

 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	 
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Ref.No.SU/BOS/Science/148

Date: 26/05/2026

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

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

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-III (Sem.V & VI) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (2.0)			
1.	Botany	9.	Geology
2.	Physics	10.	Zoology
3.	Statistics	11.	Chemistry
4.	Mathematics	12.	Electronics
5.	Microbiology	13.	Drug Chemistry
6.	Industrial Microbiology	14.	Pollution
7.	Biochemistry	15.	Food Science and Quality Control
8.	Computer Science (Optional)	16.	Biotechnology (Optional/Vocational)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2026-2027 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in>Syllabus>Syllabus as per NEP2020.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2026 & March/April 2027. 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,

Yours faithfully,



Dy Registrar

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

**Shivaji University,
Kolhapur**



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**Syllabus for
Bachelor of Science Part-III
(B. Sc. III)
In
Zoology
(NEP-2.0)**

To be implemented from June, 2026 onwards

SHIVAJI UNIVERSITY, KOLHAPUR

Revised Syllabus for the Bachelor of Science in Zoology

(As per NEP- 2.0)

Applicable from the Academic Year 2026 –27

1. Title: B. Sc. III Zoology, Shivaji University, Kolhapur Revised Syllabus as per NEP – 2.0

2. Faculty: Faculty of Science and Technology.

3. Year of Implementation: From June 2026

4. Objectives of a Bachelor of Science (B.Sc.) in Zoology Program include:

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.

5. Program Outcomes (POs):

After successful completion of the Programme, students will be able to:

PO1: Acquire fundamental and advanced knowledge of animal structure, function and evolution.

PO2: Understand comparative anatomy and physiological adaptations in vertebrates.

PO3: Apply biological principles to analyze organ systems and their evolutionary trends.

PO4: Interpret anatomical and physiological data using appropriate biological terminology.

PO5: Relate structure and function of organ systems to survival and adaptation.

PO6: Students will gain fundamental knowledge of Zoology which will help them for PG studies and Research.

PO7: Students will be able to know good laboratory practices and lab safety.

PO8: Apply gene manipulation techniques in animal biotechnology.

PO9: Develop transgenic and cloned animals for pharma and organ production.

PO10: Create advanced methods to improve animal health and productivity.

PO11: Analyze and classify biological data effectively.

PO12: Summarize data using central tendency and dispersion measures.

PO13: Assess relationships between variables via correlation analysis.

PO14: Apply gene manipulation techniques in animal biotechnology.

PO15: Develop transgenic and cloned animals for pharma and organ production.

PO16: Create advanced methods to improve animal health and productivity.

PO17: Analyze and classify biological data effectively.

PO18: Summarize data using central tendency and dispersion measures.

PO19: Assess relationships between variables via correlation analysis.

6. Program Specific Outcomes:

PSO-1. Students will be able to explain fundamental concepts of Animal Physiology, Anatomy, Molecular Biology, Developmental Biology, Aquaculture fisheries, Biostatistics, Laboratory Techniques, Sericulture, Pest control etc.

PSO-2. Students will be able to prepare and qualify for competitive examinations

PSO-3. Students will understand good laboratory practices and safety.

PSO-4. Students will develop research-oriented skills.

7. Program Education Outcomes:

PEO-1: Students after graduation (Graduates) will possess strong analytical, critical thinking, and problem-solving skills relevant to the areas in Zoology and they will be prepared for careers in various sectors.

PEO-2: Graduates will be able to utilize their Zoological knowledge and skills to address societal needs and challenges include areas like environmental sustainability, healthcare, Animal Husbandry etc.

PEO-3: Graduates will demonstrate a commitment to lifelong learning and professional development, and they will possess strong communication, teamwork, and leadership skills.

PEO-4: Graduates will be equipped to pursue further education, such as an M.Sc. or Ph.D., in Zoology or related disciplines and will be able to work effectively in multidisciplinary and interdisciplinary environments.

PEO-5: Graduates will be equipped to innovate and develop solutions that benefit society.

8. The B. Sc. III Course (Zoology) (Level 5.5) will be of Two Semesters (Sem. V and Sem VI).

9. Pattern of Examination: The Examinations will be conducted semester-wise for Theory and Practical.

10. Fee structure: As per Shivaji University guidelines.

11. Eligibility Criteria for Admission to B. Sc. Part III (Level 5.5): Please see B. Sc. Rules and Regulations of Shivaji University, Kolhapur

12. Medium of Instruction: English

13. Structure of course: Given in Framework Chart

14. Scheme of Teaching and Examination:

a. Each theory course paper constitutes of 3 units require 30 hours of teaching lectures and there shall be two lectures per theory (2 Cr) course per week.

b. B. Sc. III Zoology Course will be of 44 Credits (1100 marks).

c. Examination of each **theory course** shall be of **50 marks** (40 university examination + 10 internal assessment). University examination of 40 marks (1.5 hours' duration) will be conducted at the end of each Semester. Internal assessment of 10 marks will be done before the semester examination during each semester.

d. Examination of practical course shall be of 100 marks (4 Cr) and 50 marks (2 Cr) per semester.

e. Pattern and Nature, marking scheme for theory and Practical Examination for Major Specific SEC and VSC courses are included in syllabus.

f. Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus. Weightage should be provided to each unit as per the hours allotted for teaching.

15. Standard of Passing: The standard of passing shall be as per the following table.

	Semester End Exam	Internal Assessment	Course Exam (Total)
Maximum Marks	40	10	50
Minimum Marks required for Passing	14	4	18

- i) There shall be a separate head of passing for semester end examination and internal examination.
- ii) Minimum 18 marks out of 50 and 35 marks out of 100 are required for passing of practical examination of each course.
- iii) Passing criteria for OJT and Field Project (FP) as per the University guidelines.

Nature of Question paper and scheme of marking:

Theory question paper: Maximum marks -40

Total No. of questions – 3. All questions are compulsory. Question No.1 is MCQ type (8 Marks). Question No.2 is Long answer questions type (8 Marks). Question number 3 is short answer type question carries 16 marks. (Nature of question paper is as attached here)

COMMON NATURE OF QUESTION FOR THEORY PAPER:

SEMESTER V Zoology Paper (IX, X Major & XI Major Elective I A/B)

SEMESTER VI Zoology Paper (XII, XIII Major & XIV Major Elective II A/B)

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
Bachelor of Science Credit Framework
B. Sc. III-Zoology (To be implemented from June 2026)

Level	Sem.	Major (Zoology)		IDC/MDC/ OE/GE	VSC/SEC		AEC, VEC, IKS			OJT, FP, CEP, CC, RP			Total Credits	Degree/ Cum. Cr. MEME
		Mandatory	Elective	OE (For Other Faculty)	VSC	SEC	AEC	VE C	IKS	CC	FP/ OJT	RP/ Dissert		
5.5	V	Major Paper-IX Comparative Anatomy of Vertebrates (2 Cr)	(Choose One) Paper XI Major Elective I (A) Animal Biotechnology And Biostatistics (2 Cr) Paper XI Major Elective I (B) Aquaculture and Fisheries (2 Cr)	Paper-V OE- Communicable Diseases And Public Awareness (संसर्गजन्य रोग आणि सार्वजनिक जागरूकता) (2 Cr)	Vocational Skill Course Practical Paper-III Laboratory Technology (2 Cr) (Major specific)	--	AEC III (2 Cr) (English)	--	--	--	OJT- (4 Cr)	--	--	Degree 132
		Major Paper -X Molecular Biology And Molecular Diagnostics (2 Cr)												
		Major Practical V (a) (2 Cr) Major Practical V (b) (2 Cr)	Choose One Practical Elective IA (2 Cr) OR Practical Elective IB (2 Cr)											
	Credits	4(T)+4(P)= 8		2(T)+2(P)= 4	2 (T) = 2	2(P)= 2	--	2 (T)= 2	--	--	--	4	--	
	VI	Major Paper-XII Developmental Biology (2 Cr)	Choose One Paper XIV Major Elective II (A) Histology And Immunology Paper XIV Major Elective II (B) Bioinformatics (2 Cr)	---	PRCHVSC- 606 Vocational Skill Course Practical Pest Control Techniques (2 Cr) (Major specific)	Practical Paper- SEC III Sericulture (2 Cr)	AEC-IV (2 Cr) (English)	--	IKS (Major Specific) Zoological Concepts in Ancient Indian (2Cr)	--	Field Project (FP) (2 Cr)	--	--	
Major Paper-XIII Animal Physiology (2 Cr)														
Major Practical VI (a) (2 Cr) Major Practical VI (b) (2 Cr)		(Choose One) Practical Elective II A (2 Cr) OR Practical Elective II B (2 Cr)	--											2(P)=2
Credits	4(T)+4(P)=8	2(T)+2(P)=4	--	2(P)=2	2(T)=2	2(T)=2	--	2(T)=2	--	2	--	22		
Total Credits		16	8	2	4	2	4	--	2	--	6+	--	44	
Exit Option: Exit Option:4 credits NS/Internship/Skill courses														

Structure of B. Sc. III Zoology
B.Sc.-III (NEP-2.0) SEMESTER V

Sr. No.	Particulars	Title of Paper
1	Major (Mandatory Theory)	Major Paper-IX, Comparative Anatomy of Vertebrates (2 Credits, 30 Hours)
2		Major Paper -X, Molecular Biology And Molecular Diagnostics (2 Credits, 30 Hours)
3	Major (Elective Theory)	Paper XI Major Elective I (A) Animal Biotechnology And Biostatistics OR Paper XI Major Elective Paper I (B) Aquaculture and Fisheries (2 Credits, 30 Hours)
4	Major Mandatory Practical	Major Practical Paper-V (a) Based on Comparative Anatomy of Vertebrates (2 Credits, 60 Hours) Major Practical Paper-V (b) Based on Molecular Biology And Molecular Diagnostics (2 Credits, 60 Hours)
5	Major Elective Practical	Elective Practical I A Based on Animal Biotechnology And Biostatistics (2 Credits, 60 Hours) OR Elective Practical I B Based on Aquaculture and Fisheries (2 Credits, 60 Hours)
6	OE (Basket)	Practical Paper OE-V Communicable Diseases And Public Awareness (संसर्गजन्य रोग आणि सार्वजनिक जागरूकता) (2 Credits, 30 Hours)
7	VSC (Major Specific)	Vocational Skill Course Practical Paper- VSC II Laboratory Technology (2 Credits, 60 Hours)
8	OJT Major Specific	On Job Training (OJT) (4 Credits, 60 Hours)

Major Mandatory (Theory)

Major Pape- IX - Comparative Anatomy of Vertebrates

(2 Credits, 30 hours)

Course Outcomes (COs)

CO1: Students will be able to describe the structure and organization of major organ systems in vertebrates.

CO2: Students will be able to explain the functions and physiological significance of different vertebrate organ systems.

CO3: Students will be able to compare organ systems in vertebrates and interpret their evolutionary trends and adaptations.

CO4: Students will be able to apply comparative anatomical knowledge to analyze structure–function relationships in vertebrates.

Unit 1:

I. Integumentary System 5

1. Generalized structure of integument
2. Functions of Integument
3. Soft epidermal derivatives
4. Hard epidermal derivatives

II. Skeletal System 5

1. Types of vertebrae based on centrum
2. Vertebral column of Rat
3. Appendicular skeleton of Rat

III. Digestive System 4

Brief account of the alimentary canal and digestive glands

Unit 2:

I. Respiratory System 4

Brief account of Gills, lungs, air sacs

II. Circulatory System 4

Evolution of heart and aortic arches

Unit 3:

I. Evolution of Kidney 4

Succession of kidney

II. Nervous System : 4

Comparative account of brain

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, The Vertebrate 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.

Major Mandatory (Theory)

Major Paper X - Molecular Biology And Molecular Diagnostics

(2 Credits, 30 hours)

Course Outcomes (COs)

The course in molecular biology and molecular diagnostics is aimed at making the students:

CO 1: Understand the basic concepts and processes in molecular biology.

CO 2: Understanding the molecular methods for medical diagnosis.

CO 3: Apply the knowledge in the field of molecular diagnostics

Unit 1: Molecular Biology

10

1) Nucleic acids -

- i. DNA - Watson and Crick's model of DNA
- ii. RNA – Types and Structure

2) DNA Replication

- i. Types of replications
- ii. Process of prokaryotic DNA replications

3) Regulation of gene expression - Lac operon

4) Genetic Code:

- i. Dictionary of the Genetic Code
- ii. Properties of the Genetic Code
- iii. Wobble hypothesis

Unit 2: Protein Synthesis

12

1) Transcription in prokaryotes

- i. Prokaryotic RNA polymerase
- ii. Process of transcription in prokaryotes
- iii. Post-transcriptional modification in RNA

2) Translation in prokaryotes

- i. Synthesis of aminoacyl tRNA
- ii. Process of translation in prokaryotes

Unit 3: Molecular Diagnostics

08

- i. Gel Electrophoresis (Agarose)
- ii. Blotting techniques - Southern, Northern and Western
- iii. Polymerase Chain Reaction and real-time PCR
- iv. Fluorescent in situ hybridization (FISH)
- v. DNA Fingerprinting

Suggested Readings:

1. Watson J. D. (2024). Molecular Biology of Genes, 8th ed. Pearson and its imprint, Benjamin-Cummings Publishing Company
2. Cell and Molecular Biology, 8th Edition, De. Robertis EDP and De Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia.
3. Molecular Biology of the Cell - 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, K. Roberts & James D. Watson, Garian Publishing, New York.
4. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick (2017) Lewin's Genes Jones and Bartlett Publishers, Inc
5. Cell and Molecular Biology, EJ. Dupraw, Academic Press, New York.
6. Cell Structure and Function - A. G. Loewy, P. Siekevitz, J. R. Meninger & J. A. N. Gallant, Saunder College, Philadelphia.
7. Snustad, D.P. and Simmons, M.J. (2009), An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
8. Principles of Biomedical Ethics. VI Edition, Oxford University Press.
9. David Posada (2009) Bioinformatics for DNA Sequence Analysis Springer Nature Humana Press

Major Elective I (Theory)

Paper XI Elective Paper I-A: Animal Biotechnology And Biostatistics

(2 Credits, 30 hours)

Course Outcomes (COs)

The course in molecular biology and molecular diagnostics is aimed at making the students:

CO1: Understand restriction enzymes and cloning vectors for gene manipulation.

CO2: Gain skills in gene cloning, transformation and transgenic animal production.

CO3: Recognize gene knockout methods and their importance in model organisms.

CO4: Classify biological data using various statistical techniques.

CO5: Analyze data through tabulation, graphs and statistical measures.

CO6: Evaluate variable relationships using correlation techniques.

Unit - I: Animal Biotechnology: Genetic Engineering [08]

1. Restriction Enzymes: Types of Endonuclease, Nomenclature and Cleavage Pattern

2. Characteristics of Cloning vectors

- a) Plasmids
- b) Cosmids
- c) Phagemids
- d) Lambda Bacteriophages

3. Gene cloning: Transformation Techniques by

- a) Calcium Chloride Method
- b) Electroporation

Unit II: Genetically Modified Organisms [07]

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

Unit III: Biostatistics [15]

1. Biological Data

2. Classification of Biological data

3. Frequency Distribution

4. Tabulation

5. Graphical Representation of Data

- a) Histogram
- b) Frequency Polygoan

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. Beauchamp, T.I. and Childress, J.F. (2008). Recombinant DNA Genes and Genomes - A Short Course. III Edition, Freeman and Co., N.Y., USA.
2. Tom, L. B. and) (2009). *Principles of Biomedical Ethics* (Sixth Edition, 2009, Oxford University Press)
3. Joshi, P. Genetic Engineering and Its Applications. (2006). Agrobios India. 328pp.
4. De. Robertis EDP and De Robertis Jr. EMF, Lippincott Williams and Wilkins, Philadelphia, *Cell and Molecular Biology*, 8th Edition,
5. Singh, B. and Gautam, S.K. Textbook of Animal Biotechnology. 2013. Oxford & IBH Publishing Co Pvt. Ltd. 620pp.
6. Gupta, P. K. Elements of Biotechnology, Rastogi Publications.
7. Srivastava, A. K. (2018). Animal Biotechnology. Oxford & IBH Publishing Co Pvt. Ltd. 458 pp.
8. 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., New York, 352-358.
9. Arora, P. N. and Malhan, P. K. Biostatistics. Himalaya Publishing House.
10. Callear, M. L. (2010). Statistics for Biologists. Oxford University Press
11. Wayne W. Daniel (2014). Biostatistics: A Foundation for Analysis in the Health Sciences. John Wiley & Sons, Inc. 7th Edition.
12. Anjaneyulu, M. S. S. R. (2005). Biostatistics: Basic Concepts and Methodology. New Age International Publishers
13. Murthy, S.R. (2010). Introduction to Biostatistics. Jaypee Brothers Medical Publishers
14. Trivedi, K. K. (2019). Biostatistics: A Practical Guide for Researchers. Springer
15. Rastogi, V. B. (2209). Fundamentals of Biostatistics. IInd Edition. Ane Books Pvt. Ltd. New Delhi
16. Zar, J. H. (2008). Biostatistical Analysis. 4th Edition. Dorling Kindersley (India) Pvt. Ltd. New Delhi

Major Elective I (Theory)

Paper XI Elective Paper I-B: Aquaculture and Fisheries

(2 Credits, 30 hours)

Course Outcomes (COs)

The course in aquaculture and fisheries is aimed at making the students:

- CO1:** After completing this course, students will gain knowledge of aquaculture and fisheries resources.
- CO2:** Develop practical skill in fish culture and fish processing.
- CO3:** Promote entrepreneurship and employment opportunities in aquaculture.

Unit I: Aquaculture Practices, Breeding Techniques and Fish Culture (09 Hours)

1. Indian Aquaculture and Breeding Techniques

- Present status and future scope of aquaculture in India
- Types of fish hatcheries
- Developmental stages of fish seed: spawn, fry and fingerlings
- Induced breeding techniques in freshwater fishes

2. Aquaculture Practices

- Freshwater aquaculture
- Brackish water aquaculture

3. Types of Fish Culture

- Extensive fish culture
- Semi-intensive and intensive fish culture

Unit II: Fish Processing, Products, Diseases

(11 Hours)

1. Fish Processing and Preservation

- **Traditional methods:** drying, salting, smoking
- **Modern methods:** freezing, canning, irradiation

2. Storage, Packaging and Fish Products

- Storage and packaging of fish and fishery products
- Export marketing of fish and fishery products
- Fish Products: Fresh, cured and processed fish products
- Fish by-products: Fish meal, fish oil, gelatine and isinglass
- Value-added products: smoked, dried and frozen products

3. Fish Diseases

- Common bacterial, viral and parasitic fish diseases
- Diagnosis and identification
- Preventive measures and treatment strategies

Unit III: Freshwater Pearl Culture

(10 Hours)

A. 1. Introduction to Pearl Culture

- History and scope of freshwater pearl culture
- Pearl-producing mussels in India (*Lamellidens*, *Parreysia*)

2. Biology and Pearl Formation

- Anatomy of freshwater mussels
- Mechanism of pearl formation

3. Techniques of Freshwater Pearl Culture

- Selection of mussels
- Pre-operative care
- Implantation techniques (nucleus and tissue graft)
- Post-operative care and maintenance

4. Harvesting and Economic Importance

- Pearl harvesting and grading
- Economic importance and entrepreneurial potential in India

SUGGESTED READING:

1. Bardach, J. E., Ryther, J. H., & McLarney, W. O. (1972). *Aquaculture: The farming and husbandry of freshwater and marine organisms*. Wiley-Interscience.
2. Bal, D. V., & Rao, K. V. (1984). *Marine fisheries*. Tata McGraw-Hill.
3. Jhingran, V. G. (1991). *Fish and fisheries of India* (3rd ed.). Hindustan Publishing Corporation.
4. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture: Principles and practices* (2nd ed.). Wiley-Blackwell.
5. Singh, R. K., & Lakra, W. S. (Eds.). (2011). *Pearl culture*. Central Institute of Freshwater Aquaculture (CIFA).
6. Srivastava, C. B. L. (1999). *Fishery science and Indian fisheries*. Kitab Mahal Publishers.
7. Srivastava, U. K. (2006). *Fisheries science*. Kitab Mahal Publishers.

Major Practical V (a) Based on Comparative Anatomy of Vertebrates

Practicals: 60 hrs. Marks- 50 (Credits: 02)

I. Comparative Study of following

1. V.S. of skin of vertebrates
2. Digestive system of vertebrates
3. Respiratory system of vertebrates
4. Heart of vertebrates
5. Aortic arches of vertebrates
6. Brain of vertebrates
7. Evolution of Kidney

8. Types of vertebrae based on centrum
9. Vertebral column of Rat /Rabbit
10. Appendicular skeleton of Rat /Rabbit
11. Mounting of Fish Scales (Placoid, Cycloid & Ctenoid)
12. Study of Feathers in Aves

Major Practical V (b) Based on Molecular Biology & Molecular Diagnostics

1. Estimation of DNA
2. Agarose Gel Electrophoresis
3. To determine the Sequence of the Newly Synthesized DNA Strand During Replication.
4. To identify the promoter region in the given sequence of DNA
5. To identify the transcription initiation +1 region on a DNA sequence
6. To determine the mRNA Sequence from the given Gene Sequence
7. To Identify the Open Reading Frame (ORF) in a given mRNA Sequence
8. To identify 3' and 5' splice sites in the given mRNA sequence.
9. To deduce the Amino Acid Sequence from the given ORF of mRNA using the dictionary of the Genetic Code
10. To deduce at least one possible sequence of ORF using a sequence of amino acids and using the dictionary genetic code.
11. To study the following technique (using simulation)
 - a. Southern blotting
 - b. Northern blotting
 - c. Western blotting
12. To calculate the GC percentage in a given sequence of at least 200 nucleotides.
13. To arrange the sequences given from lower to higher according to the time required for denaturation in PCR. (Give any 5 sequences of the same length and 5 sequences of different lengths having almost the same GC content)
14. To analyse the photographs of FISH.
15. To identify a Matching DNA Sample Using DNA Fingerprinting Gel Analysis

Elective Practical I A Based on Animal Biotechnology and Biostatistics

Practical: 60 hrs.

(Credits: 2)

Marks: 50

I. Animal Biotechnology

1. Isolation of Cells by Enzyme Digestion
2. Isolation of Plasmid DNA/DNA from Bacterial Cultures
3. Visualization of DNA Using Feulgen Staining Technique
4. Identification and characterization of Cloning Vectors Using Charts or Models
5. Studying Restriction Enzyme Cleavage Patterns with Charts and Models
6. Virtual Demonstration of Microinjection of DNA into Frog/Mouse Eggs
7. Demonstration of Transgenic Animal Model for Organ Production
8. Study of Applications and Ethical Issues of Genetically Modified Organisms (GMO's)

II. Biostatistics: Biostatistic examples based on theory

9. Example on classification of biological data (Chronological, Geographical & qualitative data)
10. Preparation of a comprehensive Statistical data table covering eight Parts
11. Prepare frequency distribution table
12. Prepare a graphs on
 - a. Histogram with Equal Class Intervals
 - b. Frequency Polygon with Histogram
13. Calculation of Arithmetic Mean
14. Calculation of Measures of Dispersion:
 - a. Mean Deviation and
 - b. Standard Deviation
15. Examples based on correlation
 - a. Drawing Scatter Diagrams to Illustrate Positive, Negative and Zero Correlation
 - b. Calculation of Karl Pearson's Correlation Coefficient 'r'
 - c. Calculation of Spearman's Rank Correlation Coefficient 'R'

Elective Practical I B Based on Aquaculture and Fisheries

Practical: 60 hrs.

(Credits: 2)

Marks: 50

1. Identification of 10 major fish species with the help of key (05 Chondrichthyes & 05 Osteichthyes).
2. Study on different types of fish hatcheries in aquaculture
3. Identification and comparative study of fish seed stages—spawn, fry and fingerlings with reference to size, morphology and survival.
4. Demonstration of Induced breeding techniques in freshwater fishes.
5. Study of freshwater aquaculture system (River or Pond culture)
6. Comparative study on fish culture system: Extensive fish culture, Semi-intensive and intensive fish culture
7. Identification and demonstration of traditional fishing gears and crafts used in inland fisheries.
8. Observation and study of mechanized and non-mechanized fishing boats.
9. Study of fish storage practices, including icing, cold storage and transportation.
10. Study or demonstration of traditional fish preservation methods such as drying, salting and smoking.
11. Study of modern fish preservation methods including freezing, canning and irradiation.
12. Study and identification of fish products and by-products, including value-added products.
13. Study and identification of common fish diseases—bacterial, viral and parasitic—with basic preventive measures.
14. Survey or visit to a fish market to study species diversity.

Zoology Practical Open Elective [OE]

Communicable Diseases And Public Awareness

संसर्गजन्य रोग आणि सार्वजनिक जागरूकता

Theory: 30 hrs

Marks-50

(Credits: 02)

Unit I: Fundamentals of Communicable Diseases

10

- **1.1 Introduction to Communicable Diseases**
 - **Definitions:** Communicable vs. Non-Communicable Diseases, Infection, Infestation, and Contamination.
 - **The Infectious Agent:** Categories of pathogens (**Viruses, Bacteria, Fungi, Parasites**).
- **1.2 Modes of Transmission**
 - **Classification:** Direct (e.g., direct contact, droplet spread) and Indirect (e.g., vehicle-borne, vector-borne, airborne).
 - **Key Terms:** Incubation Period, Communicability Period, Herd Immunity.
- **1.3 Basic Epidemiology**
 - Definition and Aims of Epidemiology.
 - Measures of Disease Occurrence: Incidence and Prevalence.
 - Patterns of Disease Occurrence: Endemic, Epidemic, Pandemic, Sporadic.
 - Surveillance systems: Aims and methods (passive vs. active).

Unit II: Major Disease Types and Control Measures

10

- **2.1 Categories of Public Health Importance**
 - **Vector-Borne Diseases:** Epidemiology, symptoms, and control of diseases like Malaria, Dengue, and Chikungunya.
 - **Airborne and Respiratory Infections:** Tuberculosis (TB), Influenza, and COVID-19 transmission, prevention, and treatment protocols.
 - **Water-Borne and Food-Borne Diseases:** Cholera, Typhoid Fever, and Diarrheal Diseases focus on sanitation (WASH) and hygiene.
 - **Sexually Transmitted Infections (STIs):** Prevention and management of HIV/AIDS, Hepatitis B & C.
- **2.2 Prevention and Control Strategies**
 - **Immunization and Vaccination**
 - **Personal and Environmental Hygiene**

Unit III: Public Awareness and Health Communication

10

- **3.1 Principles of Health Education and Communication**
 - Definition and Objectives of Public Health Education.
 - Models of Behaviour Change (e.g., Health Belief Model) and their application to disease prevention.
 - The Importance of Cultural Sensitivity and Health Literacy in Public Messaging

- **3.2 Risk Communication**

- Strategies for Communicating Health Risks and Uncertainty During an Epidemic or Pandemic
- Addressing Misinformation and Disinformation (Infodemics).
- Building public trust in health authorities and scientific information.

- **3.3 National and Global Health Programs**

- Overview of key national programs for communicable disease control (e.g., for TB, HIV/AIDS).
- The role of International Health Regulations (IHR) and global bodies like the WHO in coordinating responses.

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संसर्गजन्य रोग आणि सार्वजनिक जागरूकता

(COMMUNICABLE DISEASES AND PUBLIC AWARENESS)

युनिट I: संसर्गजन्य रोगांची मूलतत्त्वे (Fundamentals of Communicable Diseases) [१० तास]

१.१ संसर्गजन्य रोगांचा परिचय (Introduction to Communicable Diseases)

- व्याख्या (Definitions): संसर्गजन्य (Communicable) वि. असंसर्गजन्य रोग (Non-Communicable Diseases), संक्रमण (Infection), कीटकांचे आक्रमण (Infestation), आणि दूषितीकरण (Contamination).
- संसर्गजन्य कारक (The Infectious Agent): रोगजनकांच्या श्रेणी (Categories of pathogens) – विषाणू (Viruses), जीवाणू (Bacteria), बुरशी (Fungi), परजीवी (Parasites).

१.२ प्रसारणाचे मार्ग (Modes of Transmission)

- वर्गीकरण (Classification): प्रत्यक्ष (Direct) (उदा. थेट संपर्क, थेंबांचा प्रसार) आणि अप्रत्यक्ष (Indirect) (उदा. वाहक-जनित, वेक्टर-जनित, हवा-जनित).
- महत्त्वाच्या संज्ञा (Key Terms): रोग गुप्तिकाल (Incubation Period), संसर्गक्षमतेचा कालावधी (Communicability Period), सामुदायिक प्रतिकारशक्ती (Herd Immunity).

१.३ मूलभूत साथरोगशास्त्र (Basic Epidemiology)

- साथरोगशास्त्राची व्याख्या आणि उद्दिष्ट्ये (Definition and Aims of Epidemiology).
- रोग घटना मोजमाप (Measures of Disease Occurrence): नवीन घटना दर (Incidence) आणि प्रचलितता (Prevalence).
- रोग घटनांचे नमुने (Patterns of Disease Occurrence): स्थानिक (Endemic), साथीचा रोग (Epidemic), जागतिक महामारी (Pandemic), तुरळक (Sporadic).
- रोग पाळत ठेवण्याची प्रणाली (Surveillance systems): उद्दिष्ट्ये आणि पद्धती (निष्क्रिय (passive) वि. सक्रिय (active)).

युनिट II: प्रमुख रोगांचे प्रकार आणि नियंत्रण उपाययोजना

(Major Disease Types and Control Measures)

[१० तास]

२.१ सार्वजनिक आरोग्याच्या दृष्टीने महत्त्वाच्या श्रेणी (Categories of Public Health Importance)

- वेक्टर-जनित रोग (Vector-Borne Diseases): मलेरिया (Malaria), डेंग्यू (Dengue), आणि चिकुनगुनिया (Chikungunya) यांसारख्या रोगांचे साथरोगशास्त्र (Epidemiology), लक्षणे आणि नियंत्रण (symptoms, and control).

- हवा-जनित आणि श्वसनाचे संक्रमण (Airborne and Respiratory Infections): क्षयरोग (Tuberculosis - TB), इन्फ्लूएंझा (Influenza), आणि COVID-19 चा प्रसार (transmission), प्रतिबंध (prevention), आणि उपचार प्रोटोकॉल (treatment protocols).
- जल-जनित आणि अन्न-जनित रोग (Water-Borne and Food-Borne Diseases): कॉलरा (Cholera), टायफाइड ताप (Typhoid Fever), आणि अतिसाराचे रोग (Diarrheal Diseases) - स्वच्छता (WASH) आणि वैयक्तिक स्वच्छतेवर लक्ष केंद्रित.
- लैंगिक संक्रमित संक्रमण (Sexually Transmitted Infections - STIs): HIV/AIDS, हिपेटायटीस B आणि C चा प्रतिबंध आणि व्यवस्थापन (Prevention and management).

२.२ प्रतिबंध आणि नियंत्रण धोरणे (Prevention and Control Strategies)

- प्रतिरक्षण आणि लसीकरण (Immunization and Vaccination): प्रतिकारशक्तीचे प्रकार (Types of immunity) (नैसर्गिक (natural) आणि कृत्रिम (artificial)), लसीचे प्रकार (vaccine types), आणि राष्ट्रीय लसीकरण कार्यक्रमाची भूमिका (role of national immunization programs).
- वैयक्तिक आणि पर्यावरणीय स्वच्छता (Personal and Environmental Hygiene): हात धुणे (hand washing), सुरक्षित अन्न हाताळणी (safe food handling), आणि वेक्टर नियंत्रणाची (vector control) भूमिका.
- अँटीमायक्रोबियल प्रतिरोध (Antimicrobial Resistance - AMR): कारणे (Causes), परिणाम (consequences), आणि जबाबदार प्रतिजैविक वापरास प्रोत्साहन देण्यासाठी सार्वजनिक आरोग्य मोहिम (public health campaigns).

युनिट III: सार्वजनिक जागरूकता आणि आरोग्य संवाद (Public Awareness and Health Communication) [१० तासा]

३.१ आरोग्य शिक्षण आणि संवादाची तत्त्वे (Principles of Health Education and Communication)

- सार्वजनिक आरोग्य शिक्षणाची व्याख्या आणि उद्दिष्ट्ये (Definition and Objectives of Public Health Education).
- वर्तन बदलाचे मॉडेल (Models of Behaviour Change) (उदा. आरोग्य श्रद्धा मॉडेल - Health Belief Model) आणि रोग प्रतिबंधासाठी त्यांचा वापर (application to disease prevention).
- सार्वजनिक संदेशामध्ये सांस्कृतिक संवेदनशीलता आणि आरोग्य साक्षरतेचे महत्त्व (Importance of Cultural Sensitivity and Health Literacy).

३.२ जोखीम संवाद (Risk Communication)

- साथीच्या रोगाच्या किंवा महामारीच्या काळात आरोग्य धोके आणि अनिश्चितता संप्रेषण करण्याची रणनीती (Strategies for Communicating Health Risks and Uncertainty).
- गैरसमज आणि चुकीची माहिती (Infodemics) हाताळणे (Addressing Misinformation and Disinformation).
- आरोग्य अधिकारी आणि वैज्ञानिक माहितीवर सार्वजनिक विश्वास निर्माण करणे (Building public trust).

३.३ राष्ट्रीय आणि जागतिक आरोग्य कार्यक्रम (National and Global Health Programs)

- संसर्गजन्य रोग नियंत्रणासाठी प्रमुख राष्ट्रीय कार्यक्रमांचे विहंगावलोकन (Overview of key national programs) (उदा. टीबी, HIV/AIDS साठी).
- प्रतिसाद समन्वित करण्यात आंतरराष्ट्रीय आरोग्य नियमन (IHR) आणि WHO सारख्या जागतिक संस्थांची भूमिका.

Practical Vocational Skill Course (VSC- II)
Laboratory Technology (Major Specific)

Practical : 60 hrs.

Marks – 50

(Credits: 02)

1. Handling of glassware and instruments
2. Preparation of different reagents and solutions (molarity, normality, buffers)
3. Study of Laboratory Instruments (Working & Uses) (pH Meter, Colorimeter, Centrifuge Machine, Spectrophotometer, Glucometer, Hot Water Bath)
4. Principles and applications of (Light microscopy, Phase-contrast microscopy, Fluorescence microscopy, Electron microscopy (TEM & SEM – basic concept)
5. Detection of Bleeding time and clotting time using own blood sample
6. Detection on of blood sugar level using Glucometer
7. Separation of serum and plasma from blood.
8. Determination of haemoglobin from blood.
9. Determination of Packed Cell Volume.
10. Demonstration of Electrocardiogram or ECG
11. Detection of Blood Pressure (normal & under stress)
12. Study and demonstration of common sterilization methods used in the laboratory
13. Preparation of Nutrient Agar and Culture plates
14. Determination of Gram-positive and Gram-negative bacteria by Gram staining method
15. Cell Viability assay (Trypan blue exclusion)

Suggested readings:

1. Practical Zoology- P.S. Verma & V.K. Agarwal
2. Practical Zoology -S.S. Lal
3. Introduction to Practical Biochemistry - Plummer
4. Experimental Physiology- Raghavan
5. Handbook of Clinical Laboratory Techniques – P. S. Ajmani
6. Textbook of Biomedical Laboratory Techniques – P. Venkatesan
7. Fundamental Techniques in Microbiology Laboratory– Jenifer Antony
8. Essential Laboratory Techniques and Biochemical Analysis– Edited by Darshan Malik *et al.*
9. Practical Biochemistry: Principles and Techniques – Keith Wilson & John Walker
10. The Laboratory Companion: A Practical Guide to Materials, Equipment, and Technique– Gary S. Coyne
11. Fundamental Laboratory Techniques for Animal Science – Robert J. Callan & Martin A. Spalding

OJT (On Job Training) (4 Credits, 120 Hours)

Separate Annexure Attached

Structure of B. Sc. III Zoology

B.Sc.-III (NEP-2.0) SEMESTER VI

Sr. No.	Particulars	Title of Paper
1	Major (Mandatory Theory)	Major Paper-XII, Developmental Biology (2 Credits, 30 Hours)
2		Major Paper -XIII, Animal Physiology (2 Credits, 30 Hours)
3	Major (Elective Theory)	Paper XIV Major Elective Paper II (A) Histology And Immunology OR Paper XIV Major Elective Paper II (B) Bioinformatics (2 Credits, 30 Hours)
4	Major Mandatory Practical	Major Practical Paper-VI (a) Based on Developmental Biology (2 Credits, 60 Hours) Major Practical Paper-VI (b) Based on Animal Physiology (2 Credits, 60 Hours)
5	Major Elective Practical	Major Elective Practical II A Based on Histology And Immunology (2 Credits, 60 Hours) OR Major Elective Practical II B Based on Bioinformatics (2 Credits, 60 Hours)
6	VSC Major Specific	Vocational Skill Course (VSC) Practical Paper-III Pest Control Techniques (2 Credits, 60 Hours)
7	SEC	Skill Enhancement Course (SEC III) Sericulture (2 Credits, 60 Hours)
8	IKS Major Specific	IKS in Zoology (Major Specific) Zoological Concepts in Ancient Indian Culture (2 Credits, 30 Hours)
9	Field Project (FP)	Field Projects (FP) (4 Credits, 60 Hours)

Major Mandatory (Theory)

Major Paper XII- Developmental Biology

(2 Credits, 30 hours)

Course Outcomes (COs)

On successful completion of the course, the students will be able to:-

CO1: Identify model organisms used to investigate developmental biology and compare the developmental programs of different organisms.

CO2: Explain the concept of growth and differentiation.

CO3: Compare and contrast spermatogenesis and oogenesis.

CO4: Illustrate general features of development of multicellular organisms and describe morphological processes that transform a fertilized egg into a multicellular organism.

CO5: Analyze different types of eggs and sperms and differentiate early embryonic stages.

CO6: Understand the concept and applications of stem cells.

CO7: Understand various developmental abnormalities.

UNIT- I

1. Introduction to Developmental Biology (04)

- 1.1. Definition, scope and early theories of experimental embryology
- 1.2. Model Organisms in developmental Biology (Non-chordate & Chordate)

2. Fertilization and Early development (07)

- 2.1. Overview: Structure of gametes
- 2.2. Types of eggs and vitellogenesis
- 2.3. Fertilization: Types and process
- 2.4. Cleavage and its types

UNIT-II

3. Frog Development (07)

- 3.1. Structure of egg and egg membranes
- 3.2. Cleavage
- 3.3. Blastula and fate map
- 3.4. Gastrulation and fate of three germ layers
- 3.5. Development of brain (Primary and secondary neurulation)
- 3.6. Metamorphosis in frog and its hormonal regulation.

UNIT III

4. Chick Development

(09)

- 4.1: Structure of Hen egg and sperm,
- 4.2. Fertilization, Cleavage and Blastulation
- 4.3. Gastrulation and fate of three germ layers
- 4.4. Organogenesis: Development of Brain, gut and heart and formation of blood upto 72 hours

5. Study of following Topics:

(03)

- 5.1. Placenta and its types
- 5.2. Foetal membranes and its significance
- 5.3 Stem Cells: Potency, Properties and sources
- 5.3. Regeneration: Examples and significance

SUGGESTED READINGS:

1. Developmental Biology, 9th edition (2010), S.F. Gilbert. Publisher –Sinauer, Associates Inc.
2. An Introduction to Embryology, 5th edition (2004), B. I. Balinsky. Publisher – Thomas Asia Pvt. Ltd.
3. Developmental Biology, (2001), R. M. Twyman, Publisher - Bios Scientific, Publishers LTD.
4. A Text book of Embryology (2015). N. Arumugam. Saras Publication
5. Developmental Biology (2018). Sastry and Shukla. Rastogi Publication
6. Essential Developmental Biology (2025). Dr. Jyoti Rani. Pencil Bitz Publications
7. Essentials of Developmental Biology (2021). JMW Slack 4th edition.
8. Principles of Development (2018). Louis Wolpert 5th edition

Major Mandatory (Theory)

Major Paper- XIII Animal Physiology

(2 Credits, 30 hours)

Course Outcomes (COs)

- CO1:** Understand fundamental principles of physiology
- CO2:** Explain the mechanisms of digestion, respiration in vertebrates
- CO3:** Understand the circulatory system functions and blood physiology
- CO4:** Comprehend excretory physiology and mechanisms
- CO5:** Understand the muscular system and conduction of nerve impulse
- CO6:** Explain the anatomical location, structure and functions of endocrine glands.

CO7: Describe the chemical classification of hormones and their synthesis, secretion, transport and metabolism.

Unit I: (11 hrs.)

1. Digestion:

- a. Introduction to the digestive system.
- b. Physiology of digestion

2. Respiration

- a. Introduction of respiration
- b. Respiratory system in human
- c. Mechanism of Breathing in human
- d. Exchange of gases and transport of oxygen and CO₂ in blood

3. Circulation

- a. Introduction of circulation
- b. Structure of Heart (External and internal)
- c. Cardiac cycle and mechanism of working of heart
- d. Blood pressure and ECG

Unit – II (11 hrs.)

4. Excretion

- a. Structure of nephrons
- b. Mechanism of Urine formation
- c. Counter-current Mechanism

5. Muscle

- a. Types of muscles
- b. Ultrastructure of skeletal muscle
- c. Mechanism of muscle contraction

6. Nerve

- a. Structure of Neuron
- b. Origin and conduction of nerve impulse in non-myelinated nerve fibres
- c. Synapse and Synaptic transmission

Unit – III Endocrinology (8 hrs.)

Endocrine Glands (Structure & Function) : Thyroid, Parathyroid, Adrenal & Islets of Langerhans

SUGGESTED READINGS

- 1. A Text Book of Medical Physiology, 11th Ed., John E. Hall, Harcourt Asia Ltd.
- 2. Guyton A. C. and Hall J. E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd.
- 3. Tortora G. J and Derrickson B. (2009). Principles of Anatomy and physiology. XII Edition, John Wiley and Sons Inc.
- 4. Widmaier, E. P., Raff H. and Strong K. T. (2011). Vander's Human Physiology. The mechanisms of Body Function. 12th Ed., Mc Graw-Hill Higher Education, New York.
- 5. Prof. R. L. Kotpal (2019). Modern Text Book of 5th Edition, Zoology: Vertebrates. Rastogi Publications.

6. Chatterjee C. C. (2025). Human Physiology Vol. 1 and Vol. 2 15th Edition.
7. Dhami P. S. and Dhami J. K. (2009). Chordate Zoology, R. Chand & Co. 5th Ed.
8. Endocrinology - S. Vinay Kumar and Ramesh Gupta
9. Textbook of Endocrinology – Mac E. Hadley
10. Animal Physiology (2019). N. Arumugam and A. Mariakuttikan, 12th Ed., Saras Publication.

Major Elective II (Theory)

Major Elective Paper XIV: II A - Histology And Immunology

(2 Credits, 30 hours)

Course Outcomes (COs)

After completion of the course, the student will be able to:

- CO1: Identify and describe the microscopic structure of mammalian organs.
- CO2: Understand innate and adaptive immunity and explain their mechanisms of action.
- CO3: Understand the process of haematopoiesis and the development of immune cells.
- CO4: Identify cells and organs of the immune system and explain their functions.
- CO5: Describe the structure, classes, and biological functions of antibodies.
- CO6: Distinguish between humoral and cell-mediated immune responses.
- CO7: Understand the structure and types of MHC molecules and their role in immune response.
- CO8: Explain antigen processing and presentation pathways.
- CO9: Understand cytokines and complement system pathways and their biological significance.
- CO10: Analyse the principle, methodology, and applications of ELISA.
- CO11: Describe hybridoma technology and production of monoclonal antibodies.

Unit I: Histology of Mammalian Organs:

08 hrs.

- a. Tools and Techniques used in Histology
- b. Histology of Tooth, Tongue, Salivary Gland, Oesophagus, Stomach, Intestine, Liver, Pancreas, Kidney, Testis and Ovary

Unit II: Basics of Immunology:

12 hrs.

- a. Cells of Immune system
- b. Organs of Immune system (Primary and Secondary lymphoid organs)
- c. Haematopoiesis: Definition & Process
- d. Properties and types of Antigen
- e. Basic Structure of Antibody
- f. Types and structure of MHC Molecule
- g. Pathways of antigen processing and presentation
- h. Types and functions of Antibodies
- i. Immune responses- Humoral and cell-mediated

Unit III: Working of the Immune System:

10 hrs.

- a.** Innate immunity - Definition, Mechanisms of innate immunity - First line of defense -
Second line of defense
- b.** Adaptive/Acquired immunity- Definition, Active acquired immunity - Natural and Artificial,
Passive acquired immunity - Natural and Artificial
- c.** Introduction to Hypersensitivity
- d.** ELISA: Principle, Methodology and applications
- e.** Hybridoma technology: Production of Monoclonal antibodies

SUGGESTED READINGS:

1. Textbook of Histology: William Bloom and Don W. Fawcett
2. Histology: Arthur W. Ham, published by Lippincott.
3. Histology: Greep, R.O and Well, L. McGraw-Hill publication
4. An Atlas of Histology. Heinemann Educational Book Ltd. London and ELS: Freeman. W. H. and Bracegirdle, B.
5. Microscopic Anatomy of Vertebrates, Lea and Febigen. Philadelphia: Kendall, J
6. Histology of Mammals: Athavale M. V and Latey, A. N.
7. Kindt, T. J., Goldsby, R. A., Osborne, B. A. and Kuby, J (2006) Immunology, VI Edition
8. W. H. Freeman and Company. David, M., Jonathan, B., David, R.B. and Ivan R. (2006) Immunology, VII Edition, Mosby, Elsevier Publication
9. Abbas, K. Abul and Lichtman H. Andrew (2003) Cellular and Molecular Immunology. V Edition. Saunders Publication
10. Essential Immunology – Ivan M. Roitt
11. Introduction to Immunology – John W. Kimball.
12. Immunology – D. M. Weir
13. Immunology – Janis Kuby
14. Elements of Immunology by F. H. Khan, Pearson Publications, 2009.

Major Elective II (Theory)

Major Elective Paper XIV: II B - Bioinformatics

(2 Credits, 30 hours)

Course Outcomes (COs)

After completion of the course, the student will be able to:

CO1: After completing this course, students will gain fundamental bioinformatics skills.

CO2: Download and visualize DNA and protein structures.

CO3: Perform sequence comparisons using BLAST.

CO4: Navigate biological databases effectively.

CO5: Calculate genetic distances from alignments.

CO6: Interpret protein structures and phylogenetic trees.

Unit I- Definition, Scope & Applications of Bioinformatics in Systematics 8

a. Definition, Scope and Importance

b. Fundamentals of computers and software basics

1. Computer Software Requirements for Bioinformatics: Operating systems (Windows and Linux), Web browsers (Chrome and Firefox), Code writers (TextPad and Notepad Plus).

c. Applications of Bioinformatics in Systematics (Taxonomy & evolution), Forensics, and Healthcare.

Unit II- Databases and sequencing in Bioinformatics 10

a. Introduction to Biological data

1. Classification of Biological database (Primary, Secondary, Derived)

2. Types of Biological data (Nucleotide, Protein, Structural)

3. Database record and submission of data to database

b. Biological sequence and Alignment concepts:

1. DNA, RNA, and protein sequences

2. Sequence file formats (FASTA, FASTQ, GenBank)

3. Sequence alignment concept (Overview)

4. Pairwise and multiple sequence alignment

5. Global Alignment and Local alignment

Unit III- Structural Bioinformatics and Phylogenetics 12

a. Basics of protein structure

1. Levels of protein structure (Primary, Secondary, and Tertiary)

2. Protein Structure visualization tools (2D & 3D): JPred4 (for 2D), AlphaFold (3D).

b. Introduction to phylogenetics

1. Molecular evolution and phylogenetic trees

2. Phylogenetic tree terminology (Branches, nodes, leaves) and Types

3. Methods of phylogenetic analysis (conceptual)
4. Rooted vs unrooted trees
5. Tree building methods (Distance and character based)

SUGGESTED READINGS:

1. Introduction of Bioinformatics. Attwood, T.A. and Parry-smith, D. J. (2001)
2. Bioinformatics: A practical guide to the analysis of Genes and proteins, (Edited) B. F. Publication. Baxevaris, A.D. (1998)
3. Text Book of Bioinformatics. Rastogi Publications. Sharma V, Munjal A, Shanker A (2016).
4. Computer Fundamentals – Fourth Edition – Pradeep K. Sinha, Priti Sinha, BPB Publication-2007.
5. *Essential Bioinformatics*. Cambridge University Press. Xiong, J. (2006).
6. *Bioinformatics: Concepts, Skills and Applications*. CBS Publishers. Rastogi, S. C., Mendiratta, N., & Rastogi, P. (2010).
7. *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbor Laboratory Press. Mount, D. W. (2004).
8. *Introduction to Bioinformatics*. Oxford University Press. Lesk, A. M. (2014).
9. *Bioinformatics and Functional Genomics*. Wiley-Blackwell. Pevsner, J. (2015).

Online Reading Resources:

- **NCBI Tutorials** – Databases, BLAST, and sequence formats
- **UniProt Knowledgebase** – Protein sequence and annotation resources
- **BOLD Systems** – DNA barcoding for taxonomy and conservation
- **Phylogeny.fr** – Online phylogenetic analysis platform
- **JPred4 and AlphaFold Official Documentation** – Protein structure visualization tools

Major Practical VI (a) Based on Developmental Biology

Practicals: 60 hrs. Marks- 50 (Credits: 02)

1. Study of various developmental stages in the life cycle of any one suitable invertebrate model
2. Study of life cycle of any one suitable vertebrate model
3. Demonstration of regeneration in *Hydra/ Planaria*
4. Study of types of eggs: *Drosophila*, frog, Chick and Human (Slides / Chart)
5. Temporary mounting of sperm and perform the sperm count by haemocytometer
6. Study of the types of placentae through permanent slides / photographs
7. Study of Cleavage, V.S. of blastula, gastrula and morula of frog
8. Study of V.S. of blastula and gastrula of chick
9. Study of Metamorphosis in frog.
10. Study of Whole Mounts of developmental stages of Chick through permanent slides: WM of 18 Hrs, 24 Hrs, 33 Hrs, 48 Hrs. and 72 Hrs of chick embryos

11. Study of T.S. of Chick embryos with the help of permanent slides: T.S. of 18 Hrs, 24 Hrs, 33 Hrs, 48 Hrs. 72 Hrs of
12. Temporary/ Permanent preparation of Whole Mount of chick embryo
13. Study of types and applications of Stem Cells
14. Visit to Sperm & Oocyte bank / IVF Centre / Hatchery

Major Practical VI (b) Based on Animal Physiology)

Practicals: 60 hrs. Marks- 50 (Credits: 02)

1. Estimation of Haemoglobin by Sahli's Haemoglobinometer
2. Determination of the Packed Cell Volume (PCV) of whole blood by centrifugation method
3. Study of total count of RBC and WBC count.
4. Preparation of Haemin (Teichmann) Crystals
5. Interpretation of the Electrocardiogram (ECG) under normal & stress
6. Measurement of Arterial Blood Pressure and Heart Rate under resting and stress (exercise) conditions.
7. Study of Peak Expiratory Flow Rate (PEFR):
8. Estimation of Blood Glucose: Quantitative analysis of capillary blood using a digital glucometer to assess glycemic control.
9. Study of Erythrocyte Sedimentation Rate (ESR)³¹
10. Study of activity of salivary amylase enzyme
11. To study Effect of temperature on enzyme activity
12. To study Effect of pH on enzyme activity
13. To study abnormal Urine constituents (Use of Chart is permissible)
14. Interpretation of muscle twitch
15. Histology of Endocrine glands (Thyroid, Parathyroid, Adrenal & Islets of Langerhans)

Major Elective Practical II A Based on Histology And Immunology

Practicals: 60 hrs.

Marks – 50

(Credits: 02)

A. Micro techniques

1. Instruments used for Micro techniques
2. Preparation of wax spread slides
3. Preparation and submission of Permanent histological slides (HE-2, WM-1, HC -2)
 - a. HE techniques.
 - b. Histochemistry (AB pH 1, AB pH 2.5, PAS, Feulgen)
4. Histological study of Tooth (V.S.), Tongue, Salivary gland, Oesophagus, Stomach, Liver, Pancreas, Kidney, Testis and Ovary

B. Immunology

1. Study of primary and secondary lymphoid organs (Photograph, Models)
2. Histological study of - Bone marrow, Thymus, Lymph node, Spleen (slides/ Photographs)
3. Separate serum and plasma from the blood sample
4. Differential Leucocyte Count (DLC)
5. Study of antigen–antibody reaction (Demonstration)
6. Preparation of Stained blood smears to study various types of white blood cells
7. Determination of Total WBC Count Using Haemocytometer
8. Determination of Total RBC Count Using Haemocytometer
9. Demonstration of ELISA and Immuno-electrophoresis
10. Cell counting and viability test for splenocytes of farm breed animals/ cell lines

Major Elective Practical II B Based on Bioinformatics

Practical: 60 hrs.

Marks – 50

(Credits: 02)

1. Identification of computer devices (input/output) and study of computer hardware (*CPU, GPU, RAM and Storage*).
2. Demonstration of operating system (Windows) and compressed folder management (.zip, .rar, .gzip or .gz).
3. Study of basic software used in bioinformatics (*browsers and text pads*).
4. Navigating primary biological databases (*NCBI, BOLD Systems, UniProt*).
5. Study of various file formats to store biological data (*Fasta & Fastq, GenBank, UniProt*)
6. Study of a biological database record (nucleotide & protein): accession number, title, organism,

sequence length, and annotations.

7. Demonstration on downloading nucleotide sequences and protein structures from public databases (*NCBI for nucleotide and UniProt for Protein structure*).

8. Pairwise alignment, scoring and evaluation of alignment quality.

9. Hands-on pairwise Local and Global alignment using online tools (*EMBOSS WATER (Local) & EMBOSS NEEDLE (Global)*).

10. Hands-on use of NCBI BLAST for basic sequence similarity search.

11. Demonstration of 2D protein structures using online webserver (*JPred4*).

12. Demonstration of 3D protein structures using online webserver (*AlphaFold*).

13. Construction of distance matrix from aligned sequences.

14. Construction of simple phylogenetic tree, terminologies, and interpretation.

15. Demonstration on multiple sequence alignment and phylogenetic tree construction Using Web Based Bioinformatics Tools.

Practical Vocational Skill Course (VSC III)

Pest Control Techniques (Major Specific)

Practical : 60 hrs.

Marks – 50

(Credits: 02)

1. Types of Pests (Collection, Identification and differentiation of various types of pest - Any two each)

- a. Cell sap sucking pests.
- b. Leaf eating pests.
- c. Shoot, fruit and stem boring pests.
- d. Household and stored grain pests.

2. Plant based pesticides

- a. Neem (*Azadirachta indica*)
- b. Tobacco (*Nicotiana tabacum*) extracts
- c. Garlic,
- d. Ginger based formulations
- e. Pyrethrum and rotenone

3. Preparation of Plant based Pesticides (Any suitable pesticides prepared by students)

4. To study Pesticide Application Techniques and Field use.

5. Predators Used in Pest Control.

- a. Ladybird beetles,
- b. Dragon fly,

- c. Praying mantis,
- d. Spiders,
- e. Lacewing

6. Parasitoids Used in Pest Control.

- a. *Chalcid* Vesps
- b. *Braconid* Vesps
- c. *Ichneumonid* Vesps

7. Demonstration of Entomopathogens in Pest Control (Mode of infection and application methods)

Types of pathogens:

- a. Bacterial (*Bacillus thuringiensis*),
- b. Fungal (*Metarhizium anisopliae*)
- c. Viral (NPV)

8. Pheromonal Pest control Method

- a. Types of Pheromones: Sex Pheromone, Aggregation pheromone, Alarm Pheromone, Trail pheromone, social pheromone etc.
- b. Different Phenomenal traps: Delta traps, Sticky traps, Funnel traps, Water Traps, Bucket traps, Baffle traps, Mcphail traps etc

9. Integrated Pest management

- a. Cultural control methods
- b. Mechanical and physical control methods
- c. Biological control methods
- d. Chemical control as a last resort

10. Field Visit to farm / Agriculture college / Entomological Museum (Submission of Report)

SUGGESTED READINGS:

1. Insect Pest Management — David R. Dent & Richard H. Binks
2. Applied Entomology: Insect Ecology and Integrated Pest Management — Lakshman Chandra Patel
3. A. S. Atwal, Agriculture pests of India and South East Asia
4. K. P. Srivastava, G.S. Dhaliwal & Gursharan Singh, A textbook of applied entomology.
5. Larry P. Pdigo, Entomology and pest management.
6. Sathe and Jadhav Sericulture and pest management –DPH-Delhi.
7. S. Pradhan Agricultural Entomology.
8. Govt. Maharashtra. Crop pest and how to fight them B.D. Ratnaik, Text Book of Entomology.
9. R. Mathur Text Book of Entomology.
10. V. B. Avasthi, Introduction to General and Applied Entomology.

11. K.P. Srivastava, The Text Book of Applied Entomology.
12. Koul O. and Dhaliwal G.S. Biopesticides and Pest Management.
13. Krishnaswami S. Silkworm rearing sericulture manual Luyuplian, Silkworm disease.
14. Mathur and Upadhyay, A Text Book of Entomology.
15. Abrol D.P. Honey bee diseases and their management.
16. Insect Ecology: Concepts to Management — K.V. Hari Prasad
17. Insect Predators in Pest Management — Edited by Omkar

Practical Skill Enhancement Course (SEC III) Sericulture

Practical: 60 hrs.

Marks – 50

(Credits: 02)

1. Study of Mulberry cultivation- Taxonomy, varieties, propagation, planting, soil science (pH, nutrients), water/ weed management and leaf quality.
2. Study of rearing house of Silkworm
3. Study of rearing equipment's of Sericulture
4. Study of disinfection methods and commercial use of disinfectant in Sericulture (100 dfls)
5. Study of rearing methods of Silkworm
 - a. Chawki rearing
 - b. Late age rearing
6. Rearing of Silkworm to study the life cycle of Mulberry /Tasar / Muga / Eri Silkworm (Any one)
7. Study of Silkworm diseases caused by
 - a. Protozoan- Pebrine.
 - b. Virus- BMNPV, Grasserie
 - c. Bacteria- Flacherie
 - d. Fungus- Muscardine, Aspergillosis
8. Study of pests of Silkworm- Uzi fly and Dermestid beetle
9. Post –Cocoon Technology- Silk reeling, processing and silk technology
10. Demonstration of :
 - a. Digestive system of Silkworm larva.
 - b. Silk glands.
 - c. Mounting of larval mouth parts and spiracle.
11. Calculate Cocoon weight, shell weight and shell ratio.
12. By-products of Silkworm rearing and their utilization.
13. Visit to Sericulture centre submission of report.

Suggested Readings:

1. Krishnaswami S, Narasimhanna MN, Suryanarayan SK, Kumararaj S (1973) Manual of Sericulture. Vol. 2. Silkworm Rearing. FAO, Rome.
2. Vasantharaj David, V.V. Ramamurthy, 2015, Elements of Economic Entomology, 8th edition, Brillion Publishing, New Delhi.
3. Practical Manual Commercial Sericulture (ELP) (EL-AGP 812) Prepared by: School of Agriculture & Allied Sciences The Neotia University.
4. Shukla and Upadhyay (2014) Applied and Economic Zoology.
5. Manju Yadav (2013) Economic Zoology.
6. Jawaaid Ahsan & Subhas Prasad Sinha (2010) A handbook of economic Zoology.
7. P. R. Venkitaraman (1983) Text Book of Economic Zoology.
8. Kavane R.P. and Sathe T.V. (2011) Wild silk technology, DPH, New Delhi.

Indian Knowledge System – II (Major Specific IKS)

Zoological Concepts in Ancient Indian Culture

Theory: 30 hrs

Marks-50

(Credits: 02)

Course Outcomes (COs)

CO1: Students will be able to describe the historical development of zoological knowledge in India from ancient to colonial periods.

CO2: Students will be able to explain traditional Indian practices related to animal conservation, classification, husbandry, and veterinary medicine.

CO3: Students will be able to analyze the scientific, cultural, and ethical significance of ancient Indian zoological and veterinary knowledge in the context of modern biology.

Unit 1

7

1. History of Zoology in India
2. Indus Valley civilization
3. Contribution of Zoological Researchers in India.
 - a. Salim Ali
 - b. The Asiatic society

Unit 2

8

1. Animal Conservation in
 - a. Maurya Period
 - b. Chalukya Period
2. Ancient Indian classification of living beings in Vedic India

1. Animal keeping in ancient India
 - a. Animal husbandry in Harappan culture
 - b. Cow husbandry in Mathura during Krishna's era, Mauryan age and Ashoka period
2. Veterinary Medicine
 - a. Animal surgery
 - b. Ethno-Veterinary medicine
 - c. Snake venom as a valuable medicine
 - d. Medicinal importance of Cow therapy
3. Hunting of animals for food & its domestication in Ancient India

Suggested Readings:

1. History of Zoology and Present Status in India, Chandrakasan Sivaperuman
2. Indus Valley Civilization: A History from Beginning to End Kindle Edition
 - a. By Hourly History
 - b. Salim Ali: The Birdman of India Kindle Edition by Aadhi Valliappan
3. Zoological Survey of India-History and Progress 1916-1990 (1990). Edited by Director, Zoological Survey of India. Published by ZSI, Kolkata.109pp.
4. Ashoka and the Maurya Dynasty The History and Legacy of Ancient India's Greatest Empire Colleen Taylor Sen
5. The Mughal painters of natural history. Burlington magazine 90 (539): 49–50.
6. Grove, Richard. 1995 Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600–1860. Cambridge University Press. ISBN 0-521-56513-8
7. Bird study in India: its history and its importance. ICCR, New Delhi.
8. Animal Kingdom (Tiryak) in Epics by Saranya P.S
9. Bird Study in India: Its History and its Importance by Salim Ali
10. Concept of Animal Husbandry Practices In Ancient India Team Pashudhan Praharee By Team Pashudhan Praharee
11. The Vedic Age Hardcover by R. C. Majumdar
12. Veterinary Medicine and Animal Keeping in Ancient India by R Somvanshi
13. Vedic Paathshala Veterinary Science In Ancient India
14. Animal Husbandry and Allied Technologies in Ancient India Hardcover by P. P. Joglekar

Field Project (FP)

(2 Credits, 60 Hours)

Separate Annexure II attached

Annexture I

B. Sc. III, Sem. V

OJT (On Job Training) (4 Credits, 120 Hours)

All students should complete the OJT before the start of SEM VI(Follow the timeline provided by SUK). For details, follow the Shivaji University guidelines.

Refer: SU/AM/240 dated 22/04/2024

After completion of OJT, the student should submit a detailed report. It should be evaluated by an expert committee.

Evaluation Scheme:

Sr No	Particulars	Marks
1	Effectiveness and Quality of Presentation	10
2	Knowledge Depth and Practical Skills	10
3	Diversity in study and presentation	10
4	Practical applications of taught concepts	10
5	OJT Report	30
6	Attendance, student log, Certificate, and Evaluation	30
	Total	100

परिशिष्ट १- आंतरवासिता हमीपत्र

१. विद्यार्थ्याचे नाव			
२. सध्याचा पत्ता			
३. कायमस्वरूपी पत्ता			
४. ई-मेल आयडी			
५. भ्रमणध्वनी (मोबाईल) क्र.			
६. आधार क्र.			
७. पॅन क्र.			
८. एकूण जी.पी.ए.(सरासरी श्रेयांक) (आंतरवासिता करण्यापूर्वी पूर्ण केलेल्या सर्व सत्रांची सरासरी श्रेयांक)			
९. आंतरवासिता पद्धत (ऑफ लाईन/ऑ लाईन/हायब्रीड मोड)			
१०. आंतरवासिता प्राधान्ये			
	स्थळ (Place)	प्रमुख क्षेत्र (Sector)	संस्था/संघटना (Institute/ Organisation)
प्राधान्य-१			
प्राधान्य-२			
प्राधान्य-३			
मी आंतरवासिता भोरणाच्या अटी, शर्ती आणि आवश्यकतांशी सहमत आहे. विद्यार्थ्यांची स्वाक्षरी: ----- दिनांक:----- सदर विद्यार्थ्याने आंतरवासिता परिचय वर्गात भाग घेतला आहे आणि आंतरवासिता कार्यक्रमात भाग घेण्यासाठी आवश्यक ती सर्व कागदपत्रे आणि प्रक्रियेच्या गरजा पूर्ण केल्या आहेत याची मी खात्री केली आहे. तसेच त्याने/तिच्या मार्गदर्शकाकडून मान्यता प्राप्त केली आहे. विभागातील समन्वयक शिक्षकाची स्वाक्षरी दिनांक:			

परिशिष्ट २ (अ) व्यक्तिगत माहिती प्रपत्राचा नमुना

नाव : -----

संपर्क क्रमांक आणि ईमेल आयडी -----

शिक्षण -----

उच्च शिक्षणसंस्थेचे नाव वर्ष

१२ वी/मुख्य विषय : सीजीपीए:

उच्च शिक्षणसंस्थेचे नाव वर्ष

पदवी/मुख्य विषय : सीजीपीए:

आंतरवासिता/कामाचा अनुभव

संस्था - संघटना

प्रकल्प :

थोडक्यात माहिती :

शैक्षणिक अनुभव :

सत्र: वर्ष:

प्रकल्प :

थोडक्यात माहिती :

इतर कर्तृत्व आणि वैयक्तिक आवडी निवडी

विद्यार्थ्याची स्वाक्षरी

परिशिष्ट ३ संस्थेस सेवा पुरविण्याबाबतचे पत्र

(अभिविभाग/महाविद्यालयाच्या लेटरहेडवर)

प्रति,

व्यवस्थापक (मानव संसाधन)

विषय : <वर्ग> मध्ये शिक्षण घेणा-या विद्यार्थ्यांना - आठवड्यांच्या आंतरवासिताची विनंती

मां. महोदय/महोदया,

<वर्ग> साली स्थापन झालेल्या <महाविद्यालय/विद्यापीठाचे नाव> ला सर्व शैक्षणिक उत्कृष्टता आणि पायाभूत सुविधांचे महत्त्व-----मध्ये राष्ट्रीय मूल्यांकन आणि मान्यता परिषदेने < ----- > श्रेणीची मान्यता दिली आहे.

वरील बाबी लक्षात घेता मी आपल्याला विनंती करतो की, आपल्या नामांकित संस्थेत कृपया आमच्या खालील <विद्यार्थी संख्या> विद्यार्थ्यांना व्यावहारिक प्रशिक्षणाची परवानगी द्यावी. आपली खातरजमा झाल्यानंतर विद्यार्थ्यांना प्रशिक्षणात दाखल होण्यासाठी किमान एक आठवड्याचा कालावधी द्यावा.

अ.क्र.	नाव	उपस्थिती क्र Roll No.	वर्ष, (प्रथम/द्वितीय/तृतीय/चतुर्थ)	विभाग (विषय)

या विद्यार्थ्यांची व्यक्तिगत माहिती प्रपत्रे या पत्रासोबत जोडलेली आहेत. आपल्याकडे रिक्त पदे असल्यास, कृपया वरील शाखांमधील विद्यार्थ्यांच्या मुलाखती घेण्यासाठी नियोजन करावे.

आपल्या संमतीची अपेक्षा!

आपला विश्वासू

नोडल अधिकारी/टीपीओ

(महाविद्यालयाचे/अभिविभागाचे नाव आणि दिनांक)

परिशिष्ट ४ विद्यार्थ्यांचे कार्यमुक्तता पत्र
<अभिविभाग/महाविद्यालयाच्या लेटरहेड>

प्रति,

मा. महाव्यवस्थापक (मानव संसाधन)

विषय : विद्यार्थ्यांचे कार्यमुक्तता पत्र.

मा. महोदय/महोदया,

कृपया उपरिनिर्दिष्ट विषयाच्या संदर्भातील आपले पत्र/ई-मेल दिनांक.....पहा. आपल्या प्रतिष्ठित संस्थेत खालील विद्यार्थी आपल्या अनुमतीने व आपल्या मार्गदर्शनाखाली आणि देखरेखीखाली औद्योगिक आंतरवासिता प्रशिक्षण घेतील :

अ.क्र.	नाव	उपस्थिती क्र Roll No.	वर्ष (प्रथम/द्वितीय/तृतीय/चतुर्थ)	विभाग (विषय)

हे प्रशिक्षण अभ्यासक्रमाचा आवश्यक भाग असल्याने प्रशिक्षणासाठी अभ्यासक्रमात खालील मार्गदर्शक तत्त्वे निश्चित करण्यात आली आहेत. त्यामुळे कृपया संबंधित विद्यार्थ्यांस मार्गदर्शकाने खालील मार्गदर्शक तत्त्वे सूचित करावीत, अशी विनंती करण्यात येत आहे.

- आंतरवासिताचे वेळापत्रक तयार करून त्याची एक प्रत आम्हाला पाठवावी.
- प्रत्येक विद्यार्थ्याने आंतरवासिता दैनंदिनी तयार करून अहवाल देणे आवश्यक आहे.
- कृपया दररोज विद्यार्थ्यांची आंतरवासिता दैनंदिनी तपासावी.
- प्रशिक्षण काळातील कामाच्या वेळांबाबत सूचना देणे आणि उपस्थितीची नोंद राखणे

विद्यार्थ्यांच्या कामगिरीचे मूल्यमापन खाली नमूद केल्याप्रमाणे उत्कृष्ट, अतिशय चांगले, समाधानकारक व असमाधानकारक अशा गुणांकनाच्या आधारे करावे, अशी विनंती आहे.

- उपस्थिती आणि सामान्य वर्तन
- कामगार आणि पर्यवेक्षकांशी संबंध
- शिकण्यासाठी पुढाकार आणि प्रयत्न
- ज्ञान आणि कौशल्य सुधारणा
- संस्थेला दिलेले योगदान

प्रशिक्षण पूर्ण झाल्यानंतर सीलबंद लिफाफ्यात कामगिरीचा अहवाल, स्वाक्षरी करण्या-या अभिका-यास अग्रेषित करावा. या संदर्भातील आपल्या प्रयत्नांमुळे विद्यार्थ्यांचे ज्ञान आणि व्यावहारिक कौशल्ये यामध्ये सकारात्मक वाढ होईल. आपल्या सहकार्यावरल मनःपूर्वक धन्यवाद आणि त्यासाठी आम्ही कृतज्ञ आहोत.

विद्यार्थी संस्थेच्या नियमांचे पालन करतील आणि आंतरवासितादरम्यान योग्य ती शिस्त पाळतील. विद्यार्थी आपल्याला तारखेनुसार अहवाल देतील सोबत-कंपनी/संस्थेकडून आलेले पत्र या पत्राची प्रत

आपले विश्वासू,

मोडल अधिकारी/टीपीओ

(अभिविभागाचे/महाविद्यालयाचे नाव आणि दिनांक)

परिशिष्ट ५ विद्यार्थ्यांच्या कामांची देनंदिनी (नोर्दीचे स्वरूप)

आठवडा	नेमून दिलेले काम	केलेले उपक्रम	मुख्य शिक्षण (प्राप्त ज्ञान/ कौशल्ये)	पूर्व टिप्पणी

उद्योग-पर्यवेक्षकाची स्वाक्षरी

परिशिष्ट ६ उपस्थिती पत्रक
(आंतरवासिता देण्या-या संस्थेच्या अधिकृत लॅटरहेडवर)

संस्थेचे नाव व पत्ता

विद्यार्थ्याचे नाव	
उपस्थिती क्र.	
आभ्यासक्रमाचे नाव	
प्रशिक्षण सुरु होण्याची तारीख	
प्रशिक्षण पूर्ण होण्याची तारीख	

महिना आणि वर्ष :

आठवडा	सोमवार	मंगळवार	बुधवार	गुरुवार	शुक्रवार	शनिवार
१						
२						
३						
४						
५						
६						
७						
८						
९						
१०						

- उपस्थिती पत्रक प्रशिक्षण देनांदिनीमध्ये चिकटवून ठेवावे. ते काढू नका किंवा फाडू नका.
- उपस्थिती रकान्यामध्ये लाल शार्पने सुट्ट्या चिन्हांकित केल्या पाहिजेत. अनुपस्थितीला लाल शार्प 'अ' म्हणून चिन्हांकित करावे

आंतरवासिता पर्यवेक्षकाचे नाव आणि स्वाक्षरी

परिशिष्ट ७ पर्यवेक्षकाचा आंतरवासिता-मूल्यमापन अहवाल
(आंतरवासिता देण्या-या संस्थेच्या अधिकृत लेटर हेडवर)

विद्यार्थ्याचे नाव -----

दिनांक -----

कार्य पर्यवेक्षकाचे नांव :-

आंतरवासितेचे पदनाम -----

संस्था/संघटना -----

आंतरवासिताचा पत्ता -----

आंतरवासिता तारखा -----पासून ते -----पर्यंत

कृपया आपण खालील वर्तन ज्या वारंवारीतेने काळजीपूर्वक पाहिले ते दर्शवून आंतरवासिता विद्यार्थ्याचे मूल्यांकन करा:

मापदंड/निकष:	सुधारण होणे अपेक्षित	समाधानकारक	चांगला	उत्कृष्ट
वर्तन Behaviors				
कामकाजातील विश्वासार्हता Performs in a dependable manner				
सहकारी आणि पर्यवेक्षकांबरोबर सहकार्य Cooperates with co-workers and supervisors				
कामकाजातील अभिरुची Shows interest in work				
प्रशिक्षणातील गती Learns quickly				
उपक्रमशीलता Shows initiative				
कामकाजातील गुणवत्ता Produces high quality work				
जबाबदारीचे भान Accepts responsibility				
टीका-टिपण्णची स्वीकारता Accepts criticism				

संघटनात्मक कौशल्यांतील निपुणता Demonstrates organizational skills				
तांत्रिक ज्ञान आणि कौशल्यांचा वापर Uses technical knowledge and expertise				
उचित न्यायनिर्णयक्षमता Shows good judgment				
नवनिर्मितीक्षमता आणि कल्पकता Demonstrates creativity/originality				
समस्यांचे प्रभावीपणे विश्लेषण Analyzes problems effectively				
स्वावलंबन Is self-reliant				
संवादक्षमता Communicates well				
प्रवाची लेखनशैली Writes effectively				
व्यावसायिक अंनवृत्ती Has a professional attitude				
व्यावसायिक वर्तनव्यवहार Gives a professional appearance				
वक्तशीरपणा Is punctual				
वेळेचा प्रभावी वापर Uses time effectively				

टांतरवासिता विद्यार्थ्यांची सर्वांगीण कामगिरी :सुधारणा/समाधानकारक/चांगले/उत्कृष्ट (यापैकी टिक करा)

अतिरिक्त टिप्पण्या (असल्यास) :

उद्योग पर्यवेक्षकाची स्वाक्षरी

नाव

मानवसंसाधन व्यवस्थापकाची स्वाक्षरी

नाव

परिशिष्ट ८ विद्यार्थ्यांचा आंतरवासिता अनुभव : अभिप्राय

(आंतरवासिता पूर्ण झाल्यानंतर विद्यार्थ्यांनी भरावे)

विद्यार्थ्यांचे नाव :

दिनांक :

औद्योगिक पर्यवेक्षकाचे नाव :

पदनाम :

पर्यवेक्षक ईमेल :

आंतरवासिता:सवेतन.....विनावेतन.....

संस्था/संघटना :

आंतरवासिताचा

पत्ता:.....

शिक्षक समन्वयक :

विभाग :

आंतरवासिता दिनांकपासून तेपर्यंत

आपल्या आंतरवासिताच्या कामाचे थोडक्यात वर्णन द्या (आपण ज्यासाठी जबाबदार आहात त्या कामांची नावे स्वरूप):

तुमचा आंतरवासिताचा अनुभव तुमच्या अभ्यासाच्या प्रमुख क्षेत्राशी संबंधित होता का?

- होय/व-याच अंशी
- होय/थोड्याफार प्रमाणात
- नाही/अजिवात नाही

खालील विधानांशी आपण किती प्रमाणात सहमत किंवा असहमत आहात हे दर्शवा.

हा अनुभव असा आहे:	पूर्णपणे सहमत	सहमत	मत नाही	असहमत	पूर्णपणे असहमत
मला व्यवसाय क्षेत्र शोधण्याची संधी दिली Given me the opportunity to explore a career field					
मला सराव करण्यासाठी वर्गातील सिद्धांतांचे उपयोजन करण्याची परवानगी दिली Allowed me to apply classroom theory to practice					
माझी निर्णयक्षमता आणि समस्या सोडविण्याची कौशल्य विकसित करण्यास मदत केली Helped me develop my decision-making and problem-solving skills					
कायमस्वरूपी नोकरीपूर्वी मला कार्यविश्वाशी संबंधित ज्ञानप्राप्तीसाठी मदत झाली Expanded my knowledge about the work world prior to permanent employment					

मला माझे लेखी आणि मौखिक संप्रेषण कौशल्ये विकसित होण्यासाठी मदत day:h- Helped me develop my written and oral communication skills					
नेतृत्व कौशल्ये वापरण्याची संधी दिली (इतरांवर प्रभाव पाडणे, इतरांसोबत कल्पना विकसित करणे, निर्णय घेण्यास आणि कृतीस अत्तेजन देणे) Provided a chance to use leadership skills (influence others, develop ideas with others, stimulate decision-making and action)					
कामाच्या संवंधातील नैतिक परिणामांमंदल माझी संवेदनशीलता वाढविली Expanded my sensitivity to the ethical implications of the work involved					
अनोख्या परिस्थितीत आत्मविश्वासपूर्वक वागण्याकरिता आत्मकबळ दिले Made it possible for me to be more confident in new situations.					
मला माझे पारस्परिक कौशल्य सुधारण्याची संधी fnyh- Given me a chance to improve my interpersonal skills					
मला जबाबदारी हाताळायला आणि वेळेचा सुयोग्य वापर करायला मदत केली. Helped me learn to handle responsibility and use my time wisely					
मला स्वतःचे नवीन पैलू शोधण्यात मदत केली जी मला पूर्वी माहित नव्हती Helped me discover new aspects of myself that I didn't know existed before					
मला नवी अभिरुची आणित क्षमता विकसित करण्यासाठी मदत केली Helped me develop new interests and abilities					
मला माझ्या कार्यक्षेत्राची उद्दिष्टे स्पष्ट करण्यास मदत केली Helped me clarify my career goals					
मला भविष्यात रोजगार मिळू शकेल यासाठी आवश्यक संपर्क साधने पुरविली Provided me with contacts which may lead to future employment					

मला माहिती मिळविण्यासाठी आणि / किंवा ती वापरण्यासाठी संस्थेत उपलब्ध नसलेली उपकरणे वापरण्याची परवानगी दिली. Allowed me to acquire information and/or use equipment not available at my Institute					
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- संस्थेच्या आंतरवासिता कार्यक्रमात शिक्षकांनी विद्यार्थ्यांसाठी मार्गदर्शक असणे अपेक्षित आहे.
तुमच्या शिक्षक समन्वयकाने असे काम केले असे तुम्हाला वाटते का? होय/नाही नसल्यास का?
- आपल्या शिकण्याच्या करारामध्ये निर्धारित केलेली प्रारंभिक ध्येये, कार्ये आणि नवीन कौशल्ये आपण किती चांगल्या प्रकारे पूर्ण करू शकलात? आपण कोणत्या प्रकारे नवीन दिशा घेण्यास किंवा आपल्या कराराच्या पलीकडे विस्तार करण्यास सक्षम आहात? होय/नाही नसल्यास का?
- आपण कोणत्या क्षेत्रात सर्वात जास्त विकास आणि सुधारणा केली?
- आपल्या आंतरवासिता काळातील सर्वात महत्त्वपूर्ण कामगिरी किंवा समाधानाचा क्षण कोणता होता?
- आंतरवासितामध्ये तुम्हाला काय आवडले नाही?
- तुमचा एकंदर अनुभव लक्षात घेता तुम्ही या आंतरवासिताचे मूल्यमापन कसे कराल?
समाधानकारक/चांगले/उत्कृष्ट (एकाला गोल करा)
- आपला आंतरवासिताचा अनुभव कसा सुधारता आला असता याबद्दल सूचना द्या (तुम्हाला अतिरिक्त जबाबदारी सांभाळता आली असती का? आपल्या आंतरवासिताबद्दल तुमच्या शिक्षकांशी अधिक चर्चा करणे आपल्याला आवडले असते का? बारकाईने देखरेखीची गरज होती का? अधिक उजळणीची गरज होती का?)

विद्यार्थ्यांची स्वाक्षरी -----

नाव, -----

उपस्थिती क्रमांक, -----

दिनांक-----

परिशिष्ट १ संस्थेचा आंतरवासिता मूल्यमापन अहवाल : नमुना प्रपत्र
(अधिविभागाच्या/महाविद्यालयाच्या लेटरहेडवर)

१. विद्यार्थ्यांचे नाव -----
भ्रमणध्वनी (मोबाईल) क्र. -----
२. उपस्थिती क्र. -----
३. शाखा/सत्र -----
४. प्रशिक्षण कालावधी -----
५. घरचा पत्ता (संपर्क क्रमांकासह) -----
६. प्रशिक्षण (आंतरवासिता) स्थळाचा पत्ता -----
७. प्रशिक्षण देणा-या संस्थेचा पत्ता -----
८. प्रशिक्षण/पर्यवेक्षकाचे प्रभारीचे नाव/पदनाम -----
९. कामाचे स्वरूप -----
१०. मूल्यमापन दिनांक -----
११. कृपया खालील बाबींचे मूल्यांकन करा :

अ.क्र.	तपशील	गुण पेकी	गुण पेकी	मिळालेले गुण
१.	सादरीकरणाची गुणवत्ता आणि परिणामकारकता	१०	५	
२	ज्ञानाची सखोलता आणि प्रात्यक्षिक कौशल्ये	१०	५	
३	शिकण्याच्या अनुभवाची विविधता आणि प्रासंगिता	१०	५	
४	व्यावहारिक अनुप्रयोग आणि शिकवलेल्या संकल्पनांशी संबंध	१०	५	
५	आंतरवासिता अहवाल	३०	१५	
६	उपस्थितीची नोंद, विद्यार्थी लॉग, पर्यवेक्षक मूल्यमापन	३०	१५	

समग्र श्रेणी :

मार्गदर्शकाची स्वाक्षरी

Annexture II

B. Sc. III, Sem. VI Field Project

(2 Credits, 60 Hours)

Topics: (Sample)

- Biodiversity Conservation and Management, Aquaculture and Fisheries, Aquatic Biology, Environmental studies focusing on practical application, sustainability, water analysis, soil analysis, Pollution Studies, producing biofuels, Toxicology, Biology of various animals, Pest Control, Animal Behaviour, Animal Physiology etc. (Any suitable topic)

Format of Report

- Front Page
- Certificate
- Acknowledgement
- Index
- Introduction
- Surveys, Field Visits
- Experimental Studies/Results/Observations/Calculations
- Summary, Findings and Outcomes
- References

Guidelines of Evaluation:

FP will be evaluated through a detailed report submission followed by oral examination evaluated by the examiners/experts appointed by the Examination Section of the University. Maximum 20 students per batch will be evaluated per day for FP. The FP will be evaluated as per the following marks distribution

Sr. No.	Particulars	Marks (50)
1	Report as per format	15
2	Quality of Report	10
3	Knowledge Depth and Practical Skills	10
4	Oral Examination (Q and A Session)	15