



SU/BOS/Science/06

Date: 01/01/2024

To,

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

The Head/Co-ordinator/Director
All Concerned Department (Science)
Shivaji University, Kolhapur.

Subject: Regarding syllabi of B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

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 revised syllabi, nature of question paper and equivalence of B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

B.Sc.-III (Sem. V & VI) as per NEP-2020 (1.0)			
1.	Mathematics	12.	Computer Science (Opt)
2.	Statistics	13.	Computer Science (Entire)
3.	Physics	14.	Information Technology (Entire)
4.	Microbiology	15.	Food Science and Technology (Entire)
5.	Industrial Microbiology	16.	Food Science
6.	Electronics	17.	Food Science and Quality Control (Entire)
7.	Chemistry	18.	Food Technology & Management (Entire)
8.	Sugar Technology (Entire)	19.	Biochemistry
9.	Geology	20.	Biotechnology (Optional/Vocational)
10.	Zoology	21.	Biotechnology (Entire)
11.	Botany	22.	Environmental Science (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020(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 2024 & March/April 2025. 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,

By Registrar
Dr. S. M. Kubal

Copy to:

SHIVAJI UNIVERSITY, KOLHAPUR.



Accredited By NAAC with A++ Grade

Revised Syllabus for

B.Sc. Part- III

NEP 1.0

Zoology

Syllabus to be implemented from June, 2024 onwards.

SHIVAJI UNIVERSITY, KOLHAPUR

Revised Syllabus for Bachelor of Science

B. Sc. III – Zoology NEP 1.0 –To be implemented from June 2024

GENERAL OBJECTIVES OF THE COURSE

1) Aims:

1. To impart the knowledge of animal science to the pupils.
2. To make the pupils to use the knowledge in their daily life.
3. To make the pupils aware of natural resources and environment.
4. Application of knowledge in Zoology for nutrition, agriculture & live stock.
5. To provide practical experiences which form a part of their learning processes.
6. To develop aptitude for scientific work & ability to pursue studies far beyond graduation.
7. To encourage the pupils to take life science as a carrier which is the need nowadays.
8. To make the pupils fit for the society.

2) Objectives –

1. To impart knowledge is the basic aim of education. The students are expected to acquire the knowledge of animal science, natural phenomenon, manipulation of nature & environment by man.
2. Understanding the scientific terms, concepts, facts, phenomenon & their interrelationships.
3. Applications of the knowledge.
4. To develop skills in practical work, experiments & laboratory materials, instruments.
5. To develop interests in the subject & scientific hobbies.
6. To develop scientific attitude which is the major objective? This makes the students open minded, critical observations, curiosity, thinking etc.
7. Abilities to apply scientific methods, collection of scientific data, problem solving, organize science exhibitions, clubs etc.
8. Appreciation of the subject, contributions of scientists, scientific methods, scientific programs etc.

3) DURATION

- The course shall be full time course.
- The duration of course shall be three years.

4) **PATTERN:** Pattern of Examination will be semester for theory and annual for practical with INTERNAL ASSESSMENT (Project/Seminar/Field work for theory) Scheme

5) **MEDIUM OF INSTRUCTION:** The medium of instruction shall be in English.

6) **STRUCTURE OF COURSE:** B.Sc. III – Zoology THEORY – No. of papers: Eight, No of practicals: Four SEMESTER V-Paper IX to XII & SEMESTER VI- Paper XIII to XVI

SEMESTER-V Theory

Sr. No.	Subject	Marks	University	Internal
1	Zoology Paper- IX	50	40	10
2	Zoology Paper- X	50	40	10
3	Zoology Paper- XI	50	40	10
4	Zoology Paper- XII	50	40	10

Total=200

SEMESTER-VI Theory

Sr. No.	Subject	Marks	University	Internal
1	Zoology Paper- XIII	50	40	10
2	Zoology Paper- XIV	50	40	10
3	Zoology Paper- XV	50	40	10
4	Zoology Paper- XVI	50	40	10

Total = 200

PRACTICALS- Annual

09	Practical—V	50
10	Practical – VI	50
11	Practical – VII	50
12	Practical – VIII	50

Total 200

Total = 600

7. SCHEME OF TEACHING AND EXAMINATION (Teaching scheme - Hrs/Week)

No	Sem. - V	Sem. - VI	L	P	Total
1	Paper No IX Paper No. XIII	Paper No IX Paper No. XIII	3		
2	Paper No IX Paper No. XIII	Paper No IX Paper No. XIII	3		
3	Paper No IX Paper No. XIII	Paper No IX Paper No. XIII	3		
4	Paper No IX Paper No. XIII	Paper No IX Paper No. XIII	3		
			12		12
1	Practical V			5	
2	Practical VI			5	
3	Practical VII			5	
4	Practical VIII			5	
				20	20
	Total				32

8) SCHEME OF EXAMINATION

Question paper will be set in the view of the / in accordance with the entire syllabus and preferably covering each unit of syllabi.

9) EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS (FOR REVISED SYLLABUS)

Refer copy of revised syllabus

10) OTHER FEATURES

1. Required Books, Journals stated in each syllabus of Part I, Part II and Part III Zoology and Fisheries.

A) **LIBRARY :** Reference and Text Books, Journals, and Periodicals, Reference Books for Advanced Studies.

B) **SPECIFIC EQUIPMENTS:** Necessary to run the Course (T.V., L.C.D., and Overhead Projector), (Computer and necessary software's, operating systems etc.)

C) LABORATORY SAFETY EQUIPMENTS

- Fire Extinguishers at least two sets in each laboratory. (Lab. area 600 sq.ft.)
- Leakage of gases be avoided.
- Primary medical aid box (First Aid Kit)
- Sugar / Glucose – 500 gm pack: Pinch of sugar and a cup of drinking water in hypoglycemic condition. OR In extreme weakness of student or person concerned.
- Rules of animal ethics should be strictly followed.

D) LABORATORY INSTRUCTIONS

- 1) Always wear an apron inside the laboratory. Do not wear it outside.
- 2) Do not drink or eat inside the laboratory.
- 3) Do not place pencil, fingers or any material in the mouth. Moisten labels with water.
- 4) Use microscopes and other instruments carefully.
- 5) Discard all used glassware such as test tube, pipettes, petry-plates, glass slides in a receptacle meant for it.
- 6) Put cotton plugs, papers, matches, waste dissection material etc. in a waste-paperbasket. Do not throw them in sink not leave them on desk or floor.
- 7) Regard all cultures as pathogenic. Take every precaution against infection.
- 8) Report all accidents to the instructor immediately.
- 9) Wash hands thoroughly with soap and water before and after dissection and experiment.
- 10) Always turn off water, gas and electricity before leaving the laboratory.
- 11) When students enter in laboratory they should have – A Laboratory Journal, pencil and eraser, foot rule, dissection box with dissecting instruments, a small napkin.
- 12) All drawings must be made with drawing pencil only.
- 13) As the journal is to represent student's bonafide work during the whole year, student should keep it as clean as possible and DO NOT LOOSE IT
- 14) Students should not forget that unless their journals are certified, they are not allowed to appear for the university examination

11) COMMON NATURE OF QUESTION FOR THEORY PAPER:

SEMISTER – V Zoology Paper (IX, X, XI, XII)

SEMISTER VI Zoology Paper (XIII, XIV, XV, XVI)

Q. 1	Multiple Choice Questions (Eight questions)	08
Q. 2	Long answer questions (Attempt any two out of three)	16
	A.	
	B.	
	C.	
Q. 3	Short Notes (Attempt any four out of Six)	16
	a.	
	b.	
	c.	
	d.	
	e.	
	f.	

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus of B.Sc. Part III NEP 1.0

Sem.-VI: (DSE-E-29) Zoology Paper- IX

DSE-E29 (COMPARATIVE ANATOMY OF VERTEBRATES)

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits 2)

Unit 1: Integumentary System	4
1. Generalized structure of integument	
2. Functions of Integument	
3. Soft epidermal derivatives	
4. Hard epidermal derivatives	
Unit 2: Skeletal System	4
1. Types of vertebrae based on centrum	
2. Vertebral column (Rat/Rabbit)	
3. Appendicular skeleton (Rat/Rabbit)	
Unit 3: Digestive System	4
Brief account of the alimentary canal and digestive glands	
Unit 4: Respiratory System	4
Brief account of Gills, lungs, air sacs	
Unit 5: Circulatory System	4
Evolution of heart and aortic arches	
Unit 6: Evolution of Kidney	3
Succession of kidney	
Unit 7: Nervous System	3
Comparative account of brain	
Unit 8: Sense Organs	4
Comparative account of ear and eye of vertebrates	

SUGGESTED READINGS:

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition
2. The McGraw-Hill Companies. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

3. Outlines of comparative anatomy, Romer & Parsons, Central Book Depot, TheVertebrate Body (Saunders).
4. Biology of Vertebrates Walter & Sayles; (McMillan).
5. Chordate Zoology, P.S. Dhami & J. K. Dhami - R. Chand & Co., New Delhi.
6. Modern Textbook of Zoology, R. L. Kotpal, Rastogi Publications, Meerut.
7. The Life of Vertebrates, 3rd Edition, 1993, J. Z. Young E. L. B.S. Oxford.
8. Chordate Zoology - E.L. Jordan, S. Chand & Co., New Delhi.
9. The Phylum Chordata - 1987, H.H. Newman, Distributor Satish Book Enterprise, Agra.8.Comparative Anatomy of the Vertebrates G. C. Kent.

SHIVAJI UNIVERSITY, KOLHAPUR

**Syllabus of B.Sc. Part III NEP 1.0
Sem.-V: (DSE-F29) Zoology Paper- X**

Molecular Cell Biology and Biotechnology

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits 2)

Unit 1: Molecular Biology 10

- 1) Nucleic acids -
 - i. DNA - Watson and Crick's model of DNA and forms of DNA
 - ii. RNA – Structure and types
- 2) DNA Replication
 - i. Types of replications
 - ii. Process of prokaryotic and eukaryotic DNA replications
- 3) DNA Damage and Repair mechanism
- 4) Regulation of gene expression- Operon concept (Lac operon)
- 5) Genetic Code:
 - i. Properties of Genetic code
 - ii. Codon assignment
 - iii. Wobble hypothesis

Unit 2: Protein Synthesis 8

- A) Transcription in prokaryotes and eukaryotes
 - i. Process of transcription
 - ii. RNA polymerase
 - iii. Post transcriptional modification in RNA
- B) Translation in prokaryotes
 - i. Initiation
 - ii. Elongation
 - iii. Termination

Unit 3: Molecular Techniques in Gene Manipulation 12

1. Restriction enzymes: Nomenclature, detailed study of Type II.
2. Characteristics of Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophages
3. Gene cloning: Transformation techniques by Calcium chloride method and electroporation
4. Construction of genomic and cDNA libraries
5. Southern, Northern and Western blotting
6. DNA sequencing: Sanger method
7. Polymerase Chain Reaction,
8. DNA Finger Printing

SUGGESTED READINGS:

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. IIEdition, Academic Press, California, USA. Glick, B.R. and Pasternak, J.J. (2009).
2. Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009).
3. An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA. Snustad, D.P. and Simmons, M.J. (2009).
4. Principles of Genetics. V Edition, John Wiley and Sons Inc. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007).
5. Recombinant DNAGenes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA. Beauchamp, T.I. and Childress, J.F. (2008).
6. Principles of Biomedical Ethics. VI Edition, Oxford University Press.
7. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia.
8. Cell Biology, C.B. Powar, Himalaya Publication House.
9. Cell and Molecular Biology, E.J. Dupraw, Academic Press, New York.
10. Cell Structure and Function - A. G. Loewy, P. Siekevitz, J. R. Meninger & J. A. N. Gallant, Saunder College, Philadelphia.
11. Molecular Biology of the Cell - 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, K. Roberts & James D. Watson, Garlan Publishing, New York.

SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus of B.Sc. Part III NEP 1.0 Sem.-
Sem.V: (DSE-F-30) Zoology Paper- XI
Biotechniques and Biostatistics
Theory: 30 hrs. (37.5 Lectures of 48 minutes) (Credits 2)

Unit I: Genetically Modified Organisms	7
1. Production of cloned and transgenic animals:	
a. Nuclear Transplantation	
b. Retroviral Method	
c. DNA Microinjection	
2. Applications of Transgenic Animals:	
a. Productions of pharmaceuticals	
b. Production of donor organs	
3. Gene Knockout in mice.	
Unit II: Culture Techniques and Applications	8
1. Cell Culture Technique:	
a) Basic cell culture Equipment	
b) Cell culture growth Media	
c) Sterilization Techniques	
d) Primary cell culture by using dissociated cells and explant culture method	
e) Primary cell culture method, Passaging, Hayflick limit, advantages and limitations of primary cell culture	
f) Cell lines, Secondary cell culture, Advantages and limitations.	
2. Stem Cells: Introduction to stem cells	
a) Potency of stem cells: Totipotency, Pluripotency, Multipotency, Unipotency	
b) Sources of stem cells: Embryonic, Fetal, Adult	
c) Applications of stem cells in Medicine	
3. Cryopreservation Technique	
Unit III: Biostatistics	15
1. Biological Data	
2. Classification of Biological data	
3. Frequency Distribution	
4. Tabulation	
5. Graphical Representation of Data	
6. Measures of central tendency -	
a) Mean	
b) Median	
c) Mode	
7. Dispersion	
a) Mean Deviation	
b) Standard Deviation	
8. Correlation –	
a) Scattered diagram	
b) Karl Pearson's correlation coefficient	
c) Spearman's rank correlation coefficient	

SUGGESTED READINGS:

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. I Edition, Academic Press, California, USA. Glick, B.R. and Pasternak, J.J.(2009).
2. Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
3. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009) An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA. Snustad, D.P. and Simmons, M.J. (2009).
4. Principles of Genetics. V Edition, John Wiley and Sons Inc. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007).
5. Recombinant DNA Genes and Genomes- A Short Course. III Edition, Freeman and Co., N.Y., USA. Beauchamp, T.I. and Childress, J.F. (2008).
6. Principles of Biomedical Ethics. VI Edition Oxford University Press.
7. Elements of Biotechnology - P. K. Gupta, Rastogi Publications.
8. Gene V & VI, 1994, Lewin B., Oxford University Press, Oxford.
9. Concept of Genes- Pearson Edition 9. Cell and Molecular Biology
10. Joshi, P. Genetic Engineering and Its Applications. 2006. Agrobios India. 328pp.
11. A.K. Srivastava. Animal Biotechnology. 2018. Oxford & IBH Publishing Co Pvt.Ltd, 458pp.
12. B. Singh, S.K. Gautam. Textbook of Animal Biotechnology. 2013. Oxford & IBH Publishing Co Pvt.Ltd, 620pp.
13. P. N. Arora and P. K. Malhan. Biostatistics. Himalaya Publishing House, 4-B, Murani Lal Street, Ansari Road, Darya Ganj, New Delhi.
14. Steel, R.G.D., Torrie, J.H. and Dicky, D.A. (1997) Principles and Procedures of Statistics, A Biometrical Approach. 3rd Edition, McGraw Hill, Inc. Book Co., New York, 352-358.
15. M. Butler. Animal Cell culture and Technology. Second Edition, Rob Beynon UMIST, Manchester, UK. BIOS Scientific Publishers, London and New York
16. John Masters. Animal Cell Culture: 2000. A Practical Approach. OUP Oxford, 334pp.
17. Singh B, Gautam SK (2013) Text Book of Animal Biotechnology, TERI.

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus of B.Sc. Part III NEP 1.0

Sem.-V: (DSE-F-31) Zoology Paper- XII

AQUATIC BIOLOGY

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits 2)

Unit 1: Aquatic Biomes	8
a. Freshwater ecosystem (lakes, wetlands, streams and rivers), b. Estuaries c. Intertidal zones d. Oceanic pelagic zone e. Marine benthic zone f. Coral reefs	
Unit 2: Freshwater Biology	12
1. Lakes	
a. Lake as an Ecosystem b. Lake Morphometry c. Physicochemical characteristics i. Light ii. Temperature iii. Thermal Stratification iv. Dissolved solids v. Carbonates vi. Bicarbonates vii. Phosphates and Nitrates viii. Turbidity ix. Dissolved gases (Oxygen Carbon dioxide) x. Nutrient Cycle – (Nitrogen, Sulphur and Phosphorus)	
2. Streams	
a. Different stages of stream development b. Physicochemical Environment c. Adaptation of hill stream fishes	
Unit 3: Faunal Adaptations	07
Study of faunal adaptations regarding the following habitat: a. Lentic and Lotic b. Estuarine c. Intertidal Zones d. Deep Sea	
Unit 4: Freshwater Pollution	03
a. Causes of pollution (Sewage, Agricultural runoff, Industrial Discharges) b. Eutrophication c. Management	

Suggested Reading:

1. Anathakrishnan T. N. (1990): Bioresources Ecology 3rd Edition, CRC Press
2. Gerald and Paul Weihe (2015): Textbook of Limnology, Waveland Press
3. Goldman, Charles R., Horne, Alexander J. (1994): Limnology, 2nd Edition, McGraw Hill Publications
4. Hem Raj (2021): Aquatic Biology. Dinesh and Vinesh Co. Publications
5. Hosetti, B. B. and Arvind Kumar (2016): Textbook of Applied Aquatic Biology. Astral Publications
6. Kalff Jacob (1998): Limnology, Prentice Hall Publications
7. Odum, E. P. and Barrett, G. W. (2004): Fundamentals of Ecology, 5th Edition, Cengage India Private Limited
8. Trivedy R. K. and P. K. Goel (1984): Chemical and Biological Methods for Water Pollution Studies. Environmental Publications, Karad

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus of B.Sc. Part III NEP 1.0

Sem.-VI: (DSE-E-30) Zoology Paper- XIII

DEVELOPMENTAL BIOLOGY

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits 2)

Unit 1: Fertilization and early development 06

1. Structure of gametes (Revision) and Types of Eggs
2. Fertilization – Types and Process of Fertilization
3. Peculiarities of cleavage divisions and Types of Cleavages
4. Types of Morphogenic Movements
5. Organizer and Induction
6. Fate of three germ layers

Unit 2: Early Development of Frog 06

1. Structure of mature egg and its membranes
2. Cleavage
3. Blastula and its fate map
4. Process of gastrulation
5. Neurulation
6. Metamorphosis in frog and its hormonal regulation

Unit 3: Chick Embryology 15

1. Structure of sperm
2. Structure of egg and vitellogenesis
3. Fertilization and cleavage
4. Blastula and its fate map
5. Process of gastrulation
6. Organogenesis
 - a. Development of neural tube and brain up to 72 hours of incubation
 - b. Development of gut up to 72 hours of incubation
 - c. Development of blood and heart up to 72 hours of incubation
 - d. Foetal membranes and significance Unit

Unit 4: Implantation and placentation 03

1. Implantation and placentation of embryo in human being
2. Placenta –Types and significance

SUGGESTED READINGS:

1. Developmental Biology, 1997, Gilbert S.F. Saunder Associates Inc. U.S.A.
2. Developmental Biology, 1992 Browder L.W. Erickson C.A. & Williams, R J. Saunders College, Publications, London.
3. An Introduction to Embryology 1981, Balinsky B.L., Saunders College, Philadelphia.
4. Developmental Biology; Patterns/Principles/Problems, 1982, Saunders J. W. Collier MacMillan, Publishers, London.
5. Vertebrate Embryology By Robert S. McEwen, Oxford and IBN Publishing Co. 1978
6. Early embryology of Chick by Bradley M. Pattern, The Blakiston Company, Toronto
7. A Text Book of Embryology, Dr. Puranik P. G., S. Chand & Co.
8. Developmental Biology, 1984, Browder L.W., Saunders College Publications, U.S.A.
9. Development of Chick embryo, 1972, Lillie.
10. Developmental Biology, 1991, 3rd Edition, Sinaur Associates, Inc. U.S.A. Gilbert, S. F. (2006).
7. Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA. Balinsky, B.I. (2008).
8. An introduction to Embryology, International Thomson Computer Press. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
9. Inderbir Singh's Hunam Embryology by V. Sharada Devi (Editor) The Health Science publisher, 2018

SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus of B.Sc. Part III NEP 1.0
Sem.-VI: (DSE-E-32) Zoology Paper- XIV
IMMUNOLOGY

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits 2)

Unit 1: Overview of the Immune System	4
i. Introduction to basic concepts in immunology	
ii. Principles of innate and adaptive immune system	
Unit 2: Cells and Organs of the immune system	6
i. Components of the immune system	
ii. Cells of the immune system	
iii. Haematopoiesis	
iv. Organs (Primary and Secondary lymphoid organs) of the immune system	
v. Immune responses- Humoral and cell-mediated	
Unit 3: Antigens	5
i. Basic properties of antigens	
ii. Types of antigens, pathways of antigen processing and presentation	
iii. Epitopes, haptens and adjuvants	
Unit 4: Immunoglobulin / Antibodies	6
i. Structure, Classes, and Functions of Antibodies	
ii. Polyclonal Antibodies vs. Monoclonal Antibodies	
iii. Antigen – Antibody interactions	
UNIT 5: Working of the Immune System	9
i. Types, structure, and functions of MHC	
ii. Basic properties and functions of cytokines	
iii. Complement system: Components and pathways	
iv. Allergy, Hypersensitivity, and autoimmunity	
v. Immune disorders	
vi. Vaccines	

SUGGESTED READINGS:

1. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition.
 2. W.H. Freeman and Company. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
 3. Abbas, K. Abul and Lichtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication
 4. Essential Immunology- Ivan M. Roitt
 5. Introduction to Immunology – John W. Kimball.
 6. Immunology – D.M. Weir
 7. Immunology – Janis Kuby
- Elements of Immunology By F. H. Khan, Pearson Publications, 2009

SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus of B.Sc. Part III NEP 1.0
Sem.-VI: (DSE-E-31) Zoology Paper- XV

Applied Zoology

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits 2)

Unit 1: Apiculture	8
1. Types and casts of honey bee	
2. Honey Comb	
3. Bee Keeping	
a. Artificial models of bee hive – Newton and Langstroth models	
b. Beekeeping Equipment	
c. Extraction of Honey	
4. Medicinal Value of Honey	
Unit 2: Animal Husbandry	5
1. Indigenous and exotic breeds of cattle	
2. Preservation and artificial insemination in cattle	
3. Induction of early puberty	
4. Synchronization of estrus in cattle	
5. Commercial importance of dairy farming	
Unit 3: Pearl culture	4
1. Species of oyster	
2. Process of Pearl formation: natural and artificial	
3. Maintenance of oysters	
4. Harvesting	
5. Importance of Pearl	
Unit 4: Freshwater prawn culture	3
1. Species of Prawn	
2. Site selection	
3. Farm Construction	
4. Production system: fertilization, Larval Development, Food and feeding	
5. Harvesting	
Unit 5: Fish Technology	5
Genetic improvements in the aquaculture industry:	
1. Induced breeding	
2. Transportation of fish seed	
3. Feeding and development	
4. Harvesting and Marketing	
Unit 4: Goat Farming-	5
1. Breeds	
2. Feeding	
3. Housing	
4. Economic Importance	

SUGGESTED READINGS:

1. Mollusca - Hyman.
2. Prawn and Prawn Fishery of India - Kurian.
3. Fish Culture - K. H. Alikuhni.
4. Fish Culture - Lagter.
5. Fishes of India. - Khanna.
6. Hand Book of Animal Husbandary and Dairy - Mudlyer.
7. Bee keeping in India - Sardar Sing.
8. Bee Keeping in India- M. G. Smith.
9. Poultry keeping in India - Naidu P.N.M.
10. Poultry Husbandary - M. A. Jule. 18. Poultry Husbandary - Moorthy.
11. Outlines of Dairy Technology - Sukumar De.
12. Milk and milk products - Clarence Henry Eckles, Willes Barnes Combs, Harold Macy

SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus of B.Sc. Part III NEP 1.0
Sem.-VI: (DSE-E-32) Zoology Paper- XVI
ANIMAL PHYSIOLOGY

Theory: 30 hrs. (37.5 lectures of 48 minutes) (Credits: 02)

Unit 1:

1. Digestion: (4)

- a. Introduction to the digestive system.
- b. Physiology of digestion in the alimentary canal.
- c. Absorption of carbohydrates, proteins, lipids

2. Respiration: (5)

- a. Introduction to Respiratory system
- b. Mechanism of ventilation
- c. Respiratory pigment - properties and functions.
- d. Exchange of gases and Transport of oxygen and carbon dioxide in blood
- e. Oxygen dissociation curve

3. Cardiovascular System: (4)

- a. Normal Composition of blood
- b. Structure of Heart
- c. Origin and conduction of the cardiac impulse
- d. cardiac cycle
- e. Blood Pressure
- f. Interpretation of ECG

Unit 2:

1. Muscle: (4)

- a. Types of Muscles,
- b. Ultra-structure of skeletal muscle fiber
- c. Mechanism of muscle contraction

2. Nerve (4)

- a. Structure of Neuron
- b. Origin and Conduction of Nerve impulse in nonmyelinated neurons
- c. Synapse and Synaptic transmission.

3. Excretion: (4)

- a. Structure of Kidney
- b. Structure of nephron
- c. Mechanism of Urine formation
- d. Countercurrent Mechanism

Unit 3:

Study of endocrine glands (5)

- a. Introduction to the endocrine system and hormones
- b. Anatomy, histology, Hormones (Nature, role, regulation, and disorders) of Thyroid gland, Parathyroid gland, Adrenal gland, and Islets of Langerhans

SUGGESTED READINGS:

1. A Text Book of Medical Physiology, Eleventh ed., John E. Hall, Harcourt Asia Ltd
Arthur C. Guyton M.D.
2. Principles of Anatomy and Physiology, Tenth Ed, John Wiley & Sons, Gerard J.
Tortora and Sandra Reynolds Grabowski
3. Text Book of Animal Physiology and Biochemistry, Singh. H.R,
4. Comparative Animal Physiology, Nagabhushanam
5. Human Physiology: Chatterjee, C. C.
6. Text Book of Animal Physiology, Veer Bal Rastogi,
7. A Review of Medical Physiology, William F. Ganong, 22nd ed, McGraw Hill, 2005
8. Human Physiology, Sherwood, Klandrof, Yanc, Thompson Brooks/Cooke, 2005.
9. Animal Physiology, Knut Schmidt-Nielsen, 5th ed, Cambridge Low Price Edition.
10. A textbook of Vertebrate Zoology Prasad, S.N.
11. The Text-Book of Vertebrate Zoology, Agarwal, IV, P and Dalela, R.C.
12. Chordates , Dhami and Dhami
13. Vertebrates, Kotpal, R.C.
14. Textbook of Histology: Bloom W and Fawcett D.W.
15. Histology: Lippincott. Ham, A.W.
16. Histology: Greep, R.O and Well, L.

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus of B.Sc. Part III NEP 1.0

Zoology Practical – I (Credits-02)

Comparative Anatomy of Vertebrates and Developmental Biology

I. Comparative Study of the following

1. V.S. of the skin of vertebrates
2. Digestive system of vertebrates
3. Respiratory system of vertebrates
4. Heart of vertebrates
5. Brain of vertebrates

II Osteology: The skeleton of rabbit/ Rat (Disarticulated)

III Study of gametes

1. Study of Sperm in any suitable animal
2. Study of types of eggs
 - a. Amphioxus egg
 - b. Frog Egg
 - c. Hen's Egg
 - d. Insect Egg

IV Study of developmental stages of frogs.

1. Cleavage
2. Blastulation
3. Gastrulation
4. Neurulation
5. Stages of metamorphosis in frog
 - a. External gill stage
 - b. Internal gill stage
 - c. Forelimb stage
 - d. Hind limb stage
 - e. Tail bud stage
 - f. Juvenile stage

IV. Study of Chick Embryo

1. Whole mount of chick embryo – 18, 24, 33, 48 and 72 hours.
2. T.S. of chick embryo – 18, 24, 33, 48 and 72 hours.
3. Preparation of the whole mount of chick embryo.

V. Study of structures of the placenta

1. Histological Types
 - a. Epitheliochorial
 - b. Endotheliochorial
 - c. Hemochorial
 - d. Syndesmochorial
 - e. Hemoendothelial
2. Morphological Types
 - a. Diffused
 - b. Intermediate
 - c. Cotyledonary
 - d. Zonary: Complete and incomplete
 - e. Discoidal: Monodiscoidal and Bidiscoidal

SHIVAJI UNIVERSITY, KOLHAPUR

Syllabus of B.Sc. Part III NEP 1.0

Zoology Practical – II (Credits-02)

Applied Zoology and Immunology

Unit 1: Applied Zoology

1. Apiculture

- a. Casts of Honey Bees
- b. Bee Hive (Photographs or models)
- c. Pollen Basket
- d. Sting Apparatus
- e. Honey
- f. Newton's model of Bee Hive
- g. Beekeeping Equipment

2. Preservation & Artificial insemination in cattle

8. Pearl culture

- a. Species of oyster
- b. Process of Pearl formation: natural and artificial
- c. Importance of Pearl

9. Freshwater prawn culture

- a. Species of Prawn
- b. Site selection
- c. Farm Construction
- d. Production system
- e. Harvesting

10. Goat farming

- a. Breeds (any four = 2 Indigenous and 2 Exotic)
- b. Housing
- c. Feeding

6. Visit to goat farm or animal breeding center – submission of visit report

B] Immunology

1. Study of lymphoid organs (Photograph, Models, Videos)

2. Histological study of (slides or photographs)

- a. Spleen
- b. Thymus
- c. Lymph nodes

3. Preparation of stained blood smears to study various types of blood cells

4. Determination of ABO Blood Group

5. Single immunodiffusion

6. Double immunodiffusion

7. Demonstration of Immuno-electrophoresis

SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus of B.Sc. Part III NEP 1.0
Zoology Practical – III (Credits-02)

Molecular Cell Biology, Animal Biotechnology & Biotechniques, Biostatistics

I] Micro technique

1. Preparation of wax blocks
2. Preparation of permanent histological slides by HE technique
3. Histochemical technique
 - a. AB PH 1 technique
 - b. AB PH 2.5 technique
 - c. PAS technique

II] Biotechniques

1. Chromatography – Separation of amino acid by paper chromatography
2. DNA isolation
3. Demonstration of DNA by Feulgen Technique
4. To study the following technique (photographs)
 - a) Southern blotting
 - b) Northern blotting
 - c) Western blotting
 - d) DNA sequencing (Sangers method)
 - e) PCR
 - f) DNA fingerprinting

III] Animal Biotechnology: To study the following equipment through Photographs

- 1) Basic Cell culture Equipment's:
 - a) Laminar Air Flow
 - b) CO₂ incubator
 - c) Autoclave
 - d) Centrifuge
 - e) Refrigerator and freezer
 - f) Cell counter (Hemocytometer)
 - g) Microscope
- 2) Isolation of cells by enzyme digestion

IV] Biostatistics

Any 10 example based on theory

V] Project (any suitable work possible in local area or from the syllabus) Report of the same to be submitted at the time of practical examination

SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus of B.Sc. Part III NEP 1.0
Zoology Practical – IV (Credits-02)

A] Aquatic biology

1. Determination of area of a lake using graphimetric & gravimetric method
2. Identify the zooplanktons present in Lake Ecosystem
3. Determination of turbidity or transparency from nearby lake or water body
4. Determination of dissolved oxygen
5. Determination of free CO₂
6. Determination of alkalinity (Carbonates & bicarbonates) from water collected from nearby lake or water body
7. Estimation of total hardness of water
8. Instruments used in limnology & their significance
 - a) Secchi disc
 - b) Van Dorn bottle
 - c) Conductivity meter
 - d) Turbidity meter
 - e) PONAR grab sampler
9. Study of animals with reference to their respective habitat
 - a) Lentic and Lotic (Any Common Carp)
 - b) Estuarine (Shrimps)
 - c) Intertidal Zones (Rocky: Sea cucumber or mussels; Sandy: Sea Star, Crab;
 - d) Muddy: Lung fish)
 - e) Deep Sea: Anglerfish/ Ribbon Eel
10. Visit to seashore/water reservoir/animal sanctuary to study animal diversity.

Report of tour should be submitted at the time of practical examination

B] Animal Physiology

11. Interpretation of ECG
12. Erythrocyte Sedimentation Rate (ESR)
13. To Determine the packed cell volume of whole body by centrifugation method
14. Estimation of Haemoglobin
15. Total count of RBC., WBC and Differential count
16. Measurement of blood pressure and heart beat under normal and stress condition.
17. Study of Peak Expiratory Flow Rate (PERF)
