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)

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.

Semester III

Zoology Major

1. Fundamentals of Chordates

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.

1. 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.

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.

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.
- Modern Text book of 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 – 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