Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/434 **Date: 15/07/2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

Ref: No.SU/BOS/Science/270 & 271 Date: 03/05/2025 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Statistics	9.	Zoology
3.	Mathematics	10.	Chemistry
4.	Microbiology	11.	Electronics
5.	Plant Protection	12.	Industrial Microbiology
6.	B.A./B.A.B.Ed. Geography	13.	Biotechnology(Voc/Opt)
7.	Biotechnology(Entire)		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

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०२३१—२६०९४८७

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B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Physics	9.	Zoology
3.	Statistics	10.	Chemistry
4.	Mathematics	11.	Electronics
5.	Microbiology	12.	Drug Chemistry
6.	Plant Protection	13.	Industrial Microbiology
7.	Astrophysics and Space Science	14.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

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Yours faithfully,

By Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

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5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited by NAAC with A^{++} Grade

Syllabus for

B. Sc. Part – II (Zoology)

(Faculty of Science and Technology)

Semester-III and IV

(To be implemented from June 2025 as per NEP 2.0)

SHIVAJI UNIVERSITY, KOLHAPUR

NAME OF FACULTY : Faculty of Science and Technology

PROGRAMME NAME AND CODE : B.Sc. Zoology

PART : Part - II

1	YEAR OF IMPLEMENTATION	
2	PREAMBLE	
3	PROGRAMME LEARNING OUTCOMES (PO)	
4	COURSE OUTCOMES (CO)	
5	OBJECTIVES PROGRAMME	
6	DURATION OF THE COURSE	
7	MEDIUM OF INSTRUCTION	
8	ELIGIBILITY FOR ADMISSIO N	
9	SCHEME OF TEACHING AND EXAMINATION PATTERN (Theory/Practical/Internal)	
10	EQUIVALENCE OF THE PAPERS	
11	STRUCTURE OF PROGRAMME	
12	STANDARD OF PASSING AND DETERMINATION OF SGPA/CGPA, GRADING AND DECLARATION OF RESULTS	
13	NATURE OF QUESTION PAPER, DURATION AND SCHEME OF MARKING	
14	SYLLABUS : COURSE TITLE, CODE, CREDITS, VERTICALS NAME, REFERENCES etc.	

अभ्यासक्रमामध्ये उपरोक्त बाबींचा समावेश करण्यात आलेला आहे.

अध्यक्ष

अभ्यास / अस्थायी मंडळ

SHIVAJIUNIVERSITY,KOLHAPUR

NEP-2020 (2.0): Credit Framework for UG(B. Sc.) Programme under Faculty of Science and Technology

SEM (Level)	COURSES			OE	VSC/SEC	AEC/VEC/IKS	OJT/FP/CEP /CC/RP	Total Credits	Degree/Cum. Cr. MEME
	Course-1	Course-2	Course-3						
SEMI (4.5)	DSC-I(2) DSC-II (2) DSC P-I(2)	DSC-I(2) DSC-II (2) DSC P-I(2)	DSC-I(2) DSC-II (2) DSC P-I(2)	OE-1(2) (T/P)		IKS-I(2)		22	UG Certificate 44
SEMII (4.5)	DSC-III(2) DSC-IV (2) DSC P-II(2)	DSC-III(2) DSC-IV (2) DSC P-II(2)	DSC-III(2) DSC-IV (2) DSC P-II(2)	OE-2(2) (T/P)		VEC-I(2) (Democracy, Election and Constitution)		22	
Credits	8(T)+4(P)=12	8(T)+4(P)=12	8(T)+4(P)=12	2+2=4 (T/P)	--	2+2=4	--	44	Exit Option:4 credits NSQF/Internship/Skill courses
	MAJOR		MINOR						
SEMIII (5.0)	Major V(2) Major VI (2) Major P III (2)	--	Minor V(2) Minor VI (2) Minor P III(2)	OE-3(2) (T/P)	VSC I (2) (P) (Major specific) SEC I(2) (T/P)	AEC I(2) (English)	CC-I (2)	22	UG Diploma 88
SEMIV (5.0)	Major VII(2) Major VIII (2) Major P IV (2)	--	Minor VII(2) Minor VIII (2) Minor P IV (2)	OE-4(2) (T/P)	SEC-II(2) (T/P)	AEC-II(2) (English) VEC-II(2) (Environmental studies)	CEP-I(2)	22	
Credits	8(T)+4(P)=12		8(T)+4(P)=12	2+2=4(T/P)	4(T/P)+2(P)=6	2+4=6	2+2=4	44	Exit Option:4 credits NSQF/Internship/Skill courses
SEMV (5.5)	Major IX(2) Major X (2) Major P V (4)	Major I (ELEC)(2) Major P-I (ELEC) (2)	-	OE-5(2) (T/P)	VSC II (2) (Major specific)(P)	AEC III(2) (English)	OJT (04)	22	UG Degree 132
SEMVI (5.5)	Major XI(2) Major XII (2) Major P VI (4)	Major II (ELEC)(2) Major P-II(2) (ELEC)	-		VSC III (2) (Major specific) (P) SEC III(2) (T/P)	AEC IV(2) (English) IKS 2 (Major specific) (2)	FP-(02)	22	
Credits	8(T)+8(P)=16	4(T)+4(P)=8	-	2(T/P)	2(T/P)+4(P)=6	4+2=6	4+2=6	44	
Total Credits	40+20=60		24	10	12	16	10	132	Exit Option

SEMVII (6.0)	Major -XIII(4) Major -XIV(4) Major(P).-VII(4) Major (P) .-VIII(2)	MAJOR III (4) (ELEC)	RM-I(4)	-	-	-		22	UG Honours Degree 176
SEMVIII (6.0)	Major -XV(4) Major -XVI(4) Major (P)- IX(4) Major (P). - X(2)	MAJOR IV (4) (ELEC)	-	-	-	-	OJT(04)	22	
Credits	16(T)+12(P)=28	8(T)	4	-	-	-	04	44	
									Exit Option
Total Credits	68+28=96		28	10	12	16	14	176	
SEMVII (6.0)	Major -XIII (4) Major -XIV (4) Major(P).-VII (2)	MAJOR (4) (ELEC)	RM-I (4)	-		-	RP-4	22	UG Honours with Research Degree 176
SEMVIII (6.0)	Major -XV (4) Major -XVI (4) Major (P)-VIII (2)	MAJOR (4) (ELEC)		-		-	RP-8	22	
Credits	16(T)+4(P)=20	8(T)	4	-	-	-	12	44	
Total Credits	60+28=88		28	10	12	16	22	176	

Note:

- University may decide to offer maximum of three subjects (Courses) in the first year. The student may select one subject out of combination of three subjects (Courses), (which a student has chosen in the first year) as a **MAJOR** subject (Course) and one subject (Course) as **MINOR** Subject in the second year. Thereby it is inferred that the remaining third subject (Course) shall stand discontinued.
- **DSC:** Discipline Specific Course
- **MAJOR:** Mandatory/Elective
- **MINOR:** Course may be from different disciplines of same faculty of DSC Major
- **OE(Open Elective):** Elective courses/**Open Elective to be chosen compulsorily from faculty other than that of the Major.**
- **VSC/SEC: Vocational Skill Courses (MAJOR related)/Skill Enhancement Courses**
- **AEC/ VEC / IKS:** Ability Enhancement Courses (English, Modern Indian Language)/Value Education Courses/ Indian Knowledge System (Generic & Specific))
- **OJT/FP/RP/CEP/CC:** On-Job Training (Internship/Apprenticeship) / Field Project (Major related)/ Research Projects (Major related) Community Engagement **(Major related)/ Co-Curricular courses(CC)** such as Health& Wellness, Yoga Education, Sport, and Fitness, Cultural activities, NSS/NCC and Fine /applied/visual/performing Arts / Vivek Vahini etc.

SHIVAJI UNIVERSITY KOLHAPUR

NAME OF FACULTY: FACULTY OF SCIENCE AND TECHNOLOGY

PROGRAM NAME: B.Sc. PART- II (NEP 2.0)

1: YEAR OF IMPLEMENTATION: 2025-26

2: PREAMBLE

With immense pleasure, we present herewith the B.Sc.-II, Zoology, NEP 2020 syllabus of Shivaji University, Kolhapur. While designing the syllabi, we have taken into consideration that the learner must get thorough information and knowledge about the field of Zoology from classical to applied fields. During the course of syllabi design, rounds of meetings were conducted among the teachers to deliberate upon the units to be kept for the syllabi. Also, from industry experts suggestions were taken to include more interesting and fruitful topics that will enhance their skills in the field.

The B.Sc. II Syllabus is designed as a perfect blend of traditional and advanced knowledge of the field. The practical's are perfectly distributed into identification to improve the knowledge of the learners and also performing practical's to provide a hands-on experience to the learners. The Open Elective Course, Skill Enhancement Course and Vocational Skill Course are designed with concepts and topics that will really be helpful to the learners in industry or on field.

Looking into the prepared syllabus, we are sure that the learners will enjoy the syllabus of B.Sc. II NEP 2020 presented to them for their 3 and 4 semesters. We are sincerely thankful to the staff of the Zoology Department, industry experts, and our BOS members for their valuable contribution in the construction of this syllabus. We hope you all enjoy the syllabus. Happy learning, and valuable suggestions and recommendations are most welcome.

3: PROGRAMME LEARNING OUTCOMES (PLOs)

The **Programme Learning Outcomes (PLOs)** for a **B.Sc. Part II in Zoology** can generally include the following, though they may vary slightly based on the specific university or curriculum:

Knowledge and Understanding:

1. **Core Zoological Concepts**: Understanding the classification, structure, function, and anatomy of chordate animals.
2. **Reproductive Physiology and Biochemistry**: Knowledge of reproductive physiological processes in animals and their biochemical basis.
3. **Applied Entomology**: Managements and control of vector and vector borne diseases.

Skills Development:

4. **Laboratory Techniques**: Biochemical techniques.
5. **Fieldwork Proficiency**: Skills in animal identification, sampling, and understanding biodiversity through field studies.

Applications:

8. **Problem-Solving in Zoology**: Application of zoological knowledge for handling real world issues related to Public health and Pest management.

Generic Outcomes:

9. **Teamwork and Leadership**: Ability to collaborate effectively in group projects and lead field or laboratory initiatives.
10. **Preparation for Higher Studies**: Foundation for advanced education or professional courses in zoology or related fields.

These outcomes align with the aim of equipping students with theoretical knowledge, practical skills, and an understanding of ethical and environmental aspects of zoology.

4: COURSE OUTCOMES (COs)

Semester III

Zoology Major

1. Fundamental of Chordates

COURSE OUTCOMES (COs):

CO1. Understand the Morphology and anatomy of Chordate.

CO2. Enable the students to identify the similarities and differences among the animals in different classes of Chordate animals.

CO3. Apply their knowledge to study the functioning of different organs and systems of chordates.

CO4. Enable the students to identify venomous and non-venomous snakes.

2. Biochemistry

Course Outcomes

CO-1: Enable the students to understand the structure, types and classification of proteins, carbohydrates and fats.

CO-2: Enable the students to understand enzymes and enzyme action.

CO-3: Metabolic pathways of various bio-molecules and their functional significance.

CO-4: Enable the students to acquire the skills of biochemical tests and estimations.

Zoology Minor

1. Fundamentals of Non-Chordates

Course Outcomes (COs)

CO1: Understand structure and functions of Protozoa (Paramecium)

CO2: Analyze the anatomical and physiological systems in Annelida (Earthworm)

CO3: Compare and contrast functional adaptations in diverse invertebrate groups

CO4: Explore behavioral and structural specializations in minor invertebrates

CO5: Recognize the medical and economic significance of invertebrates

2. Biodiversity, Wild life management and Toxicology

Course Outcomes (COs)

CO1: Understand the Concept and Importance of Biodiversity

CO2: Demonstrate Knowledge of Wildlife Management Principles

CO3: Describe Key Features of National Parks and Sanctuaries in India

CO4: Understand Basic Principles of Toxicology

CO5: Develop Awareness of Environmental and Wildlife Conservation Challenges

3. OE - Aquarium Construction and Maintenance:

Course Outcomes

CO1. Acquire knowledge of ornamental fishes which is highly professional and attractive avenues for youth.

CO2. Enable to acquire skills of aquarium setup and aquarium fish keeping.

CO3. Enable to acquire skills of Fish transportation and management.

4. VSC – I Domestic and Pet Animal Feed Preparation:

Course Outcomes (COs)

CO1. Understand the student the dietary needs of animals
CO2. Enables the students to design the feed for the animals according to their physiological conditions.
CO3. Acquire the skill of feed preparation of animals.
CO4. To develop entrepreneurship qualities in the field of animal feed production

5. SEC - Poultry Farming
Course Outcome (COs)
CO1. To understand different breeds and techniques in poultry farming.

CO2. To acquire the skills of poultry management.

CO3. Students gain confidence to pursue entrepreneurship in farming and assess the economics of a farm.

Semester IV

Zoology Major

1. Reproductive Biology

Course Outcome

CO1: Understand the structure, organization, and functions of male and female reproductive systems in animals.

CO2: Enable to explain the hormonal regulation of reproduction and its role in gametogenesis, ovulation, and spermatogenesis.

CO3: Analyze the mechanisms of reproductive cycles, including estrous and menstrual cycles, and their physiological significance.

CO4: Understand the principles and applications of assisted reproductive technologies (ART) such as IVF, ICSI, and surrogacy.

CO5: Explore the causes and treatments of infertility in males and females, along with emerging diagnostic tools.

CO6: Learn about reproductive health, contraceptive methods, and their societal implications.

2. Applied Entomology

Course Outcome

CO1. Acquire the knowledge of non-beneficial insects.

CO2. Understand the interaction of insect vectors with humans and spread of diseases.

CO3. Aware the managements and control of vector and vector borne diseases.

Zoology Minor

1. Physiology, Endocrinology and Histology

Course Outcomes (COs):

CO1: Understand fundamental principles of animal physiology

CO2: Explain the mechanisms of respiration in vertebrates

CO3: Understand circulatory system functions and blood physiology

CO4: Comprehend excretory physiology and osmoregulatory mechanisms

CO5: Identify sources, roles, and deficiency symptoms of vitamins

CO6: Understand the endocrine system and hormonal regulation

CO7: Identify and describe the histological structure of mammalian digestive organs

CO8: Apply knowledge of physiology, endocrinology, and histology to understand health and disease

2. Economic Zoology and Parasitology

Course Outcomes (COs)

CO1: Describe the economic importance of major fin fishes such as Rohu, Catla, Mrigal, and Tilapia, and explain their role in aquaculture and nutrition.

CO2: Identify commercially important shellfishes like lobster, prawn, crab, mussel, and sepia, and explain their significance in the seafood industry.

CO3: Illustrate the process of fish farming, including the construction and maintenance of fish farms, and evaluate various fishing crafts and gears used in the industry.

CO4: Recognize different breeds of goats, and demonstrate knowledge of their feeding, housing, and economic value in rural and commercial farming systems.

CO5: Understand basic principles of dairy science, including the production and processing of milk and various milk products.

CO6: Define and classify parasites based on their nature and host interaction.

CO7: Describe the morphology, anatomy, life cycle, and reproductive features of Ascaris, and understand its pathogenicity and control measures.

CO8: Analyze the structural and physiological adaptations of parasites, particularly Ascaris, for their survival within the host.

3. OE - Apiculture

CO1. Understand honey bees life cycle, their social organization, and the importance of different species

CO2. Acquire skills of handling basic tools, equipment's, and management of beehives

CO3. To understand the importance and economy of products and by-products of beekeeping.

CO4. To develop entrepreneurial skills for self-employment in beekeeping

CO5. Acquire the skills for scientific management of honey bee colonies

4. SEC - Dairy Farming

CO1. Students gain knowledge of different breeds and their selection in dairy farming.

CO2. Acquire the skills of Dairy farm management

CO3. Acquire the skills of shed construction and maintenance

CO4. Students gain self-confidence to become dairy entrepreneurs.

5: OBJECTIVES OF THE PROGRAMME

- To provide quality education in a branch of Biological sciences i.e. Zoology with different specializations.
- To provide quality education offering skill based programs and motivate the students for self-employment in applied branches of Zoology
- To conduct field visits for experiential learning.
- To facilitate Higher education & research in zoology.

6: DURATION OF THE COURSE: ONE YEAR (SEMESTER III AND IV)

TEACHING HOURS: All courses under the B. Sc. II will be of 2 credits each. The theory courses will be taught for 30 hours and practical courses for 60 hours. All the major and minor subjects will have Practical Courses. In addition VSC, OE and SEC have practical modules.

7: MEDIUM OF INSTRUCTIONS: The medium of instructions shall be English/Marathi (for OE).

8: ELIGIBILTY FOR ADMISSION:

Eligibility requirements for admission to B. Sc. Part-II (Level 5.0):

i) The students passing or ATKT the B. Sc. Part-I (or Undergraduate Certificate in Science) shall be allowed to enter upon the B. Sc. Part-II (or Undergraduate Diploma in Science).

OR

ii) An Examination of any other Statutory University or an examining Body recognized as equivalent there to.

OR

iii) Completed 3-year diploma course with subjects allied / related to the subject at B.Sc. Part I

OR

iv) Completed first year of B.E./B. Tech. with subjects allied / related to the subject at B.Sc. Part I

9: SCHEME OF TEACHING AND EXAMINATION PATTERN (THEORY / PRACTICAL / INTERNAL):

SCHEME OF TEACHING:

TEACHING HOURS: All courses under the B. Sc. II will be of 2 credits each. The theory courses will be taught for 30 hours and Practical courses for 60 hours. All the major and minor subjects will have Practical Courses. In addition VSC, OE and SEC have practical modules.

EXAMINATION PATTERN (THEORY / PRACTICAL / INTERNAL):

Scheme of Examination: Total marks shall be 50 for 2 credit course.

1. The university exam question paper in each semester end examination for each theory course (paper) for B.Sc. (all Semesters) shall be of 40 marks. Total marks for each course shall be based on continuous assessments and semester-end examination. The division of internal assessment and semester–end examination for B.Sc. will be as follows:

Particulars	2 Credit	Course Duration
1. Semester-end Examination	40 Marks	1.5 hrs.
2. Internal Assessment	10 Marks	1.0 hrs.
Total marks for each course	50 Marks	–

2. The Examination for practical course will be of 50 marks at end of each semester. The rule for practical examination shall be as per the circular/ letter issued by respective board of studies.

3. The examination pattern for Co-Curricular Activities (CC), Field Project (FP), On Job Training (OJT), Community Engagement Program (CEP) and Research Project (RP) as per the University guidelines.

Internal Assessment Process shall be as follows:

(a) The internal assessment should be conducted after completing 50% of syllabus of the course/s.

(b) In case a student has failed to attend internal assessment on scheduled date, it shall be deemed that the student has dropped the test. However, in case of student who could not take the test on scheduled date due to genuine reasons, such a candidate may appeal to the Programme coordinator /Principal /Head of the Department. The Programme coordinator /Principal /Head of the Department in consultation with the concerned teacher shall decide about the genuineness of the case and decide to conduct special test to such candidate on the date fixed by the concerned teacher but before commencement of the concerned semester-end examination.

The outline for continuous internal assessment activities shall be as under:

Outline for continuous internal assessment activities:

Level	Semester	Activities Per Semester	Marks
4.5	Semester–I	Assignment	10 marks
	Semester–II	Unit test	10 marks
5.0	Semester–III	Unit test	10 marks
	Semester–IV	Oral examination/ Group discussion	10 marks
5.5	Semester– V	Seminar/ Group discussion/ Field Work	10 marks
	Semester– VI	Study tour / Field Work / Project Work / Seminar	10 marks
6.0	Semester– VII	Case Study /Field Work/ Project Work	10 marks
	Semester– VIII	Case Study/ Field Work/ Project Work	10 marks

10: EQUIVALANCE OF THE PAPER

Equivalence of papers and chances for the students in previous-Semester pattern: Two additional chances in subsequent semesters shall be provided for the repeater students of old three-year B.Sc. program. In such case the scores obtained by the students in NEP 1.0/CBCS scheme should be converted into equivalent credits in NEP 2.0. After that the students concerned shall have to appear for the examination as per this revised pattern. If a student fails in two consecutive chances he/she has to take admission for the respective course in NEP 2.0. In such cases his previous performance of incomplete academic years (B. Sc. I, B. Sc. II or B. Sc. III) will be cancelled.

11: STRUCTUTE OF PROGRAM:

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDIT
B. Sc. -II	III	MJ-V	Fundamentals of Chordates	2
		MJ-VI	Biochemistry	2
		MJ-P III (MJ –V and VI)	Semester 3 Practical (Based on Major Discipline Specific Course)	2
		MN-V	Fundamentals of Non-Chordates	2
		MN-VI	Biodiversity, Wildlife Management & Toxicology	2
		MN-P III	Semester 3 Practical (Based on Minor Discipline Specific Course)	2
		OE – III P	Fish Aquarium Construction and Maintenance	2
		VSC - I	Domestic and Pet Animal Feed Preparation	2
		SEC - I	Poultry Farming	2
	IV	MJ-VII	Human Reproductive Physiology	2
		MJ-VIII	Applied Entomology	2
		MJ-P IV	Semester 4 Practical (Based on Major Discipline Specific Course)	2
		MN-VII	Physiology, Endocrinology & Histology	2
		MN-VIII	Economic Zoology and Parasitology	2
		MN-P IV	Semester 4 Practical	2

			(Based on Minor Discipline Specific Course)	
		OE – IV P	Apiculture	2
		SEC - II	Dairy Farming	2

12: STANDARD OF PASSING AND DETERMINATION OF SGPA/CGPA, GRADING AND DECLARATION OF RESULT

STANDARD OF PASSING:

The standard of passing shall be as per shown in the following table:

	Semester End Exam	**Internal Assessment**	**Course Exam (Total**
Maximum Marks	**40**	**10**	**50**
Minimum Marks required for passing	**14**	**04**	**18**

DETERMINATION OF SGPA/CGPA:

1. Semester Grade Point Average (SGPA)

$$SGPA = \frac{\sum(\text{Course credits} \times \text{Grade points obtained}) \text{ of a semester}}{\sum(\text{Course credits}) \text{ of respective semester}}$$

2. Cumulative Grade Point Average (CGPA)

$$CGPA = \frac{\sum(\text{Total credits of a semester} \times \text{SGPA of respective semester}) \text{ of all semesters}}{\sum(\text{Total course credits}) \text{ of all semesters}}$$

Gradation Chart:

% of Marks Obtained	Numerical Grade (Grade Point)	CGPA	Letter Grade
Absent	-	-	-
- 0 – 34	0	0.0 – 4.99	F (Fail)
35 – 44	5	5.00 – 5.49	C
45 – 54	6	5.50 – 6.49	B
55 – 64	7	6.50 – 7.49	B+
65 – 74	8	7.50 – 8.49	A
75 – 84	9	8.50 – 9.49	A+
85 – 100	10	9.50 – 10.0	O (Outstanding)

DECLARATION OF RESULT:

The result of each semester shall be declared as Pass or Fail with grade/grade points. However, ATKT rules will be followed as per University guidelines.

Revised Rules - These revised rules shall be gradually implemented with effect from the academic year 2025-26 for B.Sc. Degree Programme. However, the existing (i.e. pre-revised) rules shall remain in force for the students of old semester pattern during the transition period.

13: NATURE OF QUESTION PAPER, DURATION AND SCHEME OF MARKING

NATURE OF QUESTION PAPER

Nature of Question Paper for B.Sc. Part – II (40 + 10 Pattern) according to Revised Structure as Per NEP – 2020 to be implemented from academic year 2025-26 Maximum Marks: 40 Duration: 1.5 hrs.

Choose the correct alternative from the following and rewrite the sentence [8]

1 to 8 MCQ one mark each with four options

a)

b)

c)

d)

Attempt any TWO of the following [16]

a)

b)

c)

Attempt any FOUR of the following [16]

a)

b)

c)

d)

e)

f)

14: SYLLABUS: For Semester III

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MAJOR ZOOLOGY PAPER - V

FUNDAMENTALS OF CHORDATES

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit 1 5 hrs

Type Study: Amphioxus (*Branchiostoma lanceolatum*)

A. Systematic position, Habit and Habitat,
B. Morphological Characters
C. Digestive system
D. Circulatory system

Unit II 15 hrs

Type Study: Rat (*Rattus rattus*) (Physiology is not expected)

A. Systematic position, Habit and Habitat
B. Morphological Characters
C. Digestive System
D. Respiratory System
E. Circulatory System (Composition of Blood, Structure of Heart)
F. Excretory System
G. Reproductive System
H. Brain of Rat
I. Sense organs – (Eye and Ear)

Unit III – 10 hrs

Study of the following general topics

I. Study of Venomous and Non-Venomous Snakes

A. Identifying characters of Venomous, Mild venomous and non-venomous snakes
B. Poison Apparatus
C. Biting mechanism
D. Venom types and its effects,
E. Antivenom/Antiserum
F. First Aid Treatment

II. Aerial Adaptations in birds

III. Dentition in Mammals

Suggested Readings:

- Biology of Vertebrates Walter & Sayles ;(Mc Millan).
- Chordate Zoology, P.S. Dhami & J. K. Dhami - R. Chand & Co., NewDelhi.
- ModernText bookof Zoology,R.L.Kotpal,Rastogi Publications, Meerut.
- The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S.Oxford.
- Chordate Zoology - E.L. Jordan, S. Chand & Co., New Delhi.
- The Phylum Chordata - 1987, H.H. Newman, Distributor Satish Book Enterprise, Agra.
- Comparative Anatomy of the Vertebrates G. C.Kent.
- Pough H. (2008). Vertebrate life, 8th Edition, Pearson International.
  Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
- The Protochordates – by S. H. Bhamrah and Kavita Juneja – Anmol Publications, New Delhi
- Introduction to Protochordata – S. H. Bhamrah and Kavita Juneja – Anmol Publications, New Delhi 8) Chordate Zoology – S. Chand Company, New Delhi
- Text Book of Zoology – Vertebrates, Vol. II – T. J. Parker and W. A. Haswell Edited by Marshall and Williams, CBS Publications and Distributors, New Delhi.
- E. L. Jordan – Chordate Zoology, S. Chand and Company, New Delhi.
- A Text Book of Chordates – A. Thangamani, L. M. Narayan, S. Prasannakumar, N. Arumugam
- R. L. Kotpal – Modern Text Book of Zoology, Vertebrates

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MAJOR ZOOLOGY PAPER - VI

BIOCHEMISTRY

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit I: Carbohydrate Metabolism (without chemical structure) 14 hrs

1) Classification and biological significance of carbohydrates
2) Glycolysis
3) Krebs Cycle
4) Electron Transport Chain
5) Gluconeogenesis
6) Glycogenesis
7) Glycogenolysis
8) Pentose Phosphate Pathway

Unit II: 08 hrs

1. Lipid Metabolism:

1) Classification and biological significance of lipids
2) β oxidation of fatty acids

2. Protein metabolism:

1) Structure, Classification and biological significance of proteins
2) Transamination
3) Deamination
4) Urea Cycle/ Ornithine cycle

Unit III: 08 hrs

1. Enzymes:

1) Introduction, Classification and Nomenclature
2) Mechanism of enzyme action
3) Isoenzymes, Co-enzymes and Co-factors.

2. Vitamins:

Study of following vitamins with reference to source, role and deficiency

1. Water soluble Vitamins (B and C)
2. Fat soluble Vitamins (A, D , E and K)

Suggested Readings:

- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MAJOR ZOOLOGY PRACTICAL - III

(Based on Fundamentals of Chordates and Biochemistry)

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Unit I (Fundamentals of Chordates)

1. Amphioxus:

1. Systemic Position and Morphology
2. Transverse sections passing through
    a. Oral Hood
    b. Pharynx
    c. Intestine
    d. Tail

2. Rat: (only demonstration)

1. Systemic Position and Morphology
2. Digestive System
3. Respiratory System
4. Excretory System
5. Male and Female Reproductive System
6. Heart
7. Brain

3. Study of Venomous and Non-Venomous Snakes:

A. Identifying Characters of venomous and non-venomous snakes

B. Study of venomous snakes:
    a. Russell's viper
    b. Saw scaled viper
    c. Common krait
    d. Indian Cobra
    e. Sea Snake

C. Mild venomous snakes
    a. Cat snake
    b. Green vine snake

D. Study of non- venomous Snakes:
    a. Python
    b. Rat snake
    c. Checkered keel back
    d. Sand boa

E. First aid treatments (Simulation)

4. Dentition in Mammals: Rat, Sheep, Dog, Man.
5. Aerial adaptations in birds- Morphological and Anatomical.

Unit – II (Biochemistry)

1. Biochemical tests:
   A. Monosaccharaides - Glucose, Fructose,
   B. Disaccharides - Sucrose, Lactose
   C. Polysaccharides – Starch
   D. Lipid
   E. Protein
2. Estimation of total protein by Lowry's method.
3. Estimation of casein from milk
4. Study of activity of salivary amylase under optimum conditions.
5. Effect of Temperature on activity of salivary amylase.
6. Effect of pH on activity of salivary amylase.
7. Detection of abnormal urine constituents.
8. Determination of Ascorbic acid/Vitamin C from given sample.
9. Separation of Amino acids by paper chromatography.

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MINOR ZOOLOGY PAPER - V

FUNDAMENTALS OF NON-CHORDATES

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I **7 hrs**

1. Type study: *Paramecium*
   a) Systematic Position
   b) Locomotion
   c) Nutrition
   d) Osmoregulation
   e) Reproduction

Unit – II **15 hrs**

2. Type study: Earthworm
   a) Systematic Position
   b) Morphology
   c) Coelom
   d) Digestive System
   e) Circulatory System
   f) Excretory System
   g) Nervous System
   h) Reproductive System (Copulation and Cocoon formation)

Unit – III **8 hrs**

3. Type study following General Topics
   a) Foot in Mollusca – Chiton,Pila, Mytilus, Unio and Sepa.
   b) Pedicelaria in Echinodermata
   c) Affinities of Hemichordata
   d) Stridulation in Cicada and Cricket
   e) Salient Features of Minor Phyla : Bugula, Sagitta and Lingula
   f) Invertebrates in Medicine :
      a. Leech (*Hirudo medicinalis*) – Leech Therapy
      b. Honey Bees – Apitherapy

Suggested Readings:

1. Modern Textbook of Zoology: Invertebrates – R.L. Kotpal
2. Invertebrate Zoology – E.L. Jordan & P.S. Verma
3. A Manual of Zoology Volume 1 (Invertebrates) – Ekambaranatha Ayyar and T.N. Ananthakrishnan
4. Invertebrates – Ruppert, Fox, and Barnes
5. General Zoology – S.K. Singh & N.C. Nair

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MINOR ZOOLOGY PAPER - VI

BIODIVERSITY, WILD LIFE MANAGEMENT AND TOXICOLOGY

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I: Biodiversity **7 hrs**

a) Definition and types of Biodiversity
b) Scope and characterisation
c) Genetic, Species, and Ecosystem diversity
d) Levels of Biodiversity: Alpha, Beta, Gamma diversity
e) Importance of Biodiversity: Ecological, economic, and ethical values
f) Conservation Strategies

Unit – II: A] Wildlife Management **6 hrs**

a) Definition of wildlife and wildlife management
b) Scope and significance of wildlife management
c) Categories of wildlife: rare, endangered, vulnerable, endemic
d) Factors affecting wildlife: natural and anthropogenic

B] National Parks and Sanctuaries **09 hrs**

a) Malvan Marine Wildlife Sanctuary
b) Kaziranga National Park
c) Gir National Park
d) Bharatpur wildlife sanctuary
e) Tadoba- Andhari National Park
f) Radhanagari wildlife sanctuary

(Brief idea about locality, history, target animals, threats)

Unit – III: Toxicology **8 hrs**

a) Definition and classification of toxicology
b) Toxic agents and mode of action
    i. Pesticides- Synthetic insecticides (Organophosphate, Organochlorine, Carbamate- one each)
    ii. Metal toxicity: Lead, Mercury and Cadmium
c) Mycotoxins-
d) Applications

Suggested Readings:

1. Wildlife Ecology and Management – Eric G. Bolen & William L. Robinson
2. Wildlife Conservation and Management – S. K. Singh
3. Essentials of Wildlife Ecology and Conservation – G. C. Waugh

4. Wildlife of India – V. B. Saharia
5. Principles of Wildlife Management – R. B. Singh
6. Indian Wildlife Protection Laws – B. B. Hosetti
7. Principles of Toxicology – Stumph & Guthrie
8. Toxicology – K. C. Gupta
9. Essentials of Toxicology – Klaassen & Watkins
10. Elements of Toxicology – P. D. Sharma

B. Sc. PART – II SEMESTER – III (NEP 2.0)

MINOR ZOOLOGY PRACTICAL - III

(Based on Fundamentals of Non-Chordates, Biodiversity,

Wild life management and Toxicology)

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Unit – I *Paramoecium*

A. Systematic position
B. Morphological characters
C. Study of locomotion in *Paramoecium* (through prepared video/animation)
D. Reproduction: Asexual (Binary fission), Sexual (Conjugation)

Unit – II Earthworm

A. Systematic position
B. Morphological characters
C. Dissections,
    a. Digestive system: Alimentary canal
    b. Circulatory system: Longitudinal blood vessels, hearts and loops
    c. Nervous System: Central nervous system
    d. Reproductive System: Male and female reproductive organs
D. Temporary Preparations,
    a. Gizzard
    b. Septal Nephridia
    c. Spermatheca
    d. Setae

Unit – III

A. Foot in Mollusca – Chiton,Pila, Mytilus, Unio and Sepa.
B. Pedicelaria in Echinodermata
C. Salient Features of Minor Phyla : Bugula, Sagitta and Lingula
D. Invertebrates in Medicine :
    1) Leech (*Hirudo medicinalis*) – Leech Therapy
    2) Honey Bees – Apitherapy

Unit – IV Biodiversity and Wildlife Management

A. Study of Alpha, Beta and Gamma Diversity (from Forest and Grassland Habitats)
B. Study of species richness, evenness and abundance using samples
C. Estimation of biodiversity by Simpson's Diversity Index using sample data.
D. Study of biodiversity conservation methods.
E. Study of identification of common Indian wild animals through indirect evidence (e.g. casts, pugmarks, scats, pellets, etc.)

F. Study of any one nearby national park or wildlife sanctuary
G. Study of the effects of insecticides on human health (endosulfan effect)
H. Study of heavy metals toxicity on human health:
   Pb- (Plumbism)
   Hg- (Minamata),
   Cd. (Itai-itai)

Suggested Readings:

1. Practical Zoology: Invertebrates" – S.S. Lal
2. Manual of Practical Zoology – Invertebrates" – P.S. Verma & B.S. Tyagi
3. Manual of Practical Zoology – Invertebrates" – P.S. Verma & B.S. Tyagi
4. Practical Zoology Manual" – A.C. Dutta
5. Methods in Ecology and Environmental Science" – H.S. Sharma
6. India's National Parks and Wildlife Sanctuaries" – Pradeep Sachdeva
7. Essentials of Toxicology" – M. Asha & P. Ramaswamy
8. A Textbook of Toxicology" – Pandey & Shukla

B. Sc. PART – II SEMESTER – III (NEP 2.0)

OPEN ELECTIVE PRACTICAL COURSE (OE) - III

AQUARIUM CONSTRUCTION AND MAINTENANCE

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

I. Importance and history of aquarium fish keeping.

II. Design and construction of aquaria:

1. Aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass, preparation of glass tank,
2. Strengthening and supporting of the tank,
3. Fitting of tanks into room settings.

III. Aquarium floor setting

4. Type and size of pebbles, gravels, granites used for bed construction
5. Aquarium Accessories: Aerator, Filters, Aquarium plants,

IV. Water Quality Management

6. pH and Temperature
7. Turbidity
8. Dissolved oxygen,
9. Free CO_2
10. Total hardness
11. Ammonia

V. Fish Transport

12. Transferring the fish for changing water and cleaning of aquarium
13. Fish transport protocol for short and long distance

VI. Aquarium maintenance

14. Food and feeding,
15. Control of algal growth,
16. Control of snails and other predators

VII. Study of ornamental fish varieties

17. Indigenous and Exotic (five species each)
18. Study of Common diseases (Viral, Bacterial, Protozoans and Fungal- one disease each)

VIII Field Visit: Visit to an ornamental fish center/hatchery (submit a report during practical examination)

B. Sc. भाग – II सेमेस्टर – III (NEP 2.0)

ओपन इलेक्टिव प्रॅक्टिकल कोर्स (OE) - III

अक्वेरियम बांधणी आणि देखभाल

प्रॅक्टिकल: 60 तास. गुण-50 (क्रेडिट्स: 02)

I: अक्वेरियम फिश ठेवण्याचे महत्त्व आणि इतिहास

II: अक्वेरियम डिझाईन आणि बांधणी:

1. अक्वेरियम तयार करणे - आकार, प्रकार, काचेच्या टाकीचे प्रकार, काच कापणे, काचेची टाकी तयार करणे.
2. टाकीला बळकटी देणे आणि समर्थन करणे.
3. टाकी, खोलीच्या सजावटीत बसविणे.

III: अक्वेरियम फ्लोअर सेटिंग

4. तळ तयार करण्यासाठी वापरण्यात येणाऱ्या गोटे, खडी, ग्रॅनाइटचे प्रकार आणि आकार.
5. अक्वेरियम ॲक्सेसरीज: एअरिएटर, फिल्टर्स, अक्वेरियम वनस्पती.

IV: पाण्याच्या गुणवत्तेचे व्यवस्थापन

6. pH आणि तापमान
7. गढूळपणा
8. विरघळलेला ऑक्सिजन
9. मुक्त CO2
10. एकूण कठोरता
11. अमोनिया

V: माशांची वाहतूक

12. पाणी बदलण्यासाठी आणि अक्वेरियम साफ करण्यासाठी मासे हलविणे.
13. अल्प आणि दीर्घ अंतरासाठी मासे वाहतूक प्रोटोकॉल.

VI: अक्वेरियम देखभाल

14. अन्न आणि खाणे
15. शेवाळ नियंत्रण
16. गोगलगायी आणि इतर भक्षक नियंत्रित करणे

VII: शोभिवंत माशांच्या जातींचा अभ्यास

17. स्वदेशी (इंडिजिनस) ,परदेशी (एक्झॉटिक) (प्रत्येकी पाच)

18. **सामान्य आजारांचा अभ्यास**

(व्हायरल, बॅक्टेरियल, प्रोटोजोअन आणि फंगल).(प्रत्येकी एक)

क्षेत्रभेट (फील्ड व्हिजिट)

शोभिवंत मासे मत्स्यपालन केंद्र/ मत्स्य प्रजनन केंद्र भेट देणे (प्रॅक्टिकल परीक्षेच्या वेळी अहवाल सादर करणे).

References

- Aquarium Making: Fish-keeping and Maintenance by Mundy Obilor Jim. JimArts 2019
- A Complete Guide to Setting up and Maintenance of an Aquarium by Pawar Prabhakar. Lambert Academic Publishing 2013
- A Textbook of Pisciculture & Aquarium Keeping Book by H. S. Jagtap, S. N. Mukherjee, V. K. Garad. Daya Publishing House 2009
- 500 Freshwater Aquarium Fish: A Visual Reference to the Most Popular Species
  By Greg Jennings. Firefly Books Ltd 2018
- Setting up a Tropical Aquarium: Week by Week Stuart Thraves. Firefly Books Ltd2015
- Aquarium Food by Mills D. Kingfisher Books 1981
- Manual of tank busters by Sanford G, Crow R. Salamander 1991
- Popular aquarium plants by Thabrow De WV. Thornbill press 1981
- Breeding aquarium fish by Axelrod TFH publications 1978
- Practical Guide to tropical aquarium fish by Crow and Keeley. Tiger Book Int London 1992.

B. Sc. PART – II SEMESTER – III (NEP 2.0)

VOCATIONAL SKILL COURSE (VSC) – I (MAJOR SPECIFIC)

Domestic and Pet Animal Feed Preparation

PRACTICAL: 60 HRS. MARKS-50 (CREDITS: 02)

Practical's:

1. Components of animal feed
2. Designing a Balanced Diet for Lactating Cow/ buffalo
3. Preparation of feed for Pregnant cow/ buffalo
4. Designing a Balanced Diet for Pregnant Cow/ buffalo
5. Preparation of feed for lactating cow/ buffalo
6. Preparation of feed for Goat
7. Preparation of Feed for Layer poultry fowl
8. Preparation of feed for Broiler poultry fowl
9. Preparation of feed for ornamental fishes
10. Preparation of feed for cultured fishes (Anyone fish)
11. Preparation of feed for pet dogs
12. Preparation of feed for pet cats
13. Preparation of feed for laboratory animals (Mice/rats)
14. Test for microbial contamination in animal feed
15. Methods of storage of animal feed
16. Visit to Animal feed formulation center and submission of report at the time of examination.

References:

- D. N. Pandey & Amita Bajpai (2020) animal nutrition & feed technology for livestock, pets & laboratory animal
- Dr. Vir Singh, Ashoka Kumar (2011) Animal Feeding and Production in India
- Dr. Leonard Charles Nwaogu (2022) Feed formulation poultry: a - z professional guide for chicken, turkey. Duck, geese, guinea fowl, quail, fish, breeders stock, and all stages of life
- Athithan (2014) practical book on fish nutrition & feed technology
- Amlan Patra and Rita Payan-Carreira (2022) Animal feed science and nutrition - production, health and environment

B. Sc. PART – II SEMESTER – III (NEP 2.0)
SKILL ENHANCEMENT COURSE (SEC) – I (MAJOR SPECIFIC)
POULTRY FARMING
PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Practical's :

I. Morphology of Poultry Birds

II. Poultry Breeds

a. Indian
b. Exotic

III. Types of Poultry Breeds

a. Layers
b. Broiler
c. Dual Purpose Breeds

IV. Poultry Housing Systems

a. Extensive/Open Yard System
b. Semi-Intensive System
c. Intensive System
    1. Deep Litter System
    2. Cage System
    3. Slat System

V. Feeding and Nutrition

a. Nutritional requirements
b. Feeding ingredients for poultry birds

VI. Poultry Breed Management

a. Management of Hatchery and Chicks - Chick care and management
b. Management of Layer Birds -Housing, feeding and care
a. Management of Broiler Birds - Housing, feeding and care

VII. Poultry Farming Equipment

a. Types of Poultry Feeder and Waterer
b. Other essential poultry Equipment

VIII. Health Care in Poultry

a. Common Diseases
b. Vaccination
c. Cleaning and Disinfection

IX. Study of the followings

a. Nutritional Value of Poultry Meat and Eggs
b. By products of Poultry Farming
c. Economic Importance of Poultry Farming

Field visit and submission of report.

B. Sc. PART – II SEMESTER – IV (NEP 2.0)
MAJOR ZOOLOGY PAPER - VII
REPRODUCTIVE BIOLOGY
THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit I: Structure and hormones of Pituitary gland. (3 Hrs)

Unit II: Functional Anatomy of Human Female Reproductive system: (12 Hrs)

1. Anatomy and Histology of Female Reproductive system
    a) Ovary
    b) Fallopian tube
    c) Uterus
    d) Cervix
    e) Vagina.
2. Female Sex Hormones
3. Reproductive cycle
    a) Menstrual cycle and hormonal regulation
    b) Structure of Graafian follicle
4. Transport of Ovum and Sperm in female genital tract
5. Process of fertilization, implantation and placentation (In Short).
6. Diagnostic features of Pregnancy and hormonal regulation
7. Mechanism and Hormonal regulation of Parturition and Lactation

Unit III: Functional Anatomy of Human Male Reproductive system: (8 Hrs.)

1. Anatomy and Histology of Male Reproductive system
    a) Testis
    b) Epididymis
    c) Seminal vesicle
    d) Prostate gland
    e) Cowper's gland
    f) Penis
2. Male Sex Hormones
3. Process of Spermatogenesis and Structure of Sperm
4. Sperm maturation in epididymis
5. Sperm transport in Male genital tract and composition of semen
6. Hormonal Control of Testicular activities

Unit IV: Reproductive Health: (4 Hrs.)

1. Infertility in Male: Causes, Diagnosis and Management
2. Infertility in Female: Causes, Diagnosis and Management
3. Assisted Reproductive Technology:
    A. Sperm bank
    B. Frozen embryo

C. Intrauterine Transfer (IUT)
D. Zygote Intra-fallopian Tube Transfer (ZIFT)
E. Gamete Intra-fallopian Transfer (GIFT)
F. Intra-cytoplasmic Sperm injection (ICSI)
G. In Vitro Fertilization (IVF)
    a) Ovarian Stimulation
    b) Egg retrieval
    c) Sperm retrieval
    d) Fertilization
    e) Embryo Transfer

Unit V: Contraceptives: **(3 Hrs.)**

1. Natural Methods
2. Mechanical Methods
3. Chemical Methods
4. Intra Uterine Devices (IUDs)
5. Sterilization operations
    a) Female Sterilization operations - Tubectomy
    b) Male Sterilization operations - Vasectomy

Reference Books:

- A Textbook of Medical Physiology, Guyton and Hall, Elsevier Publication.
- Human Reproductive Biology by Kristin H. Lopez and Richard E. Jones
- Reproductive Biology by Saroj Kumar Mishra, Manoj Kumar Mohanty and Subodh Chandra Praharaj (Kalyani Publications).
- Endocrinology and Reproductive Biology by K. V. Sastry (Rastogi Publications).

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MAJOR ZOOLOGY PAPER - VIII

APPLIED ENTOMOLOGY

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit I Medical Entomology **(14hrs)**

1. Types of vectors
    a) Mechanical vectors (Meaning with examples)
    b) Biological vectors (Meaning with examples)

2. Morphology and life cycle of –
    a) Mosquito (*Anopheles* and *Aedes*)
    b) House fly (*Musca domestica*)
3. Study of mosquito borne diseases –
    a) Malaria
    b) Dengue
    c) Control measures of Mosquitoes
4. Study of house fly transmitted disease
    a) Typhoid
    b) Dysentery
    c) Control measures of house fly

Unit II: Agricultural Entomology **(8hrs)**

1. Concept of insect pest
2. Biology, damage caused and Control measures of
    A. Gram pod borer, *Helicoverpa armigera*
    B. Sugarcane leafhopper, *Pyrilla perpusilla*
    C. Lemon Butterfly, *Papilio demoleus*
    D. Pulse Beetle, *Callosobruchus chinensis*
    E. Rice Weevil, *Sitophilus oryzae*
    F. Red Flour beetle, *Tribolium castaneum*

Unit III: Forensic Entomology: **(8 hrs)**

1. Introduction to forensic Entomology
2. Insects involved in the forensic investigations
    (Morphological Characteristics of adults and maggots)
    A. Blow fly, *Calliphora vicina*
    B. Common flesh fly, *Sarcophaga carnaria*
    C. Head louse *Pediculus humanus capitis*
3. Postmortem Interval (PMI) and its estimation process
4. Applications and limitations of Forensic Entomology

Suggested Readings for Paper VIII:

- Tembhare D. B. (1997) Modern Entomology. Himalaya Publishing House, New Delhi.
- Atwal, A. S.(1986).Agricultural Pests of India and South East Asia, Kalyani
- Chapman,R.F.(1998).The Insects: Structure and Function. IV Edition, Cambridge University Press, UK.
- Dennis, H.(2009).Agricultural Entomology.Timber Press (OR).
- Pedigo L. P. (2002). Entomology and Pest Management
- Ganga,G. and Chetty,S.J.(1997):An Introduction to Sericulture,2nd Edition, Oxford and IBH Publishing Co. Ltd. New Delhi.
- Mohan Rao M.M.(1988):A textbook of Sericulture BSP Publications, Sultan Bazar, Hyderabad.
- Hisao, Aruga:Principles of Sericulture.Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Catts EP, Goff ML. Forensic entomology in criminal investigations. Annu Rev Entomol 1992;37:253-72.
- Amendt J, Krettek R, Zehner R. Forensic entomology. Naturewissenschaften 2004;91:51-65. 3.
- Sukontason K, Narongchai P, Kanchai C, Vichairat K, Sribanditmongkol P, Bhoopat T, et al. Forensic entomology cases in Thailand: a review of cases from 2000 to 2006. Parasitol Res 2007;101:1417-23.

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MAJOR ZOOLOGY PRACTICAL - IV

(Based on Reproductive Biology and Applied Entomology)

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Unit I: Reproductive biology

1. Study of Animal house:
   a) Set up and maintenance of animal house
   b) Breeding techniques
   c) Care of normal and experimental animals with the help of model/photographs
2. Stages/phases of menstrual cycle.
3. Surgical techniques: Principles of surgery in endocrinology in rats through Demonstration or Video
   a) Ovariectomy
   b) Tubectomy
   c) Hysterectomy
   d) Orchiectomy
   e) Vasectomy
4. Examination of histological sections from photomicrographs/permanent slides of Rat /Rabbit
   a) Testis
   b) Epididymis
   c) Ovary
   d) Fallopian tube
   e) Uterus (proliferative and secretary phases),
   f) Cervix
   g) Vagina

5.Structure of human sperm and ovum
6. Composition of Semen
7. Detection of pregnancy by using kit.
8. Study of contraceptive devices by photographs or models.

Unit II: Applied Zoology:

9. Study of arthropod vectors associated with human diseases:

   a) *Anopheles* Mosquito
   b) *Aedes* mosquito
   c) *Musca* Housefly

10. Study of mosquito borne diseases –

d) Malaria
e) Dengue

11. Study of house fly transmitted disease

a) Typhoid
b) Dysentery

12. Study of insect pests through damaged products/photographs.

A. Crop Pests:
   a) Gram pod borer (*Helicoverpa armigera*)
   b) Sugarcane leaf hopper (*Pyrilla perpusilla*)
   c) Lemon Butterfly (*Papilio demoleus*)

B. Stored grains pests
   a) Pulse Beetle (*Callosobruchus chinensis*)
   b) Rice Weevil (*Sitophilus oryzae*)
   c) Red Flour beetle (*Tribolium castaneum*)

13. Study of Insects involved in the forensic investigations

a) Blow fly, *Calliphora spp.*
b) Common flesh fly, *Sarcophaga spp.*
c) Head louse *Pediculus humanus capitis*

14. Study tour: visit to any one sea shore or national park, sanctuary or zoo to study animal diversity. Submission of report during the practical examination. Duration for study tour may be of 2 to 7 days.

Suggested Reading

1. Arthropod Vectors (*Anopheles*, *Aedes*, Housefly): Volume I, Pages 60–80
2. Mosquito-Borne Diseases (Malaria, Dengue): Volume I, Pages 90–110
3. Crop Pests (*Helicoverpa armigera*, *Pyrilla perpusilla*): Volume II, Pages 200–220
4. Stored Grain Pests (*Callosobruchus chinensis*, *Sitophilus oryzae*): Volume II, Pages 230–240
5. Diseases Caused by Houseflies (Myiasis): Chapter 6, Pages 140–160
6. Mosquito Biology and Disease Transmission: Chapter 8, Pages 180–200
7. Forensic Entomology (*Calliphora vicina*, *Sarcophaga carnaria*): Chapter 10, Pages 300–320
8. Identification of Crop and Stored Grain Pests: Pages 50–70
9. Models and Photographs of Arthropod Vectors: Pages 100–110

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MINOR ZOOLOGY PAPER - VII

Physiology, Endocrinology and Histology

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I: Physiology **16 hrs**

1: Introduction to Animal Physiology
- Definition, scope and importance
- Levels of physiological regulation
- Homeostasis and feedback mechanisms

2: Respiration
- Types of respiration: aerobic and anaerobic
- Respiratory organs and Mechanism of Breathing (in rat and *Scoliodon*)

3: Circulation
- Composition and functions of blood
- Blood groups and coagulation
- Structure and mechanism of working of heart in mammals

4: Excretion and Osmoregulation
- Structure and function of nephron
- Mechanism of urine formation

5: Vitamins (with reference to source role and deficiency)
- Water soluble vitamins: B complex and C
- Fat soluble vitamins: A, D, E and K

Unit – II: Endocrinology **7 hrs**

1: Introduction to Endocrinology
- Definition
- General properties of hormones

2: Study of Endocrine organs with respect to structure and functions
- Pituitary gland
- Adrenal Gland
- Thyroid Gland
- Pancreatic gland

Unit – III: Histology of mammalian organs **7 hrs**

1: Alimentary canal
- Oesophagus
- Stomach

- Small intestine
- Large intestine

2: Digestive glands

- Liver
- Pancreas

Suggested Readings:

1) Animal Physiology and Biochemistry – R. Rastogi
2) Animal Physiology – A.K. Berry
3) Animal Physiology – P.S. Verma, V.K. Agarwal (S. Chand & Co.)
4) Essentials of Animal Physiology – S.C. Rastogi
5) Animal Physiology and Anatomy – K. V. Sastry
6) Textbook of Endocrinology – Mac E. Hadley
7) Endocrinology – S. Vinay Kumar & Ramesh Gupta
8) Animal Physiology & Endocrinology – R.L. Kotpal
9) Vertebrate Endocrinology – Norris & Carr
10) Essentials of Animal Histology – G.P. Pal
11) A Textbook of Histology – Ham & Cormack
12) Animal Histology – Dr. M. A. Suvarna (Vidya Books, Kolhapur)
13) Histology and Histotechnique – M.A. Subramanian

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MINOR ZOOLOGY PAPER - VIII

Economic Zoology and Parasitology

THEORY: 30 Hrs. MARKS-50 (CREDITS: 02)

Unit – I: Fisheries **11 hrs**

1. Economic importance of fin fishes
   a) Rohu *(Labeo rohita)*
   a) Catla *(Catla catla)*
   b) Mrigal *(Cirrhinus mrigala)*
   c) Tilapia *(Oreochromis mossambicus)*

2. Economic importance of shell fishes
   a) Lobster
   b) Prawn
   c) Crab
   d) Mussel
   e) Sepia

3. Fish Farming
   a) Construction and Maintenance of a fish farm
   b) Fishing Crafts and gears

Unit – II: Goat farming and Dairy science **08 hrs**

1. Goat Farming
   a) Breeds of Goat
   b) Feeding
   c) Housing
   d) Economic Importance

2. Dairy Science
   a) Milk and milk products

Unit – III: Parasitology **11 hrs**

1. Definition and types of parasites
2. Type study: *Ascaris*
   a) Systematic Position
   b) Habit and Habitat
   c) Morphology
   d) Digestive System
   e) Reproductive system
   f) Life Cycle
   g) Pathogenicity
   h) Parasitic adaptations
   i) Prevention and control

Suggested Readings:

1. Economic Zoology – *Shukla & Upadhyay*

2. Applied Zoology – *S.K. Gupta*
3. Economic Zoology – *Vasanth Kumar*
4. Manual of Economic Zoology – *Jagdish Prasad*
5. Textbook of Applied Zoology – *R.L. Kotpal*
6. Introduction to Economic Zoology – *S.K. Sharma*
7. Parasitology – K.D. Chatterjee
8. Medical Parasitology – R.L. Kotpal
9. Textbook of Parasitology – S.C. Parija

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

MINOR ZOOLOGY PRACTICAL - IV

(Based on Physiology, Endocrinology, Histology, Economic Zoology and Parasitology)

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

Unit I: Physiology and Endocrinology

A. Estimation of Haemoglobin percentage using Sahli's Hemoglobinometer.
B. Determination of Bleeding time (own or provided blood sample)
C. Determination of Coagulation time (own or provided blood sample)
D. Microscopic Examination of Blood Smear
E. Peak expiratory flow rate
F. Study of vitamins: Water and fat soluble
G. Study of Endocrine Glands (Slides/Charts/Models)
    - Pituitary gland
    - Thyroid gland
    - Adrenal gland
    - Pancreas (Islets of Langerhans)

Unit II: Histology

A. Study of following Permanent Slide
    - Oesophagus
    - Stomach
    - Small intestine
    - Large intestine
    - Liver
    - Pancreas

Unit III: Fisheries

A. Study of Economically Important Fishes
   (Using preserved specimens/charts/models)
    - Rohu *(Labeo rohita)*
    - Catla *(Catla catla)*
    - Mrigal *(Cirrhinus mrigala)*
    - Tilapia *(Oreochromis mossambicus)*

B. Study of Economic importance of followings
   (using preserved specimens/charts/models)
    - Prawn
    - Lobster
    - Crab
    - *Sepia*
    - Mussel

C. Study of Fish Farm Design (Chart/Model)
    - Structure and layout of fish pond:
    - Hatchery, nursery, grow-out pond
    - Water inlet/outlet, bunds, aerators

D. Fishing Crafts:
Gill net, cast net, trawl net, long lines, Seine net, Drift net, Purse seines,

Unit IV: Goat Farming and Dairy Science

A. Study of Goat Breeds:
Sirohi, Jamunapari, Osmanabadi, Boer, Beetal, Saanen

B. Study dairy products:
Milk, curd, ghee, paneer, cheese, khoa

Unit V: Parasitology

A. Ascaris:
   a. Morphology (Male, Female, Sexual dimorphism)
   b. Life cycle
   c. Parasitic adaptations

Study tour: visit to any one sea shore or national park, sanctuary or zoo to study animal diversity. Submission of report during the practical examination. Duration for study tour may be of 2 to 7 days.

Suggested Readings:

1. Practical Zoology – Vertebrates" – S.S. Lal
2. Practical Zoology: Vertebrate" – P.S. Verma & B.S. Tyagi
3. Human Histology" – Inderbir Singh
4. Fish Biology and Fisheries" – J.S. Datta Munshi & H. Srivastava
5. A Handbook of Animal Husbandry" – ICAR Publication
6. Goat Farming" – K. Pradhan
7. Dairy Technology" – Sukumar De

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

OPEN ELECTIVE COURSE (OE)

Title: Apiculture – Practical

THEORY: 60 Hrs. MARKS-50 (CREDITS: 02)

Practical:

1. Study of morphology of Honey bee.
2. Study of different species of honey bees (*Apis dorsata, A. florea, A. cerana indica,* and *A. mellifera*)
3. Study of different castes of honey bees.
4. Study of life cycle of the honey bee.
5. Study of natural and artificial bee hive.
6. Study of equipment required for bee keeping.
7. Study of techniques of rearing of honey bees.
8. Study of extraction of honey
9. Study of Processing of honey.
10. Study of extraction methods of bee-wax, royal jelly, propolis and bee venom.
11. Study of communication in bees.
12. Study of swarming in Honeybees (for Colony shifting and Nuptial flight)
13. Study of enemies, pests of honey bees
14. Study of diseases of honey bees
15. Analysis of adulteration of honey.

Institute Visit to Apiary / Bee Research Centre and submission of report at the time of Examination.

Suggested Readings:

- Roger A. Morse, Kim Flottum, 1998. Honey Bee Pests, Predators and Diseases. WicwasPr; 3rd edition.
- Alethea Morrison (Author), Mars Vilaubi (Photographer), 2013. Homegrown Honey Bees: An Absolute Beginner's Guide to Beekeeping Your First Year, from Hiving to Honey Harvest. Storey Publishing, LLC; 1edition.
- Hunt, G.J., 2000. Using honey bees in pollination Purdue University.
- aidlaw, H.H., 1997. Contemporary queen rearing.Published by Dadantand Sons. R. A. Morse, Rearing queen honey bees. Wicwas press, NY.
- Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.
- Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S
- Kim Flottum, 2014. The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden. Quarry Boo

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

OPEN ELECTIVE COURSE (OE)

शीर्षक: मधमाशीपालन प्रात्यक्षिक

THEORY: 60 Hrs. MARKS-50 (CREDITS: 02)

पाठ्यक्रमाचे उद्दिष्टे:

1. मधमाशीपालनासाठी लागणारे साधनसामग्री, उपकरणे आणि मधमाशांचे पोळे व्यवस्थापित करण्याचे मूलभूत ज्ञान मिळवणे.
2. मधमाशांच्या जीवनचक्राबद्दल तसेच मधमाशीपालनासाठी लागणाऱ्या उपकरणांचे प्राथमिक ज्ञान मिळवणे.
3. मधमाशांच्या पोळ्यांचे व्यवस्थापन, मध उत्पादन, व परागीभवनासाठी आवश्यक कौशल्ये शिकणे.
4. विद्यार्थ्यांना स्वयंरोजगाराच्या दृष्टीने या कोर्सचा उपयोग होईल.
5. मधमाशीपालनामुळे वनस्पतींच्या परागीभवनासाठी उपयोग होतो.
6. विविध मधमाशी उत्पादनांच्या विक्री व बाजारपेठेचे ज्ञान मिळवणे.

प्रात्यक्षिक अभ्यास

1. मधमाशांच्या शरीररचनेचा अभ्यास.
2. भारतीय मधमाशांच्या विविध प्रजातींचा अभ्यास (*Apis dorsata, A. florea, A. cerana indica,* आणि *A. mellifera*).
3. मधमाशांच्या विविध जातींचा अभ्यास.
4. मधमाशांच्या जीवनचक्राच्या विविध टप्प्यांचा अभ्यास.
5. नैसर्गिक मधमाशांच्या पोळ्यांचा अभ्यास.
6. कृत्रिम मधमाशांच्या पोळ्यांच्या विविध प्रकारांचा अभ्यास.
7. मधमाशा पालनासाठी लागणाऱ्या विविध साधनांचा अभ्यास.
8. मधमाशा पाळण्याच्या विविध तंत्रांचा अभ्यास.
9. मध संकलन प्रक्रियेचा अभ्यास.
10. मध प्रक्रियेचा अभ्यास.
11. मेण, रॉयल जेली, प्रोपोलिस, आणि मधमाशांच्या विषाच्या काढणीच्या पद्धतींचा अभ्यास.
12. मधमाशांमधील संवादाचा अभ्यास.
13. मधमाशांमधील गटगिरी (स्वार्मिंग) चा अभ्यास.
14. मधमाशांचे शत्रू आणि रोग यांचा अभ्यास.
15. मधाच्या भेसळीचे विश्लेषण.

    मधमाशांच्या पालन केंद्र व संशोधन संस्थेला भेट.

Suggested Readings:

- Roger A. Morse, Kim Flottum, 1998. Honey Bee Pests, Predators and Diseases. WicwasPr; 3rd edition.

- Alethea Morrison (Author), Mars Vilaubi (Photographer), 2013. Homegrown Honey Bees: An Absolute Beginner's Guide to Beekeeping Your First Year, from Hiving to Honey Harvest. Storey Publishing, LLC; 1edition.
- Hunt, G.J., 2000. Using honey bees in pollination Purdue University.
- Aidlaw, H.H., 1997. Contemporary queen rearing.Published by Dadantand Sons. R. A. Morse, Rearing queen honey bees. Wicwas press, NY.
- Alison Benjamin, By (author) Brian McCallum, 2008. Keeping Bees and Making Honey. David & Charles, Newton Abbot.
- Kim Pezza, 2013. Backyard Farming: Keeping Honey Bees: From Hive Management to Honey Harvesting and More. Hatherleigh Press, U.S
- Kim Flottum, 2014. The Backyard Beekeeper: An Absolute Beginner's Guide to Keeping Bees in Your Yard and Garden. Quarry Boo

B. Sc. PART – II SEMESTER – IV (NEP 2.0)

SKILL ENHANCEMENT COURSE (SEC) IN ZOOLOGY

Introduction to Dairy Science and Management

PRACTICAL: 60 Hrs. MARKS-50 (CREDITS: 02)

I. Introduction to Common Dairy Animals

1. Study of dairy animals
2. Breeds and their characteristics of – Breeds of cow (Indigenous and Exotic) and Buffalo (Murrha)
3. Selection of the breeds for specific climates and purposes

II. Techniques of Dairy Management

4. Study of Housing and Maintenance
5. Feeding practices: Nutritional needs and formulation of feed
6. Milking techniques: Hand milking and machine milking
7. Record-keeping for milk yield, breeding, and health

III. Milk and Milk Products

8. Study of Composition and properties of milk
9. Study of Processing techniques: Pasteurization, homogenization, and sterilization
10. Study of Common milk products: Curd, Paneer , Butter ,Cheese ,Ice Cream , Yoghurt and Ghee
11. Testing of Fat in Milk.

IV. Diseases of Dairy Animals

12. Study of common diseases in dairy animals with reference to Bovine Mastitis, Foot-and-Mouth disease (FMD), Brucellosis, Bovine viral diarrhea (BVD).
13. Study of Recognizing signs of illness in dairy animals
14. Study of Basic Treatment and first-aid
15. Prevention and control measures of diseases : Vaccination, biosecurity, and hygiene

Visit to Dairy farm / industry and submission of report.

Suggested Readings:

1. Handbook of Animal Husbandry: Indian Council of Agricultural Research (ICAR)
2. Cattle and Buffalo Production Systems: J. W. Rendel

3. Livestock Production and Management: N. S. R. Sastry, C. K. Thomas, and R. A. Singh
4. Dairy Management: Principles and Practices: G. A. Khan
5. Feeds and Feeding Practices in Dairy Animals: Ranjan Kumar
6. Milking and Milk Handling: M. N. Mathur
7. Dairy Microbiology Handbook: Richard K. Robinson
8. Technology of Milk Processing and Dairy Products: N. P. Agrawal
9. Principles of Dairy Chemistry: Jenness R. and Patton S.
10. Dairy Processing Handbook: Tetra Pak International
11. A Textbook of the Diseases of Cattle, Sheep, Goats, Pigs, and Horses, Otto Radostits et al.
12. Manual of Veterinary Therapeutics: Douglass S. K.
13. Dairy Herd Health: Martin Green
14. Practical Guide to Cattle Diseases and Their Control: Clive Brown