.** Case studies on bioaccumulation and biomagnification of drugs in aquatic and terrestrial ecosystems

6. **Ethical Considerations in Zoological Pharmacology:** Guidelines for animal experimentation and welfare.

Reference Books:

1. Essentials of Medical Pharmacology – K.D. Tripathi, Jaypee Brothers Medical Publishers, 2021
2. Textbook of Pharmacology – S.D. Seth, Elsevier India, 2018
3. Pharmacology and Toxicology – V.S. Sharma, CBS Publishers, 2017
4. Environmental Toxicology and Pharmacology – K. Murugesan & A. Ramesh, CRC Press, 2019
5. Comparative Pharmacology for Veterinary Sciences – P. Dey & A.K. Gupta, New India Publishing, 2020
6. Animal Toxins and Venoms: Pharmacological Perspectives – R. Kumar & P. Singh, Springer, 2018
7. Wildlife Pharmacology and Conservation Medicine – S. Chakraborty, Narosa Publishing, 2016.

C. PRACTICAL BASED ON DISCIPLINE SPECIFIC COURSE (MINOR)

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	PHARMACOLOGICAL ASPECT OF ZOOLOGY	USC5ZOMP	PRACTICAL :02

Course Objectives:

- To familiarize students with drug administration techniques, safety protocols, and ethical considerations in pharmacological studies.
- To analyze the physiological and behavioral effects of drugs and toxicants using zoological models.

Course Outcomes:

- Students will gain hands-on experience in pharmacological experiments, including drug administration and toxicity assessment.
- Students will develop analytical skills to evaluate drug effects, toxicity levels, and environmental impacts on model organisms.

PRACTICALS

1. Use simple methods (e.g., aqueous or ethanol extraction) to prepare crude extracts from plants used in animal self-medication.
2. Demonstration of oral, intramuscular, and intravenous drug administration in model organisms (e.g., mice or rats). (V- Lab.)
3. Select common plants (e.g., turmeric, neem, tulsi) and compare their uses in humans and reported animal usage
4. Safety measures and ethical considerations while handling animals.
5. Study the effect of stimulants (e.g., adrenaline) and depressants (e.g., propranolol) on the heart rate of Daphnia.
6. Calculation of the median lethal dose (LD50) using suitable invertebrate models (e.g., earthworms or cockroaches).
7. Study the impact of pollutants (e.g., pesticides) on fish gill movement.
8. Monitor behavioral and physiological changes (e.g., respiration rate, movement patterns) in fish aquarium fish.
9. Case studies of self-medication in animals (e.g., chimpanzees, elephants, birds)

REFERENCE BOOKS:

1. Essentials of Medical Pharmacology – K.D. Tripathi, Jaypee Brothers Medical Publishers, 2021
2. Textbook of Pharmacology – S.D. Seth, Elsevier India, 2018
3. Pharmacology and Toxicology – V.S. Sharma, CBS Publishers, 2017
4. Principles of Animal Pharmacology – H.P. Rang, Churchill Livingstone, 2020
5. Environmental Toxicology and Pharmacology – K. Murugesan & A. Ramesh, CRC Press, 2019
6. Comparative Pharmacology and Toxicology in Animals – P. Dey & A.K. Gupta, New India Publishing, 2020
7. Experimental Pharmacology for Undergraduate Students – N. Gopal, Narosa Publishing, 2016

D. VOCATIONAL SKILL COURSE

No. of Courses	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	VALUE ADDED PRODUCTS OF ANIMAL	UVSC2VAPA	PRACTICAL: 04

PRACTICALS

1. Study of morphological features of Apis dorsata, Apis mellifera, Apis cerana, and Apis florea using preserved specimens, images, or models.
2. Identification and comparison of queen, worker, and drone bees through charts or preserved samples.
3. Identification of Silkworm Varieties and Life Cycle Stages.
4. Study of Silkworm Mounting and Cocoon Formation.
5. Study of Rearing Techniques of Mulberry Silkworm (*Bombyx mori*).
6. Demonstration of Basic reeling from fresh cocoons using charkha or cottage basin method.
7. To prepare paneer from milk using coagulating agents.
8. To produce yogurt and evaluate its consistency and acidity.
9. To formulate a health drink using honey and natural additives.
10. To extract chitosan from fish scales.
11. Demonstration of salted-dried fish by dry salting, wet salting and mixed salting.
12. Preparation of Prawn (*Acetus indicus*) Chutney
13. Preparation of fish/ prawn pickle
14. Preparation of fish cutlet
15. Demonstration of icing methods in fish preservation.
16. Demonstration of cleaning and disinfection of processing materials.
17. Fish meal production.
18. Fish soup and curry production.
19. Identification of fish parasites by using charts
20. Visit to fish processing/ Dairy / Sericulture unit

Reference Books

1. Santra, S.C. (2010) *A Textbook of Apiculture* New Central Book Agency, Kolkata. Goyal, G.K. & Sharma, M.C. (2002) *Beekeeping in India* Indian Council of Agricultural Research (ICAR), New Delhi.
2. Root, A.I. (Revised Edition 2018) *ABC and XYZ of Bee Culture* The A.I. Root Company, Ohio, USA.
3. Mishra, R.C. (1995) *Handbook of Apiculture,* Indian Council of Agricultural Research (ICAR), New Delhi.
4. Sharma, K.K. & Saini, P.S. (2016) *Practical Manual of Apiculture* AgroBios (India), Jodhpur.
5. Gopakumar, K. (2002) Textbook of Fish Processing Technology, ICAR-Central Institute of Fisheries Technology, Cochin.
6. Balachandran, K.K. (2001), Post-Harvest Technology of Fish and Fish Products, Daya Publishing House, New Delhi.
7. Sen, D.P. (2005) Advances in Fish Processing Technology, Allied Publishers Pvt. Ltd., New Delhi.
8. George, M. & Koshy, M. (2016), Fishery Products Technology, Narendra Publishing House, Delhi.
9. Bardach, J.E., Ryther, J.H., & McLarney, W.O. (1972), Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms, Wiley-Interscience, New York.
10. Sukumar De (2001), Outlines of Dairy Technology, Oxford University Press, New Delhi.
11. Neelam Khetarpaul (2015), Milk and Milk Products, Daya Publishing House, New Delhi.
12. Early, R. (1998) Technology of Dairy Products, Springer Science & Business Media.
13. Rao, K. & Rajorhia, G.S. (2000), Dairy India – 6th Edition, Dairy India Yearbook Publications, New Delhi.
14. Walstra, P., Wouters, J.T.M., & Geurts, T.J. (2006), Dairy Science and Technology CRC Press, Boca Raton.
15. Webb, B.H., Johnson, A.H., & Alford, J.A. (1974), Fundamentals of Dairy Chemistry, AVI Publishing Co., Westport, Connecticut.
16. Singh, R.R.B. (2013), Textbook on Milk and Milk Products, International Book Distributing Co., Lucknow
17. Gopakumar, K. (2002), Textbook of Fish Processing Technology, ICAR-Central Institute of Fisheries Technology, Cochin.
18. Balachandran, K.K. (2001), Post-Harvest Technology of Fish and Fish Products, Daya Publishing House, New Delhi.
19. Sen, D.P. (2005), Advances in Fish Processing Technology Allied Publishers Pvt. Ltd., New Delhi.
20. George, M. & Koshy, M. (2016), Fishery Products Technology, Narendra Publishing House, New Delhi.
21. Rathore, D.S. & Verma, S.R. (1992), Freshwater Fish and Fisheries in India, Hindustan Publishing Corporation, New Delhi.

SYLLABUS DRAFT FOR

Third Year Bachelor of Science

(T.Y.B.Sc.)

SEMESTER – VI

SEMESTER – VI

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	MOLECULAR BIOLOGY	USC6ZO1	THEORY :04

Course Objectives:

- To understand the structure, function, and replication of nucleic acids and their role in gene expression.
- To explore the genetic code, protein synthesis, and post-translational modifications in prokaryotes and eukaryotes.
- To introduce recombinant DNA technology, gene cloning, and their applications in biotechnology, medicine, and agriculture.

Course Outcomes:

- Students will gain conceptual and practical knowledge of molecular biology processes, including DNA replication, transcription, and translation.
- Students will be able to explain gene regulation mechanisms, protein folding, and the impact of mutations on genetic functions.
- Students will develop hands-on skills in recombinant DNA technology, molecular cloning, and genome analysis.

Unit 1: Fundamentals of Molecular Biology (15 Lectures)

a) Structure and function of nucleic acids: DNA & RNA

b) DNA replication: Enzymes, mechanisms, and models (Semi-conservative, Rolling circle)

c) Transcription: Prokaryotic vs. Eukaryotic mechanisms, RNA polymerase, posttranscriptional modifications

d) Regulation of gene expression: Operon concept (Lac, Trp), epigenetic modifications.

Unit 2: Genetic Code and Protein Synthesis (15 Lectures)

a) Genetic code: Characteristics, Wobble hypothesis, mutations, codon usage

b) Translation: Mechanisms in prokaryotes & eukaryotes, ribosome structure, tRNA charging

c) Post-translational modifications and protein targeting

Unit 3: Recombinant DNA Technology and Genomics (15 Lectures)

a) Tools of genetic engineering: Restriction enzymes, cloning vectors, PCR

b) Gene cloning: Methods, transformation, and selection techniques

c) Applications of recombinant DNA technology in medicine, agriculture, and industry

d) Introduction to genomics and proteomics: Whole genome sequencing, bioinformatics basics

Unit 4: Molecular Techniques and Applications (15 Lectures)

a) DNA extraction and electrophoresis techniques

b) Blotting techniques: Southern, Northern, and Western blotting

c) Molecular diagnostics: DNA fingerprinting, microarrays, and applications in forensic science

REFERENCE BOOKS:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2017). Molecular Biology of the Gene (7th ed.). Pearson.
3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., & Amon, A. (2021). Molecular Cell Biology (9th ed.). W. H. Freeman.
4. Karp, G. (2018). Cell and Molecular Biology: Concepts and Experiments (8th ed.). Wiley.
5. Malacinski, G. M. (2002). Essential Molecular Biology (2nd ed.). Jones & Bartlett Learning. **6.** Brown, T. A. (2010). Gene Cloning and DNA Analysis: An Introduction (6th ed.). WileyBlackwell.
7. Primrose, S. B., Twyman, R. M., & Old, R. W. (2001). Principles of Gene Manipulation (6th ed.). Wiley-Blackwell.
8. Nelson, D. L., & Cox, M. M. (2021). Leininger Principles of Biochemistry (8th ed.). W. H. Freeman.
9. Clark, D. P., & Pazdernik, N. J. (2019). Molecular Biology (3rd ed.). Academic Press.
10. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2017). Lewin's Genes XII. Jones & Bartlett Learning.

A. DISCIPLINE SPECIFIC COURSE (MAJOR)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
2	**WILDLIFE CONSERVATION AND MANAGEMENT**	**USC6ZO2**	**THEORY :04**

Course Objectives:

- Understand wildlife conservation principles, threats, and management strategies.
- Learn practical techniques like population estimation, habitat restoration, and conflict mitigation.
- Explore wildlife laws, global conservation policies, and sustainable eco-tourism approaches.

Course Outcomes:

- Gain knowledge of conservation strategies and ecological balance.
- Develop skills in wildlife assessment, GIS, and conflict management.
- Understand laws, sustainability, and entrepreneurial opportunities in biodiversity conservation.

Unit 1: Introduction to Wildlife Conservation (15 Lectures)

a) Concept and significance of wildlife conservation.

b) Biodiversity hotspots and endemic species of India.

c) Causes of wildlife depletion: Habitat loss, poaching, climate change, urbanization.

d) Conservation strategies: In-situ (National Parks, Sanctuaries, Biosphere Reserves) & Ex-situ (Zoos, Gene Banks, Captive Breeding)

Unit 2: Wildlife Management Techniques (15 Lectures)

a) Population estimation methods: Census techniques (Direct & Indirect)

b) Habitat management: Carrying capacity, waterholes, corridors, afforestation

c) Role of Geographic Information System (GIS) & Remote Sensing in wildlife management

d) Human-wildlife conflict: Causes, mitigation strategies, and case studies

Unit 3: Wildlife Protection Laws and Policies (15 Lectures)

a) Wildlife Protection Act, 1972: Important provisions & amendments

b) International conservation efforts: CITES, IUCN, Ramsar Convention, CBD

c) Role of government and non-government organizations in conservation (WII, BNHS, WWF, NTCA)

d) Eco-tourism and community participation in conservation

Unit 4: Sustainable Wildlife Conservation and Entrepreneurship (15 Lectures)

a) Role of traditional ecological knowledge in wildlife conservation

b) Sustainable utilization of wildlife resources: Eco-friendly livelihood models

c) Conservation education and awareness programs

d) Emerging career opportunities in wildlife conservation and management

Reference Books:

1. Wildlife Ecology, Conservation, and Management – Anthony R.E. Sinclair, John M. Fryxell & Graeme Caughley, Wiley-Blackwell, 2006
2. Principles of Conservation Biology – Martha J. Groom, Gary K. Meffe & C. Ronald Carroll, Sinauer Associates, 2006
3. Essentials of Conservation Biology – Richard B. Primack, Oxford University Press, 2018
4. Wildlife Conservation in India – A.K. Ghosh, APH Publishing, 2008
5. Indian Wildlife Protection Act, 1972 (With Amendments) – Ministry of Environment, Forest & Climate Change, Government of India
6. The Biology and Conservation of Wild Felids – David Macdonald & Andrew Loveridge, Oxford University Press, 2010
7. Wildlife Ecology and Management – Eric G. Bolen & William Robinson, Pearson, 2002
8. Techniques for Wildlife Investigations and Management – Nova J. Silvy, Johns Hopkins University Press, 2012
9. Handbook of Wildlife Techniques and Management – S. Sathyakumar & A. Bashir, Zoological Survey of India, 2010
10. Wildlife Wealth of India – Asad R. Rahmani, BNHS, 2012
11. Mammals of South Asia – A.J.T. Johnsingh & Nima Manjrekar, Universities Press, 2013 **12.** Measuring and Monitoring Biological Diversity: Standard Methods for Mammals – Don E. Wilson, Russell A. Mittermeier & Richard C. Bruce, Smithsonian Institution Press, 1996
13. Applied Ecology and Environmental Management – Edward I. Newman, Blackwell Publishing, 2008
14. Fauna of India (Series) – Zoological Survey of India (ZSI), Various Years
15. Birds of the Indian Subcontinent – Richard Grimmett, Carol Inskipp & Tim Inskipp, Oxford University Press, 2011

PRACTICALS BASED ON DISCIPLINE SPECIFIC COURSE (MAJOR)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
3	PRACTICALS BASED ON MAJOR 1& 2	USC6ZOP	PRACTICAL :02

Course Objectives:

- Develop hands-on skills in molecular biology and wildlife conservation techniques.
- Understand the practical applications of molecular and ecological tools in research.
- Apply experimental methods to analyze genetic materials and assess wildlife populations.

Course Outcomes:

- Perform molecular biology experiments for DNA, RNA, and protein analysis.
- Use ecological methods for wildlife monitoring, conservation, and habitat assessment.
- Integrate laboratory and field techniques for biodiversity conservation research.

PRACTICALS

1. Preparation of solutions, buffers, and reagents.
2. Extraction of proteins from cells and tissues.
3. Preparation of Buffer stocks (TBE, TE and TAE).
4. Study of laboratory instruments (e.g., centrifuges, spectrophotometers).
5. Preparation of ball and stick model for B-DNA molecule (A=T and G=C base pairs).
6. Quantitative estimation of DNA by diphenylamine reaction using colorimeter.
7. Quantitative estimation of RNA by orcinol method using colorimeter.
8. Separation of Genomic DNA by Agarose Gel Electrophoresis.
9. To assess the habitat suitability for wildlife by analyzing the vegetation structure and composition.
10. Analyzing water quality and availability, as well as the surrounding habitat, to determine its suitability for wildlife.
11. To study the types of birds nesting (Photographs / Videos).
12. To study bird diversity in a specific area.
13. Field Visit.

REFERENCE BOOKS:

Molecular Biology-Based Experiments

1. A Laboratory Manual – Michael R. Green & Joseph Sambrook, Cold Spring Harbor Laboratory Press, 2012

2. Principles and Techniques of Biochemistry and Molecular Biology – Keith Wilson & John Walker, Cambridge University Press, 2018
3. Molecular Biology: Principles and Practice – Michael M. Cox, Jennifer Doudna & Michael O'Donnell, W.H. Freeman, 2015
4. Experiments in Molecular Biology – A. M. Narang, Alpha Science International, 2008
5. Laboratory Manual for Biotechnology – S. Harisha, Universities Press, 2005
6. Biochemical Methods – S. Sadasivam & A. Manickam, New Age International, 2008
7. Practical Biochemistry: Principles & Techniques – Keith Wilson & John Walker, Cambridge University Press, 2010

Wildlife Conservation & Management-Based Experiments

1. Techniques for Wildlife Investigations and Management – Nova J. Silvy, Johns Hopkins University Press, 2012
2. Wildlife Ecology, Conservation, and Management – Anthony R.E. Sinclair, John M. Fryxell & Graeme Caughley, Wiley-Blackwell, 2006
3. Measuring and Monitoring Biological Diversity: Standard Methods for Mammals – Don E. Wilson, Russell A. Mittermeier & Richard C. Bruce, Smithsonian Institution Press, 1996
4. Research Techniques in Animal Ecology: Controversies and Consequences – Luigi Boitani & Todd K. Fuller, Columbia University Press, 2000
5. Field Techniques for Sea Turtle Research – Kimberly Stewart, Nova Science Publishers, 2019
6. Bird Census Techniques – Colin J. Bibby, Martin Jones & Stuart Marsden, Academic Press, 2000
7. Wildlife Conservation in India – A.K. Ghosh, APH Publishing, 2008
8. Handbook of Wildlife Techniques and Management – S. Sathyakumar & A. Bashir, Zoological Survey of India, 2010
9. Wildlife Techniques Manual – Nova J. Silvy, Johns Hopkins University Press, 2012
10. The Art of Tracking: The Origin of Science – Louis Liebenberg, David Philip Publishers, 2001
11. Indian Wildlife Protection Act, 1972 (With Amendments) – Government of India, Ministry of Environment, Forest & Climate Change

B. DISCIPLINE SPECIFIC COURSE (ELECTIVE 1) (Students will select any 1 out of 2)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FORENSIC ZOOLOGY	USC6FZ	THEORY :03+ PRACTICAL :01

Course Objectives:

- Introduce forensic zoology and its role in crime and wildlife investigations.
- Train students in analyzing forensic zoological evidence and species identification.
- Familiarize students with forensic entomology, wildlife forensics, and legal frameworks.

Course Outcomes:

- Understand forensic zoology's applications in crime and conservation.
- Develop skills in species identification using morphological and molecular methods.
- Gain expertise in forensic entomology and wildlife crime investigation.

Unit 1: Introduction to Forensic Zoology (15 Lectures)

1. **Definition and Scope of Forensic Zoology:**
   - **a)** Introduction to forensic science and its relationship with zoology.
   - **b)** Applications in crime investigation, wildlife conservation, and legal contexts.
2. **Forensic Zoological Evidence:**
   - **a)** Types of animal evidence: Hair, fur, feathers, scales, bones, saliva, blood, and excreta.
   - **b)** Role of forensic zoologists in crime scene investigation and wildlife forensics.
3. **Case Studies:**
   - **a)** Real-world applications of forensic zoology in solving crimes and wildlife offenses. (Minimum three cases)

Unit 2: Forensic Entomology and Wildlife Crime Investigation (15 Lectures)

1. **Forensic Entomology:**
   - **a)** Importance and applications in determining the post-mortem interval (PMI).
   - **b)** Insect succession on cadavers: Blowflies, beetles, and other carrion insects.
   - **c)** Collection and preservation of entomological evidence.
2. **Wildlife Forensics:**
   - **a)** Identification of animal products: Ivory, horn, bone, fur, and leather.
   - **b)** Tracking illegal wildlife trade and poaching cases.
3. **Legal Framework and Ethics:**
   - **a)** Wildlife Protection Act, CITES, and other national and international regulations.
   - **b)** Ethical considerations in wildlife and forensic investigations.

Unit 3: Analytical Techniques and Applications in Forensic Zoology (15 Lectures)

1. **Analytical Techniques:**
   - **a)** Use of Microscopy for studying hair, scales, and insect parts.

b) DNA Analysis: PCR.

c) Chromatographic Techniques: HPLC and GC-MS for chemical profiling.

2. Animal Bite Mark Analysis:

a) Differentiating between human and animal bite marks.

b) Forensic odontology and dental pattern analysis.

3. Bioinformatics and Data Analysis:

a) Molecular techniques in wildlife forensics

b) Use of databases for species identification and sequence alignment and Bar coding

c) Interpretation of molecular data for forensic applications.

REFERENCE BOOKS:

1. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

2. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).

3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

4. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).

5. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

6. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

7. L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988).

8. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993).

9. S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971).

10. R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993).

11. Medical and Forensic Zoology:Dr Chetan Jawale, Dr S A Pingle, Dr S V Chaudhari, Prof Dr Sandeep Pokal Prashant Publication 2022

PRACTICALS BASED ON DISCIPLINE SPECIFIC COURSE (ELECTIVE 1)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	FORENSIC ZOOLOGY	USC6FZP	PRACTICAL: 01

Course Objectives

- Train students in forensic techniques for analyzing animal evidence.
- Develop skills in species identification, DNA analysis, and wildlife forensics.

Course Outcomes

- Gain practical knowledge of forensic zoology and entomology methods.
- Apply forensic techniques to investigate wildlife crimes and legal cases

PRACTICALS

1. Microscopic examination of animal hair and feather samples.
2. DNA extraction and PCR amplification of animal samples (V-LAB).
3. Identification of insects /worms from simulated cadaver environments.
4. Analysis of animal bite marks and their differentiation. (photographs /Videos)
5. Study of fingerprints used in forensic science and calculation of whirls.
6. Identification of wildlife products (ivory, bones, and fur).
7. Estimation of post-mortem interval using insect evidence.
8. Detection of animal blood using forensic tests (e.g., precipitin test).
9. Study of animal bone morphology and identification.
10. Project – study of hairs for different body parts / hairs of animal

REFERENCE BOOKS:

1. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
2. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).

5. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).

6. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

7. L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988).

8. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993).

9. S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971).

10. R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993).

11. Medical and Forensic Zoology:Dr Chetan Jawale, Dr S A Pingle, Dr S V Chaudhari, Prof Dr Sandeep Pokal Prashant Publication 2022

DISCIPLINE SPECIFIC COURSE (ELECTIVE 2)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
2	NANOBIOLOGY	USC6NB	THEORY :03

Course Objectives:

- To introduce the fundamentals of nanobiology and its applications in life sciences.
- To understand nanostructures, biomolecular interactions, and their role in biological systems.
- To explore nanotechnology-based advancements in medicine, biotechnology, and environmental science.

Course Outcomes:

- Understand nanobiology, nanostructures, and their properties.
- Learn applications in medicine, diagnostics, and biotechnology.
- Gain awareness of nanomaterial safety, toxicity, and ethics.

Unit 1: Introduction to Nanobiology and Nanostructures (15 Lectures)

1. **Basics of Nanobiology:**
   - **a)** Definition, scope, and significance in biological sciences.
   - **b)** Properties of nanomaterials at the molecular and cellular levels.
2. **Types of Nanostructures:**
   - **a)** Nanoparticles, nanotubes, nanowires, quantum dots, and dendrimers.
3. **Biological Synthesis of Nanomaterials:**
   - **a)** Role of bacteria, fungi, and plants in nanoparticle synthesis.
4. **Techniques for Characterization of Nanomaterials:**
   - **a)** SEM, TEM, AFM, XRD, and spectroscopic methods.

Unit 2: Applications of Nanotechnology in Biology (15 Lectures)

1. **Nanobiotechnology in Medicine and Healthcare:**
   - **a)** Nanodrug delivery systems, nanomedicine, and bioimaging.
   - **b)** Role of nanomaterials in cancer therapy and antimicrobial treatments.
2. **Nanobiosensors and Diagnostics:**
   - **a)** Biosensors for disease detection and monitoring.
   - **b)** Role of nanotechnology in rapid and accurate diagnostics.
3. **Nanobiology in Agriculture and Environment:**
   - **a)** Nano-fertilizers and nano-pesticides.
   - **b)** Use of nanomaterials in pollution control and water purification.

Unit 3: Ethical, Safety, and Future Perspectives of Nanobiology (15 Lectures)

1. **Toxicity and Environmental Impact of Nanomaterials:**
   - **a)** Interaction of nanoparticles with biological systems.

b) Safety assessment and biocompatibility concerns.

2. **Ethical and Regulatory Aspects:**
    a) Guidelines for nanomaterial use in medicine and research.
    b) Public perception and policy regulations.
3. **Future Trends in Nanobiology:**
    a) Emerging applications in regenerative medicine, tissue engineering, and synthetic biology.

Reference Books:

1. Nanobiotechnology: Concepts, Applications, and Perspectives – C.M. Niemeyer & C.A. Mirkin, Wiley-VCH, 2004.
2. Introduction to Nanoscience and Nanotechnology – K.K. Chattopadhyay & A.N. Banerjee, PHI Learning, 2009.
3. Nanobiotechnology: Principles and Applications – Madhuri Sharon, Maheshwar Sharon, Sunil Pandey, CRC Press, 2018.
4. Nanobiotechnology in Molecular Diagnostics: Current Techniques and Applications – K.K. Jain, Horizon Bioscience, 2006.
5. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications – Tuan VoDinh, CRC Press, 2017.
6. Bionanotechnology: Lessons from Nature – David S. Goodsell, John Wiley & Sons, 2004.
7. Biomedical Nanotechnology – Neelina H. Malsch, CRC Press, 2005.
8. Nanostructures for Drug Delivery – Ecaterina Andronescu & Alexandru Mihai Grumezescu, Elsevier, 2017.
9. Nanomaterials in Biology and Medicine: Methods and Protocols – Martin Braddock, Springer, 2016.
10. The Nanobiotechnology Handbook – Yubing Xie, CRC Press, 2012.

B. DISCIPLINE SPECIFIC COURSE (ELECTIVES) PRACTICALS

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
2	NANOBIOLOGY	USC6NBP	PRACTICAL :01

PRACTICALS

1. Visualization of Nanoparticles Using Simple Microscopy – Observe nanoparticle suspensions under a light microscope.
2. Study color change and stability of nanoparticle solutions.
3. Compare stain removal efficiency using nano-enhanced detergents.
4. Study of Nanomaterials in Everyday Products Testing antibacterial effects of synthesized nanoparticles.
5. Assessing nanoparticle toxicity on model organisms or cell lines (simulation-based).
6. Observe how pH and salt affect nanoparticle stability.
7. Study of nanoparticle-mediated water purification.
8. Demonstration of SEM/TEM images of biological nanostructures.
9. **Project-Based Learning** – Case study on nanobiotechnology applications in medicine and agriculture.

REFERENCE BOOKS:

1. Nanotechnology: Principles and Practices – Sulabha K. Kulkarni, Springer, 2015.
2. Handbook of Nanotechnology: Applications and Techniques – Bharat Bhushan, Springer, 2010.
3. Nanomaterials: Synthesis, Properties, and Applications – A.S. Edelstein & R.C. Cammarata, CRC Press, 1998.
4. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications – Tuan VoDinh, CRC Press, 2017.
5. Nanobiotechnology: Protocols, Experiments, and Applications – Sandra J. Rosenthal & David W. Wright, Humana Press, 2005.
6. Methods in Nano Cell Biology – Bhanu P. Jena, Academic Press, 2008.
7. Practical Handbook on Nanotechnology – M. Balakrishna Rao & J.P. Rao, IK International Publishing, 2010.
8. Bionanotechnology: Principles and Applications – Madhuri Sharon, Maheshwar Sharon, Sunil Pandey, CRC Press, 2018.
9. Biomedical Nanotechnology – Neelina H. Malsch, CRC Press, 2005.
10. Experimental Nanoscience and Nanotechnology – James A. Schwarz & Cristobal dos Remedios, CRC Press, 2010.

C. DISCIPLINE SPECIFIC COURSE (MINOR)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	BIOCHEMICAL BASIS OF ANIMAL PHYSIOLOGY	USC6ZOM	THEORY :02

Course Objectives:

- To understand the biochemical principles underlying physiological processes in animals.
- To explore the role of biomolecules, enzymes, and metabolic pathways in maintaining homeostasis.
- To analyze biochemical adaptations in different physiological and environmental conditions.

Course Outcomes:

- Explain the biochemical composition and functions of biomolecules in animal physiology.
- Describe enzymatic mechanisms and metabolic pathways regulating physiological functions.
- Apply biochemical concepts to understand physiological adaptations under various environmental conditions.

Unit 1: Biomolecules and Their Physiological Roles (15 lectures)

1. Carbohydrates: Structure, types, and role in energy metabolism
2. Lipids: Types, functions, and role in membrane structure and signaling
3. Proteins: Structure, enzymatic function, and physiological significance
4. Nucleic Acids: DNA and RNA structure, replication, and role in protein synthesis
5. Vitamins and Minerals: Functions, deficiency disorders, and metabolic importance

Unit 2: Enzymes and Metabolic Pathways in Animal Physiology (15 lectures)

1. Enzyme Structure and Function: Enzyme kinetics, cofactors, and regulatory mechanisms
2. Energy Metabolism: Glycolysis, Krebs cycle, oxidative phosphorylation, ATP production
3. Lipid Metabolism: β-oxidation, fatty acid synthesis, and role in energy storage
4. Hormonal Regulation of Metabolism: Role of insulin, glucagon, and stress hormones

REFERENCE BOOKS:

1. Lehninger Principles of Biochemistry – David L. Nelson & Michael M. Cox, W.H. Freeman, 2021
2. Biochemistry – Jeremy M. Berg, John L. Tymoczko & Lubert Stryer, W.H. Freeman, 2019 **3.** Harper's Illustrated Biochemistry – Victor W. Rodwell, David A. Bender, Kathleen M. Botham, McGraw Hill, 2021
4. Textbook of Biochemistry for Medical Students – D.M. Vasudevan & S. Sreekumari, Jaypee Brothers, 2022
5. Animal Physiology: Mechanisms and Adaptations – Eckert, Randall, Burggren & French, W.H. Freeman, 2001
6. Biochemistry – U. Satyanarayana & U. Chakrapani, Elsevier, 2021

7. Fundamentals of Enzymology – Nicholas C. Price & Lewis Stevens, Oxford University Press, 1999
8. Principles of Animal Physiology – Christopher D. Moyes & Patricia M. Schulte, Pearson, 2016
9. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry – Trevor Palmer, Horwood Publishing, 2007
10. Comparative Animal Physiology – C.L. Prosser, Wiley-Liss, 1991

C. DISCIPLINE SPECIFIC PRACTICAL COURSE (MINOR)

NO. OF COURSES	TITLE OF THE COURSES	COURSE CODE	CREDITS
1	BIOCHEMICAL BASIS OF ANIMAL PHYSIOLOGY	USC6ZOMP	PRACTICAL :02

Course Objectives:

- Understand the biochemical basis of physiological functions in animals.
- Explore the role of biomolecules, enzymes, and metabolism in homeostasis.
- Analyze biochemical adaptations in different physiological conditions.

Course Outcomes:

- Explain the structure and function of biomolecules in animal physiology.
- Describe enzyme mechanisms and metabolic pathways regulating physiological functions.
- Apply biochemical principles to understand physiological adaptations.

PRACTICALS

1. Qualitative analysis of carbohydrates (glucose, fructose, sucrose, starch).
2. Qualitative analysis of proteins (Biuret, Ninhydrin, and Xanthoproteic tests).
3. Qualitative analysis of lipids (Sudan III and Saponification tests).
4. Estimation of glucose using the Anthrone method.
5. Estimation of total proteins using the Lowry method.
6. Estimation of lipids using the Soxhlet extraction method.
7. Estimation of cholesterol.
8. Determination of Vitamin C content in biological samples.
9. Estimation of calcium/ phosphate) in blood samples.
10. Study of lipid metabolism using thin-layer chromatography (TLC).
11. Urine Analysis.
12. Project based on syllabus

REFERENCE BOOKS:

1. Experimental Biochemistry – Robert L. Switzer & Liam F. Garrity, W.H. Freeman, 1999
2. Biochemical Methods – S. Sadasivam & A. Manickam, New Age International, 2008
3. A Manual of Practical Biochemistry – K. Wilson & J. Walker, Cambridge University Press, 2010
4. Laboratory Manual in Biochemistry – J. Jayaraman, New Age International, 2011
5. Experimental Biochemistry: A Student Companion – Beedu Sashidhar Rao & Vijay Deshpande, I.K. International, 2005

6. Practical Biochemistry: Principles & Techniques – Keith Wilson & John Walker, Cambridge University Press, 2010
7. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis – Robert A. Copeland, Wiley, 2004
8. Methods in Enzymology (Series) – Sidney P. Colowick & Nathan O. Kaplan (Eds.), Academic Press, Various Years
9. Animal Physiology: A Practical Approach – Roger Eckert, W.H. Freeman, 1990
10. Practical Biochemistry for Beginners – Debajyoti Das, Academic Publishers, 2012

Note – The practicals may be conducted by using specimens authorized by the wild life and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/simulations/ models etc. as recommended by the UGC and as envisaged in the regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practical mentioned here-in above.

N.B:

III. It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

IV. Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

3. A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
4. A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

v) Head of the Concerned Department (Convener / Chairperson)
vi) Two Senior Faculty Members of the concerned Department
vii) One Faculty of related department from the same College
viii) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.