

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBAJINAGAR.**



NAAC- 'A⁺' Grade

CIRCULAR NO.SU/ B.Sc./NEP-2020/91/2026

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Boards/Committees and recommended by the Faculty of Science & Technology, **Academic Council at its meeting held on 02nd June 2026 has accepted** the following **Revised syllabi of Bachelor of Science & Basket** under the Faculty of Science & Technology **as per Norms of National Education Policy-2020 and as per Government Letter dated 13 March 2024** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc.Botany	V th and VI th semester
2.	B.Sc.Biotechnology	V th and VI th semester
3.	B.Sc.Zoology	V th and VI th semester
4.	B.Sc.Agrochemical and Fertilizer	V th and VI th semester
5.	B.Sc.Geology	V th and VI th semester
6.	B.Sc.Environmental Science	V th and VI th semester
7.	B.Sc.Home Science	V th and VI th semester
8.	B.Sc.Diary Science and Technology	V th and VI th semester
9.	B.Sc.Automobile Technology	V th and VI th semester
10.	B.Sc.Physics	V th and VI th semester
11.	B.Sc.Chemistry	V th and VI th semester
12.	B.Sc.Analytical Chemistry	V th and VI th semester
13.	B.Sc.Polymer Chemistry	V th and VI th semester
14.	B.Sc.Electronics	V th and VI th semester
15.	B.Sc.Forensic Science & Cyber Security	V th and VI th semester
16.	B.Sc.Microbiology	V th and VI th semester
17.	B.Sc.Fisheries Science	V th and VI th semester
18.	B.Sc.Mathematics	V th and VI th semester
19.	B.Sc.Forensic Science	V th and VI th semester
20.	B.Sc.Information Technology	V th and VI th semester
21.	B.Sc.Horticulture	V th and VI th semester
22.	B.Sc.Networking & Multimedia	V th and VI th semester
23.	B.Sc.Biochemistry	V th and VI th semester
24.	B.Sc.Industrial Chemistry	V th and VI th semester
25.	B.Sc.Bioinformatics	V th and VI th semester

26.	B.Sc.Instrumentation Practice	Vth and VIth semester
27.	B.Sc.Non-Conventional and Conventional Energy	Vth and VIth semester
28.	B.Sc.Statistics	Vth and VIth semester
29.	B.Sc.Computer Science	Vth and VIth semester
30.	Bachelor of Computer Application	Vth and VIth semester

This is effective from the Academic Year 2026-27 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/AC.NO.06/4498-113
Date:- 12.06.2026.

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Deputy Registrar,
Syllabus Section

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
- 7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

Dr. Babasaheb Ambedkar Marathwada University
Chhatrapati Sambhajinagar- 431001



Faculty of Science & Technology
B.Sc. Degree Programme

(Three Year / Four Years (Hons) / Four Years (Hons with Research))
(AS PER NEP-2020)

Revised
Course Structure & Curriculum
(AS PER NEP-2020)

Subject (Major): ZOOLOGY

For
B.Sc. Third Year
(Semester - V & VI)
Effective from Academic Year - 2026-27


Professor Dr. B. K. Sathe,
Dean,
Faculty of Science & Technology,
Dr. Babasaheb Ambedkar
Marathwada University,
Chhatrapati Sambhajinagar,
431001



PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.



Structure of B. Sc. (Three / Four Years Honours / Honours with Research Degree) Programme with Multiple Entry and Exit Options

Subject (Major): Zoology

BSc Third Year: 5th Semester

Course Type	Course Code	Examination Code (To be given by respective BoS)	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	ZOO/DSC/T/ 300	SAC00093005T	BIOCHEMISTRY	2		2		2+2+2+2=08
	ZOO/DSC/T/ 301	SAC00093015T	ECOLOGY	2		2		
	ZOO/DSC/P/ 326	SAC00093265P	Practical based on ZOO/DSC/T/300		4		2	
	ZOO/DSC/P/ 327	SAC00093275P	Practical based on ZOO/DSC/T/ 301		4		2	
Discipline Specific Electives (DSE) (Choose any one from ZOO/DSE/T/300 , ZOO/DSE/T/ 301 and ZOO/DSE/T/ 302) and corresponding Practicals	ZOO/DSE/T/ 300	SBC00093005T	PROTOZOOLOGY	2		2		2+2=4
	ZOO/DSE/T/ 301	SBC00093015T	FISHERY SCIENCE -I	2		2		
	ZOO/DSE/T/ 302	SBC00093025T	GENERAL ENTOMOLOGY	2		2		
	ZOO/DSE/P/ 326	SBC00093265P	Practical based on ZOO/DSE/T/300		4		2	
	ZOO/DSE/P/ 327	SBC00093275P	Practical based on ZOO/DSE/T/ 301		4		2	
	ZOO/DSE/P/ 328	SBC00093285P	Practical based on ZOO/DSE/T/ 302		4		2	
Minor (Choose any two from pool of courses) It is from different discipline of the same faculty	ZOO/Mn/T/ 300	SCC00093005T	PARASITIC DISEASES	2		2		2+2 =04
	ZOO/Mn/T/ 301	SCC00093015T	ANIMAL HUSBANDRY	2		2		
VSC (Vocational Skill Courses) (Choose any one from ZOO/VSC/T/300a nd ZOO/VSC/T/ 301) and corresponding Practicals	ZOO/VSC/T/ 300	SEC00093005T	FISH PROCESSING TECHNIQUES	2		2		2+2 =04
	ZOO/VSC/T/ 301	SEC00093015T	AQUACULTURE	2		2		
	SUB/VSC/P/ 326	SEC00093265P	Practicals based on ZOO/VSC/T/300		4		2	
	ZOO/VSC/P/ 327	SEC00093275P	Practicals based on ZOO/VSC/T/ 301		4		2	
OJT/ FP/CEP/CC/RP (Choose any one from pool of courses)	ZOO/FP/CEP/P /326	SKC00093265P	Field Project / community engagement and service		4		2	02
				12	20	12	10	22

Minor Courses for other Discipline

ZOO/Mn/T/ 300 : This is a 2 credit theory course to be designed for other discipline

ZOO/Mn/T/ 301: This is a 2 credit theory course to be designed for other discipline

BSc Third Year: 6th Semester

Course Type	Course Code	Examination Code (To be given by respective BoS)	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	ZOO/DSC/T/ 350	SAC00093506T	DEVELOPMENTAL BIOLOGY	2		2		2+2+2+2+2 = 10
	ZOO/DSC/T/ 351	SAC00093516T	EVOLUTION & ANIMAL BEHAVIOUR	2		2		
	ZOO/DSC/T/ 352	SAC00093526T	IKS-2- ANCIENT KNOWLEDGE OF ANIMAL USE IN INDIA	2		2		
	ZOO/DSC/P/ 376	SAC00093766P	Practical based on ZOO/DSC/T/350		4		2	
	ZOO/DSC/P/ 377	SAC00093776P	Practical based on ZOO/DSC/T/ 351		4		2	
Discipline Specific Electives (DSE) (Choose any one from SUB/DSE/T/ 350, SUB/DSE/T/ 351 and SUB/DSE/T/ 352) and corresponding Practicals	ZOO/DSE/T/ 350	SBC00093506T	PARASITOLOGY	2		2		2+2=4
	ZOO/DSE/T/ 351	SBC00093516T	FISHERY SCIENCE - II	2		2		
	ZOO/DSE/T/ 352	SBC00093526T	APPLIED ENTOMOLOGY	2		2		
	ZOO/DSE/P/ 376	SBC00093766P	Practical based on ZOO/DSE/T/ 350		4		2	
	ZOO/DSE/P/ 377	SBC00093776P	Practical based on ZOO/DSE/T/351		4		2	
	ZOO/DSE/P/ 378	SBC00093786P	Practical based on ZOO/DSE/T/352		4		2	
Minor (Choose any one from pool of courses) It is from different discipline of the same faculty	ZOO/Mn/T/ 350	SCC00093506T	AVIAN BIOLOGY	2		2		2+2 = 04
	ZOO/Mn/T/ 351	SCC00093516T	PET ANIMAL CARE & MANAGEMENT	2		2		
OJT/ FP/CEP/CC/RP (Choose any one from pool of courses)	ZOO/OJT/P/ 376	SJC00093766P	On Job Training		8		4	04
				12	20	12	10	22
Exit option : Award of UG degree in Major with 132 credits OR continue with Major and Minor								

Minor Courses for other Discipline

ZOO/Mn/T/ 350: This is a 2 credit theory course to be designed for other discipline

ZOO/Mn/T/ 351: This is a 2 credit theory course to be designed for other discipline

Detailed Illustration of Courses included in 5th and 6th semester:

1) Major (Core) subject are mandatory.

SUB/DSC/T/300 : This is a 2 credit theory course corresponding to Major (core) subject

SUB/DSC/T/301 : This is a 2 credit theory course corresponding to Major (core) subject

SUB/DSC/P/326 : This is a 2 credit practical course based on SUB/DSC/T/300

SUB/DSC/P/327 : This is a 2 credit practical course based on SUB/DSC/T/301

SUB/DSC/T/350 : This is a 2 credit theory course corresponding to Major (core) subject

SUB/DSC/T/351 : This is a 2 credit theory course corresponding to Major (core) subject

SUB/DSC/T/352 (IKS-2) : This is a 2 credit theory course corresponding to Indian Knowledge System related to Major

SUB/DSC/P/376 : This is a 2 credit practical course based on SUB/DSC/T/350

SUB/DSC/P/377 : This is a 2 credit practical course based on SUB/DSC/T/351

2) Discipline Specific Electives (DSE) : (Needs to be chosen any one from pool of courses available at respective college). These courses should be chosen related to Major.

SUB/DSE/T/300 : This is a 2 credit discipline specific course (elective) related to Major

SUB/DSE/T/301 : This is a 2 credit discipline specific course (elective) related to Major

SUB/DSE/T/302 : This is a 2 credit discipline specific course (elective) related to Major

SUB/DSE/P/326 : This is a 2 credit practical course based on SUB/DSE/T/300

SUB/DSE/P/327 : This is a 2 credit practical course based on SUB/DSE/T/301

SUB/DSE/P/328 : This is a 2 credit practical course based on SUB/DSE/T/302

SUB/DSE/T/350 : This is a 2 credit discipline specific course (elective) related to Major

SUB/DSE/T/351 : This is a 2 credit discipline specific course (elective) related to Major

SUB/DSE/T/352 : This is a 2 credit discipline specific course (elective) related to Major

SUB/DSE/P/376 : This is a 2 credit practical course based on SUB/DSE/T/350

SUB/DSE/P/377 : This is a 2 credit practical course based on SUB/DSE/T/351

SUB/DSE/P/378 : This is a 2 credit practical course based on SUB/DSE/T/352

3) Minor : It is from different discipline of the same faculty

SUB/Mn/T/300 : This is a 2 credit theory from different discipline of the same faculty

SUB/Mn/T/301 : This is a 2 credit theory from different discipline of the same faculty

SUB/Mn/T/350 : This is a 2 credit theory from different discipline of the same faculty

SUB/Mn/T/351 : This is a 2 credit theory from different discipline of the same faculty

1) VSC (Vocational Skill Courses) : Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

SUB/VSC/T/300 : This is a 1 credit theory course based Hands on Training corresponding to Major (core) subject.

SUB/VSC/T/301 : This is a 1 credit theory course based Hands on Training corresponding to Major (core) subject.

SUB/VSC/P/326 : This is a 1 credit practical course based on SUB/VSC/T/300

SUB/VSC/P/327 : This is a 1 credit practical course based on SUB/VSC/T/301

2) SUB/FP/CEP/P/326 : Field Project / Community engagement and service : This is a 2 credit practical course related to Field Project / community engagement and service

3) SUB/OJT/P/376 : This is a 4 credit practical course related to On job Training

Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge:** Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.
2. **Interdisciplinary Proficiency:** Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.
3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.
4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.
5. **Global Citizenship and Cultural Sensitivity:** Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1.The citizenship and society:** Apply broad understanding of ethical and professional skill in sciencesubjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.
- **PO2.Environment and sustainability:** Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.
- **PO3.Ethics:** Apply ability to develop sustainable practical solutions for science subjectrelated problems within positive professional and ethical boundaries.
- **PO4.Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.
- **PO5.Communication:** Communicate effectively on complex sciencesubject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO6.Project management and finance:** Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.
- **PO7.Life-long learning:** Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.



SEMESTER – V

ZOO/DSC/T/300 : BIOCHEMISTRY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) To introduce students to the chemical basis of life processes.
- ii) To understand the structure and function of major biomolecules.
- iii) To explain the role of enzymes in biological reactions.
- iv) To provide basic knowledge of metabolism and vitamins.
- v) To prepare students for higher studies in life sciences and biochemistry.

Course Outcomes (COs) :

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

- i) Explain fundamental biochemical concepts related to living systems.
- ii) Describe the structure and biological roles of carbohydrates, proteins, and lipids.
- iii) Understand nucleic acid structure and function.
- iv) Explain enzyme action and factors affecting enzyme activity.
- v) Outline basic metabolic pathways and the nutritional importance of vitamins.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Fundamentals of Biochemistry and Carbohydrates • pH and buffers: biological importance • Chemical bonds in biological systems • Carbohydrates: classification and nomenclature • Structure of monosaccharides and disaccharides • Polysaccharides: starch, glycogen, and cellulose • Biological importance of carbohydrates	10 Hrs
II	Proteins, Lipids, and Nucleic Acids • Amino acids: classification and properties • Biological functions of proteins • Lipids: classification (simple, compound and derived) • Fatty acids: saturated and unsaturated • Biological importance of lipids	10 Hrs
III	Enzymes, Metabolism, and Vitamins • Mechanism of enzyme action • Factors affecting enzyme activity • Enzyme inhibition: competitive and non-competitive • Metabolism: concept of metabolism, catabolism, and anabolism • Overview of glycolysis and citric acid cycle • Vitamins: Biological functions of vitamins	10 Hrs



Learning Resources:

1. Lehninger Principles of Biochemistry – David L. Nelson & Michael M. Cox.
2. Harper's Illustrated Biochemistry – Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly & P. Anthony Weil.
3. Biochemistry – Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr. & Lubert Stryer.
4. Principles of Biochemistry – Albert L. Lehninger.
5. Textbook of Biochemistry for Medical Students – D.M. Vasudevan, Sreekumari S. & Kannan Vaidyanathan.
6. Fundamentals of Biochemistry – J.L. Jain, Sunjay Jain & Nitin Jain.
7. Outlines of Biochemistry – Eric E. Conn, P.K. Stumpf, George Bruening & Roy H. Doi.
8. Biochemistry – U. Satyanarayana & U. Chakrapani.
9. Biochemistry for Beginners – Various Authors.
10. Instant Notes in Biochemistry – B.D. Hames & N.M. Hooper.

ZOO/DSC/T/301 : ECOLOGY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) To provide a basic understanding of principles and concepts of ecology.
- ii) To explain the structure and functioning of ecosystems.
- iii) To understand population and community-level interactions.
- iv) To familiarize students with natural resources and environmental issues.
- v) To create awareness about conservation and sustainable development

Course Outcomes (COs) :**After completion of the course, students will be able to:**

- i) Explain fundamental ecological concepts and ecosystem processes.
- ii) Describe population characteristics and growth patterns.
- iii) Understand community interactions and ecological succession.
- iv) Identify major natural resources and environmental problems
- v) Appreciate the importance of conservation and sustainability.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Ecology and Ecosystem • Physical environment: Abiotic and Biotic factors • Concept of habitat and niche (fundamental and realized niche) • Ecosystem: structure and functions • Energy flow in ecosystem • Food chain, food web and trophic levels • Ecological pyramids • Biogeochemical cycles: carbon, nitrogen and phosphorus	10 Hrs
II	Population and Community Ecology • Population regulation: density dependent and density independent factors • r-selected and K-selected species • Community concept and community structure • Interspecific and intraspecific interactions • Ecological succession and climax community	10 Hrs
III	Resource Ecology and Conservation • Natural resources: forest, water and soil resources • Deforestation and its ecological impacts • Conservation strategies (in-situ & ex-situ) (Indian examples)	10 Hrs



	• Wetlands: importance and conservation • Concept of Sustainable Development & Millennium Development Goals • Levels of biodiversity (genetic, species, ecosystem) • Hotspots and endangered species	
Learning Resources: 1. Fundamentals of Ecology, Dash, M.C., Tata McGraw-Hill, New Delhi. 2. Ecology, Environment and Resource Conservation, Singh J.S., Singh S.P. and Gupta, S.R., Anamaya Publishers. 3. Living in the Environment Tyler Miller, Thomson Brooks/Cole. 4. Fundamentals of Ecology – Eugene P. Odum & Gary W. Barrett. 5. Ecology: Principles and Applications – J.L. Chapman & M.J. Reiss. 6. A Textbook of Ecology and Environment – P.D. Sharma. 7. Elements of Ecology – Thomas M. Smith & Robert L. Smith. 8. Ecology – Michael Begon, Colin R. Townsend & John L. Harper. 9. Environmental Biology – P.S. Verma & V.K. Agarwal. 10. Concepts of Ecology – Edward J. Kormondy. 11. Biodiversity and Conservation – K.V. Krishnamurthy. 12. Environmental Studies – Erach Bharucha. 13. Principles of Environmental Science – William P. Cunningham & Mary Ann Cunningham.		

ZOO/DSC/P/ 326: BIOCHEMISTRY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) To develop practical skills in basic biochemical laboratory techniques.
- ii) To train students in preparation of reagents and use of laboratory instruments.
- iii) To perform qualitative analysis of biomolecules.
- iv) To estimate important biochemical constituents by simple methods.
- v) To promote scientific observation, recording and interpretation of results.

Course Outcomes (COs) :

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

- i) Handle laboratory instruments and chemicals safely.
- ii) Identify carbohydrates, proteins and lipids by qualitative tests.
- iii) Prepare solutions, buffers and reagents used in biochemistry.
- iv) Perform simple biochemical estimations.
- v) Record observations and interpret experimental results scientifically.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Fundamentals of Biochemistry and Carbohydrates: • Calibration and proper use of laboratory glassware • Preparation of solutions: normality, molarity, and percentage solutions • Preparation of buffer solutions and determination of pH (pH paper and pH meter) Qualitative Analysis of Carbohydrates: • Molisch's test ; Benedict's test ; Fehling's test ; Iodine test for starch	20 Hrs
II	Proteins, Lipids and Nucleic Acids: Qualitative Analysis of Proteins: • Biuret test; Ninhydrin test; Xanthoproteic test ; Millon's test Qualitative Analysis of Lipids: • Sudan III staining ; Grease spot test; Solubility test	20 Hrs



	Nucleic Acids: • DNA isolation from animal tissue (liver/fish muscle – demonstration) • Qualitative test for DNA (Diphenylamine test)	
III	Enzymes, Metabolism and Vitamins: Enzyme Studies: • Study of enzyme activity using salivary amylase • Effect of temperature/pH on enzyme activity Vitamins: • Qualitative test for Vitamin C (ascorbic acid) Quantitative Estimation: • Estimation of glucose by Benedict's quantitative method / colourimetric method • Estimation of protein by the Biuret method / Lowry method • Preparation of standard curve (glucose/protein) using a colourimeter	20 Hrs
Learning Resources: 1) Practical Biochemistry – David T. Plummer. 2) An Introduction to Practical Biochemistry – David T. Plummer. 3) Biochemical Methods – S. Sadasivam & A. Manickam. 4) Practical Biochemistry for Students – Various Authors. 5) Laboratory Manual in Biochemistry – Various Authors. 6) Textbook of Biochemistry for Medical Students – D.M. Vasudevan, Sreekumari S. & Kannan Vaidyanathan. 7) Fundamentals of Biochemistry – J.L. Jain, Sunjay Jain & Nitin Jain. 8) Experimental Biochemistry – Various Authors. 9) Biochemistry Laboratory Manual – Various Authors. 10) Harper's Illustrated Biochemistry – Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly & P. Anthony Weil.		

ZOO/DSC/P/ 327: ECOLOGY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) To develop practical understanding of ecological principles and field methods.
- ii) To train students in identification and measurement of abiotic and biotic factors.
- iii) To study population and community characteristics through simple methods.
- iv) To create awareness about natural resources, pollution and conservation practices.
- v) To develop skills in data collection, interpretation and report writing.

Course Outcomes (COs) :

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

- i) Measure basic environmental parameters in field and laboratory.
- ii) Analyze ecological data related to population and community studies.
- iii) Identify local flora, fauna and ecological interactions.
- iv) Understand natural resource management and pollution monitoring.
- v) Prepare field reports and practical records scientifically.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Ecology and Ecosystem • Identification and use of ecological instruments: thermometer, hygrometer, rain gauge, lux meter, pH meter • Measurement of abiotic factors: temperature, pH, light intensity, and soil moisture of a selected site • Identification and record fauna from a study area; calculate species abundance • Perform a pond / grassland survey and list producers, consumers, and decomposers • Estimate soil parameters (moisture, organic matter – basic methods)	20 Hrs
II	Population and Community Ecology • Quadrat method for estimation of frequency, density, and abundance • Line transect method for vegetation analysis • Calculation of population parameters: density, dispersion, natality, and mortality from sample data • Determination of species dominance and abundance	20 Hrs



	• Plotting and interpretation of exponential and logistic growth curves • Study of r-selected and K-selected species through local examples • Conduct a mini field project and prepare a report on population and community structure	
III	Resource Ecology and Conservation • Analysis of water quality: colour, odour, pH, turbidity (basic assessment) • Study of soil texture and moisture content • Identification of renewable and non-renewable energy resources • Study of common air, water, and soil pollutants • Study of biodiversity conservation methods: in-situ and ex-situ (local examples) • Field visit to wetland / forest / biodiversity park / water treatment plant (field report submission)	20 Hrs
Learning Resources: 1) Basic Ecology & Ecosystem: Eugene P. Odum, M. C. Dash 2) Indian University Reference: P. D. Sharma 3) Population Ecology: Begon, Ricklefs 4) Environmental Studies: Tyler Miller 5) Field Practicals: A. Kumar, S. C. Sharma 6) Practical Biochemistry – David T. Plummer 7) Laboratory Manual in Biochemistry – J. Jayaraman 8) Biochemical Methods – Sadasivam & Manickam 9) Practical Handbook of Biochemistry – Dr. Rupali Khandekar-Shinde 10) Practical Ecology – M.S. Saha. 11) Practical Methods in Ecology – Southwood & Henderson. 12) Fundamentals of Ecology – Eugene P. Odum & Gary W. Barrett. 13) Environmental Biology – P.S. Verma & V.K. Agarwal.		

ZOO/DSE/T/300: PROTOZOOLOGY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) Students will understanding the concept of Protozoology
- ii) Student will discuss about free living and parasitic protozoon.
- iii) Student will understand the basic identification of common parasites.
- iv) Students will discuss about life cycle of protozoan parasite.
- v) Students will study the methods to identify protozoon.

Course Outcome (Cos) :

After completion the course the students will be able to:

- i) Know the stages of life cycles of parasites and infective stages.
- ii) Students will be able to discuss the concept of free living and parasitic protozoan's.
- iii) Students will be able to tell the major types of protozoan parasites and their life cycles.
- iv) The students after completing this course he may join the research institute.
- v) The student may be joining as scientist in the WHO, UN.
- vi) May join as protozoologist in the state and central government public health programs.
- vii) He gets job opportunities in the pathological labs.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Introduction to protozoology : Protozoa: Definition, General Characters, Classification (up to Order) Locomotory organelles and Locomotion – (Pseudopodia, Cilia and Flagella) Nutrition, Reproduction, Economic importance, Parasitism and Protozoa diseases.	10 Hrs
II	• Free-living Protozoa: Amoeba proteus: Systematic position, Habits and habitat, Morphology, Nutrition, Reproduction Euglena: Systematic position, Habits and habitat, Morphology, Nutrition, Reproduction Opalina: Systematic position, Habits and habitat, Morphology, Reproduction and Nutrition. Paramecium: Systematic position, Habits and habitat, Morphology, Nutrition, Reproduction	10 Hrs
III	• Parasitic protozoa: Entamoeba histolytica: Systematic position, Habits and habitat, Morphology, Reproduction and life cycle,	10 Hrs

	Pathogenicity, Treatment (Therapy), Prevention Trypanosoma: Systematic position, Habits and habitat, Morphology, Reproduction and life cycle, Pathogenicity, Treatment (Therapy), Prevention Plasmodium: Systematic position, Species of Plasmodium, Habits and habitat, Morphology, Reproduction and life cycle of P. vivax. Types of malaria, Prevention and control of malaria and its Treatment.	
Learning Resources: 1. Protozoa: A Textbook for college and University Students: R.L. Kotpal, 11th Edition, Rastogi Pub. Meerut. 2. Invertebrate Zoology: E.I.Jordan and P.S. Verma, S.Chand and Company Ltd. Publication Ram Nagar New Delhi. 3. Modern Text Book of Invertebrate Zoology: R.L.Kotpal Rastogi Publication Meerut 9th Edition. 4. Protozoology, S.V.Nikam & T.T.Shaikh 2011(Oxford Book Company) 5. Parasitology: Protozoology and Helminthology. Chatterjee, K. D. (2009). XIII Edition, CBS Publishers & Distributors (P) Ltd. 6. <i>Textbook of Medical Parasitology</i>, CK Jayaram Parker, Jaypee Publishers, New Delhi, 2007 , 6th edition, ISBN: 81-8061-937 7. Introduction to Parasitology, Chandler, A.C.and Read, C.P. 1961. Wiley, New York. 8. General Parasitology, Dogiel V.A. 1965 Oxford University Press London. 9. Protozoology, Gall, R.P. 1953 Prentice-Hall. Englewood Cliffs, N.J. 10. The Invertebrates Hyman, L.H. 1940, Vol. I McGraw-Hill Book Co., Inc., New York 11. Invertebrates Zoology, Meglitsch, P.A. 1972 Oxford University Press London. 12. Textbook of Zoology, Invertebrates Parker, T.J. and Haswell, W.A. 1972. The Macmillan press Ltd. London. 13. The Invertebrates Vol II, McGraw Hill, New York.- Dawes B. (1946). 14. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co. 15. Global trends in emerging infectious diseases. Nature 2008; 451(21): 990-993. 16. Parasitology (Protozoology and Helminthology) Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. and P. Daszak. Chatterjee K. D. (1969) – 17. The Biology of animal parasites, Saunders International Student Edition. Cheng T.C. (1964)		

ZOO/DSE/T/301: FISHERY SCIENCE - I

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning objectives:

- i) Understand inland, estuarine, and marine fisheries of India
- ii) Study major fish species and their biology
- iii) Learn fishing methods and fishery management
- iv) Analyze environmental impacts on fisheries

Course Outcomes: After completion the course the students will be able to:

- i) Explain different fishery resources of India
- ii) Identify important fish species and their features
- iii) Apply fishery techniques and management practices.
- iv) Evaluate fisheries for sustainable use and economic importance

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Riverine and Reservoir Fisheries of India • River systems of India and their fishery-The Ganga rivers system, the East Coast river system, the West coast river system. Problems and management of riverine fisheries-effect of dams on riverine fisheries, river pollution. Reservoir Fisheries: • Types of reservoirs, Ecology and fisheries of important reservoirs in India, Reservoir Fisheries of Maharashtra, importance of fish ways and fish ladders.	10 Hrs
II	Estuarine Fisheries of India • Definition of an estuary, Fisheries of different estuaries in India i.e., Hooghly-Matlah estuary, Godavari estuary, Krishna estuary, Adiyar estuary, Mahanadi estuary etc. Fisheries of Chilka and Pulicat Lake	10 Hrs
III	Marine Fisheries of India • Fisheries of Bombay duck, Indian mackerel, Oil sardine, Ribbon fish, Pomfret, Tuna-Taxonomy, general description, food and feeding habits, reproduction, crafts and gears, general trends in fishery and its utilization. • Fishery of prawns, crabs and mollusca: Taxonomy, general description, food and feeding habits, reproduction, crafts and gears, general trends in fishery and its utilization.	10 Hrs



Learning Resources:

1. Marine Fisheries of India/D.V. Bal and K.V. Rao, Tata McGraw-Hill Publishing Company Ltd.
2. Marine Fisheries of India /S.L. Shanbhogue, Indian Council of Agricultural Research, New Delhi.
3. Fish and Fisheries of Indian Reservoirs/V.B. Sakhare, Daya Publishing, House, New Delhi .
4. Inland Fisheries/V.B. Sakhare, Daya Publishing House, New Delhi.
5. A Text Book of Fish and Fisheries/G.S. Sandhu, Daya Publishing House, New Delhi.
6. Reservoir Fisheries of India / V.V. Sugunan, FAO Report No,345, Daya Publishing House, New Delhi.

ZOO/DSE/T/302: GENERAL ENTOMOLOGY Total Credits : 02 Total Contact Hours : 30 Hrs Maximum Marks : 50		
Learning Objectives of the Course: i) To understand the definition, scope, and importance of Entomology. ii) To learn morphological, physiological and hormonal control in insects. iii) To understand general structure and classification of insects. Course Outcome (Cos) : After completion the course the students will be able to: i) Students able to identify insects and their morphology and physiology. ii) Students can apply knowledge to understand roles of insects in agriculture, ecology, health and in forensic science. iii) Students demonstrate the skills in collection, preservation and diagrammatic representation.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction to Entomology: - Definition and scope of Entomology, General characteristic features of Arthropoda, Importance of insects in agriculture, medicine, ecology and in forensic science. Methods of Insect Collection and Preservation. Study of typical insect: - Structure of insect body wall (cuticle), Body segmentation (Head, thorax & abdomen), Insect appendages, types of antennae, structure of legs and its modification, structure of wings and its venation.	10 Hrs
II	Animal type, Grasshopper: - Classification, external morphology, Digestive system, Nervous system, reproductive system including development. Metamorphosis: - Types of metamorphosis, Hormonal Control: - Molting (ecdysis), Metamorphosis (ecdysone, juvenile hormone).	10 Hrs
III	Insect orders: - General Characters of Thysanura (Silverfish), Odonata (Dragon fly & damsel fly), Hemiptera (bugs, hoppers & Jassids), Coleoptera (beetles), Lepidoptera (butterflies & moths), Diptera (Mosquitoes & flies), Hymenoptera (bees, wasps & ants). - Economic importance of insects (pests & beneficial insects) - Role of insects in ecosystem (pollination, decomposition)	10 Hrs

	Learning Resources: 1) General and Applied Entomology – K.K. Nayar, T.N. Ananthakrishnan & B.V. David 2) A Textbook of Entomology – R.L. Kotpal & N.P. Bali 3) Imms' General Textbook of Entomology – O.W. Richards & R.G. Davies 4) Introduction to the Study of Insects – D.J. Borror & D.M. DeLong 5) Elements of Economic Entomology – B.V. David & T. Kumaraswami 6) Agricultural Entomology – T.V. Prasad 7) Insect Physiology – V.B. Wigglesworth 8) Principles of Insect Morphology – R.E. Snodgrass 9) Medical and Veterinary Entomology – Gary R. Mullen & Lance A. Durden 10) Forensic Entomology – Jason H. Byrd & James L. Castner	
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ZOO/DSE/P/326: PROTOZOOLOGY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) Students will understanding the concept of practical Protozoology
- ii) Student will discuss about laboratory techniques in protozoology
- iii) Student will understand the laboratory diagnosis of protozoan infections
- iv) Students will discuss about protozoan culture techniques:
- v) Students will study the methods to identify protozoon.

Course Outcome (Cos) : After completion the course the students will be able to:

- i) Know the Laboratory Techniques in Protozoology.
- ii) Students will be able to discuss the concept of free living and parasitic protozoan's.
- iii) Students will be able to tell the laboratory diagnosis of protozoan infections
- iv) Students will be able to tell protozoan culture techniques:
- v) The students after completing this course he may join the research institute.
- vi) The student may be joining as scientist in the WHO, UN.
- vii) May join as protozoologist in the state and central government public health programs.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Study of slides and models: • Identification, Classification and comment of Common important Protozoa: <i>Euglena</i>, <i>Amoeba</i>, <i>Paramecium</i>, <i>Entamoeba histolytica</i>, <i>Plasmodium</i>, <i>Opalina</i>, <i>Balantidium</i>, <i>Giardia intestinalis</i>, <i>Trypanosoma</i>, <i>Leishmania</i>.	20 Hrs
II	• Study of protozoan culture techniques <i>Amoeba</i>, <i>Euglena</i>, <i>Paramecium</i>, <i>Verticella</i>. • Collection, preparation and examination of permanent slides of <i>Amoeba</i>, <i>Euglena</i>, <i>Paramecium</i>, <i>Vorticella</i>. • Stool Examination Techniques for detecting cysts and trophozoites (wet mounts, concentration).	20 Hrs
III	Laboratory Techniques in Protozoology • Protozoan staining techniques (Preparation of stains): Giemsa, Leishman, Iodine staining Haematoxylin, Acetocarmine, Borax carmine and Bouins fluid. • Preparation of thin and thick blood films of protozoan blood parasites <i>Plasmodium</i>.	20 Hrs

	• Preparation of thin and thick blood films of protozoan blood parasites Trypanosoma /Leishmania. • Study of osmoregulation / excretion / Cyclosis in <i>Paramecium</i>	
Learning Resources: 1. P.S.Verma (First Edition 1971): A Manual of Practical Zoology Invertebrates, S. Chand and Company Ltd, Ramnagar New Delhi 110055. 2. Chatterjee K. D. (1969) -Parasitology (Protozoology and Helminthology) 3. Ahlam Fathi Al-Tae and et.al Ed. 2011:"Manual of Practical Parasitology"University of Mosul, College of Veterinary Medicine Department of Microbiology 4. Protozoology, S.V.Nikam & T.T.Shaikh 2011(Oxford Book Company). 5. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co. 6. Text book Medical Parasitology of Jaypee Brothers, - Panikar C.K.J (1988) 7. Dr. S.S. Lal Practical Zoology Invertebrates 9th edition Rastogi Publications Meerut. 8. Basic laboratory methods in medical parasitology, WHO Geneva 1991: Library Cataloguing in Publication Data, Parasitology-Laboratory manuals ISBN 92 4 1544104 Typeset in India Printed in England 88/83/11444-Clays-1000 9. Lal,S.S. (Edition 2004): A Textbook of Practical Zoology Volume 3, Rastogi Publication Shivaji Road Meerut-250002 India.		

ZOO/DSE/P/327: FISHERY SCIENCE – I (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives:

i) To understand identification and classification of freshwater, brackish and marine fishes.

ii) To study economically important fish species and their ecological significance.

iii) To gain knowledge of fishing crafts, gears, and field exposure through visits.

Course Outcomes: After completion the course the students will be able to:

i) Students will be able to identify major fish species from different aquatic habitats.

ii) Students will understand fishery resources, biodiversity, and their utilization.

iii) Students will develop practical skills in recognizing fishing methods and preparing project reports.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Study of freshwater fishes: - Major carps: Catla catla, Labeo rohita, Cirrhinus mrigala - Other carps: Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix - Cat fishes: Wallago attu, Clarias magur, Heteropneustes fossilis, Mystus pp, - Study of brackish water fishes. Hilsa ilisha, Chanos chanos (milkfish), Lates calcarifer, Tilapia	20 rs
II	Study of marine water fishes: Oil sardine, Indian Mackerel, Ribbon -fish, Bombay-duck, Pomfret, Sole fish.	20 Hrs
III	Identification of crafts and gears: - Gill net, Rampani, Satpati, Machwa, Catamaran. - Visit to local or any reservoir and marine fish landing centre and student should submit a project report.	20 Hrs

Learning Resources:

1. Fish and Fisheries of India – V.G. Jhingran.
2. Textbook of Fish Biology and Fisheries – Pandey & Shukla.
3. Handbook of Fisheries and Aquaculture – ICAR Publications.
4. An Introduction to Fishes – S.S. Khanna & H.R. Singh.
5. Economic Zoology – G.S. Shukla & V.B. Upadhyay.
6. Marine Fisheries of India/D.V. Bal and K.V. Rao, Tata McGraw-Hill Pub. Ltd.
7. Inland Fisheries/V.B. Sakhare, Daya Publishing House, New Delhi.
8. Fisheries Biology, Assessment and Management – Michael King.
9. Practical Manual of Fisheries – K. P. Biswas.
10. Applied Fisheries/V.B. Sakhare, Daya Publishing House, New Delhi.

ZOO/DSE/P/328: GENERAL ENTOMOLOGY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) Understand basic techniques of insect collection, preservation, and curation.
- ii) Study external morphology and identifying characters of insects.
- iii) Learn different types of insect antennae, legs, wings, and wing venation.
- iv) Understand structural organization of a representative insect (grasshopper).
- v) Study digestive, nervous, and reproductive systems of insects.
- vi) Learn classification of major insect orders up to family level.
- vii) Identify economically important and common insect groups.
- viii) Understand insect life cycles and metamorphosis through charts and models.
- ix) Develop practical skills in field identification, specimen preparation, and report writing.
- x) Promote scientific interest in insect diversity and applied importance.

Course Outcome (Cos) : After completion the course the students will be able to:

- i) Collect, preserve, pin, spread, and maintain insect specimens scientifically.
- ii) Identify various types of antennae, modified legs, and insect wings.
- iii) Explain external morphology of grasshopper as a typical insect.
- iv) Describe digestive, nervous, and reproductive systems of grasshopper.
- v) Classify common insects into major orders using diagnostic characters.
- vi) Recognize insects belonging to Thysanura, Odonata, Hemiptera, Coleoptera, Lepidoptera, Diptera, and Hymenoptera.
- vii) Prepare charts/models showing insect life cycles and metamorphosis.
- viii) Conduct field visits for insect observation and biodiversity recording.
- ix) Prepare preserved collections of agriculturally important insects.
- x) Apply entomological knowledge in agriculture, biodiversity, and pest management studies.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	- To study the Collection and preservation of insects - To study types of insect antennae. - To study types and modification of insect legs. - To study structure of wings and venation of any insect.	20 Hrs
II	- To study external characters of Grasshopper. - To study digestive, nervous, reproductive system of grasshopper. - To study insect orders up to the family with general characters.	20 Hrs

	(Thysanura (Silverfish), Odonata (Dragon fly & Damsel fly), Hemiptera (Hoppers/Jassids/bugs), Coleoptera (Beetle), Lepidoptera (Butterfly & Moths), Diptera (Mosquito & flies), Hymenoptera (Bees/Wasps/ Ants).	
III	• To prepared life cycle of any insect (Charts/Models). • Compulsory field visit to identify insects, report writing and submission. (2 P). • Collection, pinning, spreading and preservation of 10 agriculturally important insects and submission of specimens and report. (2P)	20 Hrs
	Learning Resources: 1) General and Applied Entomology – K.K. Nayar, T.N. Ananthakrishnan & B.V. David 2) A Textbook of Entomology – R.L. Kotpal & N.P. Bali 3) Elements of Entomology – Rajendra Singh 4) Introduction to the Study of Insects – D.J. Borror & D.M. DeLong 5) Imms' General Textbook of Entomology – O.W. Richards & R.G. Davies 6) Economic Entomology – B.V. David 7) Manual of Practical Entomology – S. Prasad 8) Agricultural Entomology – T.V. Prasad 9) Insect Morphology and Physiology – V.B. Wigglesworth 10) Practical Zoology: Arthropoda – P.S. Verma	

ZOO/Mn/T/300: PARASITIC DISEASES

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives

- i) Understand basic concepts of parasitism, host and parasite types
- ii) Study classification of parasites
- iii) Understand modes of transmission of parasitic diseases
- iv) Study host-parasite interactions
- v) Identify symptoms and pathology of major parasitic infections
- vi) Understand diagnostic methods for parasitic diseases
- vii) Learn prevention and control strategies
- viii) Develop awareness about public health importance of parasites

Course Outcomes (COs)

After completion the course students will be able to:

- i) Understand transmission and epidemiology of parasitic diseases
- ii) Identify symptoms and disease mechanisms caused by parasites
- iii) Apply knowledge of diagnostic techniques
- iv) Suggest prevention and control measures
- v) Analyze the impact of parasitic diseases on public health

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	General Introduction • Definition and scope of parasitology • Types of parasites and Hosts • Modes of transmission of parasitic infections • Importance of parasitology in community health • Burden of parasitic diseases globally and in India • Role of education in prevention of parasitic diseases	10 Hrs
II	Medically and veterinary important parasites - (Structure, life cycle, pathogenicity and control measure) Parasitic diseases of Alimentary canal, GI tract, Liver and abdominal cavity. • Amoebiasis - <i>Entamoeba histolytica</i> - • Balantidiasis - <i>Balantidium coli</i> - • Fascioliasis - <i>Fasciola hepatica</i> - • Taeniasis - <i>Taenia solium</i> (pork tapeworm) • Strongyloidiasis - <i>Strongyloides stercoralis</i> - • Enterobiasis - <i>Enterobius vermicularis</i> •	10 Hrs
III	Parasitic diseases of blood and tissue. • Malaria - <i>Plasmodium</i> species - <i>Plasmodium falciparum</i>	10 Hrs

	• Trypanosomiasis - <i>Trypanosoma gambiense</i> • Schistosomiasis - <i>Schistosoma haematobium</i> • Cysticercosis - <i>Taenia solium</i> • Echinococcosis (Hydatid disease) - <i>Echinococcus granulosus</i> • Filariasis - <i>Wuchereria bancrofti</i>	
	Learning Resources: 1) Textbook of Human Parasitology – R.S. Chatterjee 2) Introduction to Parasitology – Asa C. Chandler 3) Parasitic Diseases – Despommier et al. 4) Manson's Tropical Diseases – Farrar, Hotez et al. 5) Foundations of Parasitology – Roberts & Janovy 6) Human Parasitology – Bogitsh, Carter & Oeltmann 7) Medical Parasitology – D.R. Arora & B. Arora 8) Textbook of Medical Parasitology – K.D. Chatterjee 9) An Introduction to Parasitology – P.N. Sharma 10) Parasitology – Mehlhorn H. 11) Veterinary Parasitology – Taylor, Coop & Wall 12) Parasitic Diseases of Wild Mammals – Samuel et al. 13) Human Parasitic Diseases Sourcebook – Berger & Marr 14) Advances in Parasitology – Molyneux 15) Medical Entomology for Students – Mike Service 16) Essentials of Medical Parasitology – Sastry 17) Atlas of Medical Parasitology – Ash & Orihel 18) Parasitology Practical Manual – Sreekumar 19) General Parasitology – Cheng T.C. 20) Parasitology Concepts and Applications – Loker & Hofkin	

ZOO/Mn/T/301: ANIMAL HUSBANDRY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives

- i) Understand livestock management principles.
- ii) Learn breeding and feeding practices.
- iii) Study disease management in domestic animals.
- iv) Develop basic entrepreneurship skills.

Course Outcomes

- i) Identify livestock breeds.
- ii) Explain breeding techniques.
- iii) Describe feeding and housing management.
- iv) Understand livestock disease control.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction and Animal Nutrition • Definition, scope and importance of animal husbandry • Livestock resources of India and breeds • Systems of animal farming • Principles of animal nutrition • Types of feed and balanced ration • Nutritional requirements and deficiency diseases	10 Hrs
II	Breeding, Reproduction and Animal Health • Methods of breeding and genetic improvement • Estrous cycle and reproductive physiology • Pregnancy diagnosis and care • Common livestock diseases: Foot and Mouth Disease, Mastitis, Anthrax • Zoonotic diseases, vaccination and health care •	10 Hrs
III	Livestock Production and Management • Dairy, poultry, sheep and goat farming • Housing and farm sanitation • Clean milk production • Waste management and by-products utilization	10 Hrs

	Learning Resources: 1. Animal Husbandry and Livestock Management – G.C. Banerjee 2. A Textbook of Animal Husbandry – G.C. Banerjee 3. Livestock Production Management – Sastry & Thomas 4. Veterinary Obstetrics and Genital Diseases – S.N. Pandey 5. Textbook of Veterinary Gynaecology and Obstetrics – S.K. Jain 6. Reproduction in Farm Animals – Hafez & Hafez 7. Animal Reproduction – P.J. Hansen 8. Veterinary Physiology – Cunningham & Klein 9. Textbook of Veterinary Physiology – O.P. Tandon 10. Animal Breeding – Falconer & Mackay 11. Introduction to Animal Husbandry in the Tropics – Payne 12. Dairy Cattle and Buffalo Production – R. Prasad 13. Essentials of Veterinary Parasitology – Taylor et al. 14. Veterinary Microbiology – B.P. Singh 15. Textbook of Veterinary Microbiology – Quinn et al. 16. Animal Health and Disease Control – A.K. Srivastava 17. Zoonoses and Public Health – Arun Kumar 18. Preventive Veterinary Medicine – Radostits et al. 19. Veterinary Medicine – Radostits et al. 20. Handbook of Animal Husbandry – Indian Council of Agricultural Research	
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ZOO/VSC/T/300: FISH PROCESSING TECHNIQUES

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives

The course aims to:

- i) Introduce principles of fish processing and preservation.
- ii) Explain post-harvest handling and quality control.
- iii) Develop practical skills in fish product preparation.
- iv) Promote entrepreneurship in fish processing industry.
- v) Create awareness about hygiene and food safety standards.

Course Outcomes (COs)

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

- i) Explain principles of fish spoilage and preservation.
- ii) Describe traditional and modern fish processing methods.
- iii) Apply techniques for preparation of value-added fish products.
- iv) Analyze quality control and hygiene standards.
- v) Evaluate economic and marketing aspects of fish processing.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Fish Spoilage and Preservation • Introduction to fish processing • Composition of fish • Causes of fish spoilage – microbial, enzymatic and chemical • Rigor mortis in fish • Principles of fish preservation • Traditional preservation methods – drying, salting, smoking • Refrigeration and freezing methods	10 Hrs
II	Modern Processing Techniques • Canning and sterilization • Fish pickling and curing • Fish meal and fish oil production • Surimi and fish protein concentrate • Packaging methods • Cold storage and transportation	10 Hrs
III	Quality Control and Entrepreneurship • Quality standards and certification • Hygiene and sanitation practices • Food safety regulations (FSSAI guidelines) • Value-added fish products – fish cutlet, fish fingers • Export potential of fish products • Economics and marketing of processed fish	10 Hrs

	Learning Resources: 1. Fish Processing Technology – G.M. Hall 2. Fish and Fishery Products Technology – K. Gopakumar 3. Post Harvest Technology of Fish and Fish Products – S. Balachandran 4. Fish Processing and Preservation – A.M. Martin 5. Fish Technology – B. Sivaraman 6. Handling and Processing of Fish – H.A. Bremner 7. Fish Preservation and Processing – Clucas & Ward 8. Quality Assurance in Seafood Processing – H.H. Huss 9. Seafood Processing – I.S. Bozaris 10. Advances in Fish Processing Technology – Rajan & Surendran 11. Fish Quality Assessment – H.H. Huss 12. Seafood Safety Quality and Regulations – Evans et al. 13. Food Safety and Quality Assurance – K.V.K. Raju 14. HACCP in Seafood Industry – Mortimore & Wallace 15. Fish By Product Technology – S.P. Singh 16. Utilization of Fish Waste – Ravindranath 17. Value Addition in Fish Products – S. Balachandran 18. Fundamentals of Fishery Science – Khanna & Singh 19. Introduction to Fisheries – S.S. Khanna 20. Fishery Science and Indian Fisheries – Srivastava	
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ZOO/VSC/T/301: AQUACULTURE

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) Understand the basic concepts, scope and significance of aquaculture and its role in food security, livelihood and sustainable development.
- ii) Develop conceptual and practical understanding of fish seed production, hatchery management and induced breeding techniques.
- iii) Learn principles of fish nutrition, feed formulation and feeding management for improved aquaculture productivity.
- iv) Understand different aquaculture systems and integrated farming practices used in modern aquaculture.
- v) Understand methods of harvesting, processing, preservation and marketing of aquaculture products.
- vi) Develop awareness regarding economics, farm management and entrepreneurship opportunities in aquaculture.
- vii) Enhance practical skills, analytical ability and scientific approach through laboratory work and field exposure.

Course Outcome (Cos) : After completion of the course, the students will be able to:

- i) Explain the fundamental concepts, scope and significance of aquaculture and its role in sustainable food production.
- ii) Identify and classify economically important aquatic organisms used in freshwater, brackish water and marine aquaculture systems.
- iii) Describe fish seed production techniques including broodstock management, induced breeding and hatchery operations.
- iv) Apply principles of fish nutrition, feed formulation and feeding management for improved aquaculture productivity.
- v) Compare different aquaculture systems such as monoculture, polyculture, composite culture and integrated fish farming.
- vi) Recognize common fish diseases and suggest appropriate preventive and health management measures.
- vii) Explain methods of harvesting, post-harvest handling, processing and preservation of aquaculture products.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction to Aquaculture • Definition, scope and importance of aquaculture • History and development of aquaculture in India and world • Types of aquaculture: freshwater, brackish water and marine • Extensive, semi-intensive and intensive culture systems • Role of aquaculture in food security and employment	10 Hrs

	Aquaculture Species • Cultivable freshwater fishes: Indian major carps and exotic carps • Brackish water and marine fishes • Prawns and shrimps of aquaculture importance • Molluscs and pearl oysters • Criteria for selection of species	
II	Fish Seed Production • Broodstock management • Natural breeding in fishes & Induced breeding techniques by Hypophysation. Fish Nutrition and Feed Technology • Nutritional requirements of fish • Natural and artificial feeds • Feed formulation and feeding methods • Feed conversion ratio (FCR) • Role of probiotics and supplements in fish culture	10 Hrs
III	Culture Systems • Composite fish culture • Monoculture and polyculture • Cage and pen culture • Integrated fish farming (fish-poultry, fish-duck, fish-pig) Aquatic Diseases and Health Management • Common bacterial, viral, fungal and parasitic diseases • Symptoms and diagnosis • Preventive measures and treatment use of chemicals & antibiotics • Biosecurity in aquaculture – Invasive species Harvesting, Processing and Preservation • Methods of harvesting • Post-harvest handling • Fish processing and preservation techniques • Cold storage and transportation	10 Hrs
	Learning Resources: 1) Pillay, T.V.R. & Kutty, M.N. — <i>Aquaculture: Principles and Practices</i>, Blackwell Publishing. 2) Santhanam, R., Sukumaran, N. & Natarajan, P. — <i>A Manual of Freshwater Aquaculture</i>, Oxford & IBH Publishing.	

	3) Jhingran, V.G. — <i>Fish and Fisheries of India</i>, Hindustan Publishing Corporation. 4) Rath, R.K. — <i>Freshwater Aquaculture</i>, Scientific Publishers. 5) Boyd, C.E. — <i>Water Quality Management for Pond Fish Culture</i>, Elsevier Scientific Publishing. Stickney, R.R. — <i>Principles of Aquaculture</i>, Wiley-Interscience. 6) Tidwell, J.H. — <i>Aquaculture Production Systems</i>, Wiley-Blackwell. 7) Lucas, J.S. & Southgate, P.C. — <i>Aquaculture: Farming Aquatic Animals and Plants</i>, Wiley-Blackwell. 8) Bal & Rao — <i>Marine Fisheries</i>, Tata McGraw Hill. 9) ICAR — <i>Handbook of Fisheries and Aquaculture</i>, Indian Council of Agricultural Research, New Delhi.	
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ZOO/VSC/P/326: FISH PROCESSING TECHNIQUES (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives

The course aims to:

- i) Introduce principles of fish processing and preservation.
- ii) Explain post-harvest handling and quality control.
- iii) Develop practical skills in fish product preparation.
- iv) Promote entrepreneurship in fish processing industry.
- v) Create awareness about hygiene and food safety standards.

Course Outcomes (COs)

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

- i) Explain principles of fish spoilage and preservation.
- ii) Describe traditional and modern fish processing methods.
- iii) Apply techniques for preparation of value-added fish products.
- iv) Analyze quality control and hygiene standards.
- v) Evaluate economic and marketing aspects of fish processing.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Study of fish spoilage stages • Demonstration of salting and drying methods • Identification of preservation equipment	20 Hrs
II	• Preparation of fish pickle • Preparation of dried fish • Demonstration of canning process • Preparation of Fish curry	20 Hrs
III	• Preparation of value-added products (fish cutlet/fish fingers) • Study of packaging materials • Visit to fish processing unit	20 Hrs
	Learning Resources: 1) Govindan T.K. – <i>Fish Processing Technology</i> 2) Balachandran K.K. – <i>Post-Harvest Technology of Fish</i> 3) FAO – <i>Fish Processing Manual</i> 4) Stansby M.E. – <i>Industrial Fishery Technology</i> 5) Connell J.J. – <i>Control of Fish Quality</i> 6) Gopakumar K. – <i>Fish Processing and Preservation</i> 7) ICAR – <i>Handbook of Fisheries and Aquaculture</i> 8) Sikorski Z.E. – <i>Seafood: Resources and Processing</i> 9) Nair & Nair – <i>Fish Processing Technology</i> 10) Modern Fish Processing – Various Authors	

ZOO/VSC/P/ 327: AQUACULTURE (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives of the Course:

- i) Understand the basic principles and techniques of aquaculture practices.
- ii) Develop skills in identification of commercially important fish, shellfish, and aquatic organisms.
- iii) Gain hands-on experience in aquaculture farm management and pond preparation.
- iv) Understand fish breeding, seed collection, and hatchery management techniques.
- v) Acquire knowledge of fish nutrition and feed formulation.
- vi) Identify common fish diseases and apply preventive and control measures.
- vii) Develop skills in fish preservation and processing techniques.

Course Outcome (Cos) : After completion of the course, the students will be able to:

- i) Identify and classify commercially important fish and shellfish species used in aquaculture
- ii) Apply techniques of induced breeding, seed production, and hatchery management.
- iii) Demonstrate fish preservation, processing, and value addition techniques.
- vi) Apply sustainable and eco-friendly aquaculture practices.
- v) Develop scientific, technical, and entrepreneurial skills in aquaculture practices.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Identification of cultivable fishes • Estimation of water quality parameters (pH / DO) Alkalinity, chlorinity and salinity • Study of aquaculture equipment and nets	20 Hrs
II	• Preparation of simple fish feed • Calculation of Feed Conversion Ratio (FCR) • Study of hatchery layout (chart/model) • Identification of plankton • Gut Analysis of fish	20 Hrs
III	• Identification of common fish diseases (charts/models) • Preparation of pond layout plan • Field visit to fish farm and report writing	20 Hrs

	Learning Resources: 1. Pillay T.V.R. & Kuttu M.N. – <i>Aquaculture: Principles and Practices</i> 2. Santhanam R. – <i>Manual of Freshwater Aquaculture</i> 3. Jhingran V.G. – <i>Fish and Fisheries of India</i> 4. Rath R.K. – <i>Freshwater Aquaculture</i> 5. Boyd C.E. – <i>Water Quality Management for Pond Fish Culture</i> 6. Stickney R.R. – <i>Principles of Aquaculture</i> 7. Lucas J.S. & Southgate P.C. – <i>Aquaculture</i> 8. Balarin J.D. – <i>Aquaculture Systems and Practices</i> 9. Gupta S.K. – <i>Applied Ichthyology</i>	
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ZOO/FP/CEP/P/326 – Field Project / Community Engagement Project (FP/CEP)
Layout of Field Project

Total Credits: 02

Maximum Marks: 50

Project Type: Practical / Field Based Learning

Objectives of Field Project:

- To develop scientific attitude and research skills among students.
- To provide practical exposure through field visits and community interaction.
- To understand biodiversity, environment, health, agriculture, or society-related issues.
- To improve data collection, analysis, interpretation, and report writing skills.
- To encourage teamwork, communication, and presentation skills.

Layout / Structure of Project Report:

1. Cover Page

Name of College

Subject Name

Course Code: SUB/FP/CEP/P/326

Title of Project

Name of Student

Seat Number

Class / Semester

Academic Year

Name of Guide

2. Certificate

3. Acknowledgement

4. Index

5. Introduction

6. Objectives of Study

7. Study Area / Location

8. Materials and Methods

9. Observations / Data Collection

10. Results and Discussion

11. Conclusion

13. References

* The student should follow all the University guidelines regarding the filed project

SEMESTER – VI



ZOO/DSC/T/350: DEVELOPMENTAL BIOLOGY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning objectives:

- i) To Understand basic concepts and scope of developmental biology.
- ii) To Explain theories and process of gametogenesis, structure of sperm and ovum, and types of eggs.
- iii) To provide an in-depth knowledge to study the process of embryonic development in animals.
- iv) To Learn modern techniques: IVF, cloning, stem cells.

Course Outcome (Cos) :**After completion of the course, the students will be able to:**

- i. Students should be able to know the basic concepts related to embryonic development and to understand the basis of life of animal.
- ii. Students learned and develop analytical thinking and scientific understanding.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Basics of Developmental Biology • Introduction, scope and concept of developmental biology, Theories of developmental biology: Preformation, Pangenesis, Epigenesis, Axial gradient, Germplasm. Gametogenesis: • Spermatogenesis, Oogenesis, Structure of human sperm and ovum, Vitellogenesis, Types of eggs.	10 Hrs
II	Fertilization and Cleavage: • Mechanism of Fertilization, Monospermic and polyspermic fertilization, Significance of Fertilization. Types & Pattern of Cleavage, Salient features of cleavage, Blastulation and Gastrulation • Morulation, blastulation, fate map, gastrulation process up to the formation of germ layers with respect to frog.	10 Hrs
III	Chick embryology • Structure of Hen's egg, fertilization and cleavage. • Mammal Development of fetal membrane in mammals, Extra embryonic member, Placentation in mammals. • In-vitro fertilization, Transgenic animals and cloning, Embryonic stem cells and their applications.	10 Hrs
	Learning Resources: 1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc, Publishers, Sunderland, Massachusetts, USA. 2. Balinsky, B.I. (2008). An introduction to Embryology, International	

	Thomson C. Press. 3/Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc 4.Sastry & Shukal (2012) Developmental Biology, Rastogi Publication, Meerut India. 5.Jordan E. L. & Verma P. S. (2014). Chordate Zoology, S. Chand Publication. New Delhi, India 6.Arora, R. and Grover, A. (2018) Developmental Biology: Principles and Concepts. I Edition, R. Chand & Company.	
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ZOO/DSC/T/351: EVOLUTION & ANIMAL BEHAVIOUR

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning objectives:

- i) Understand the basic concept and significance of evolution in biology.
- ii) Learn theories related to origin of life and origin of eukaryotic cells.
- iii) Study classical and modern evidences supporting evolution.
- iv) Compare Lamarckism, Darwinism, Neo-Darwinism, and Modern Synthetic theory.
- v) Understand forces responsible for evolutionary changes in populations.
- vi) Learn mechanisms of speciation and extinction in evolution.
- vii) Understand the meaning, history, and scope of animal behaviour (ethology).
- viii) Study innate and learned behavioural responses in animals.
- ix) Analyze communication, migration, mimicry, social, and sexual behaviour in animals.

Learning outcomes: After completion of the course, students will be able to:

- i) Explain the concept of evolution and origin of life through scientific theories.
- ii) Describe Miller-Urey experiment and endosymbiotic theory.
- iii) Interpret evidences of evolution such as homology, analogy, fossils, and embryology.
- iv) Differentiate Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, and synthetic theory.
- v) Explain the role of mutation, gene flow, genetic drift, natural selection, and mating patterns in evolution.
- vi) Describe allopatric and sympatric speciation with examples.
- vii) Evaluate causes and significance of extinction in evolutionary history.
- viii) Distinguish innate and learned behaviour in animals.
- ix) Explain communication, migration, mimicry, schooling, and social behaviour in selected animals.
- x) Analyze reproductive strategies, courtship, parental care, and sexual selection in animals.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Introduction and Evidences of Evolution: • Introduction • Concept of Evolution. • Origin of life: Miller-Urey experiment • Origin of eukaryotic cell (endosymbiotic theory). • Evidences of Evolution: • Analogy and Homology. • Embryological Evidences & Paleontological Evidences Ex. Connecting links	10 Hrs

II	• Theories And Modern evolutionary concepts. • Theories of evolution – 1. Lamarckism theory 2. Neo- Lamarckism 3. Darwinism and Neo-Darwinism 4. Darwinism theory of Natural selection • Forces of Evolution – mutation, gene flow, genetic drift, and natural selection, Non random mating. • Speciation: Methods of speciation - Allopatric and sympatric	10 Hrs
III	• Introduction to Animal Behaviour: - • Definition, History and Scope of Ethology. • Animal behaviour: Innate and Learned behaviour. • Aspects of animal behaviour: - • Communication in bees and ants • Mimicry and colourations • Migration in fish, schooling behaviour • Social Behaviour: - • Concept of Society, Social insects (Honeybee as example), Bee communication. • Sexual Behaviour: - • Reproductive strategies, mating systems, courtship, sperm competition, sexual selection and parental care.	10 Hrs
	Learning Resources: 1) Evolution – Douglas J. Futuyma 2) Organic Evolution – Veer Bala Rastogi 3) Principles of Evolution – Eli C. Minkoff 4) Animal Behaviour – John Alcock 5) Animal Behaviour: An Evolutionary Approach – John Alcock 6) Essentials of Animal Behaviour – Aubrey Manning & Marian Stamp Dawkins 7) A Textbook of Organic Evolution – R.L. Kotpal 8) Evolutionary Biology – Monroe W. Strickberger 9) Introduction to Ethology – Niko Tinbergen 10) Behavioral Ecology – Davies, Krebs & West	



ZOO/DSC/T/352: IKS-2 - ANCIENT KNOWLEDGE OF ANIMAL USE IN INDIA

Total Credits : 02

Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives

- i. Introduce students to Indian contributions to animal science, biodiversity, and ecology.
- ii. Correlate concepts from ancient Indian texts with modern zoological principles.
- iii. Develop appreciation for sustainable practices and ethnozoology from Indian traditions.
- iv. Study ancient texts related to animal science.
- v. Promote appreciation of indigenous animal management practices.
- vi. Develop awareness about conservation ethics in Indian traditions.

Course Outcomes (COs): After completion of the course, students will be able to:

- i) Explain the role of animals in ancient Indian civilization.
- ii) Analyze traditional practices of animal husbandry and veterinary science.
- iii) Evaluate medicinal and agricultural uses of animals in ancient India.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	IKS and Zoology • Concept of IKS: Definition, scope, and relevance to life sciences; Zoology in Ancient India • Concept of Panchamahabhuta and its relation to animal physiology and ecology • Animal Classification and Biodiversity in Indian Tradition • Sacred groves and conservation: Traditional biodiversity hotspots and totemic animals • Ayurvedic veterinary science: Pashu Ayurveda and treatment of animal diseases	10 Hrs
II	Ecology and Sustainability in Indian Thought • Concept of Rta and ecological balance: Interdependence of species in Vedic literature • Water conservation and aquatic life: Stepwells, traditional ponds, and fish diversity • Ahimsa and animal ethics: Jain, Buddhist, and Vedic perspectives on animal welfare • Indicators of environment: Animal behavior for weather prediction in Brihat Samhita	10 Hrs

III	Bio-resources and Traditional Knowledge • Animals in medicine • Bioprospecting: Traditional knowledge vs modern patent issues; TKDL initiative • Zoonotic disease concepts: Ideas of contagion in Sushruta Samhita and Madhava Nidana	10 Hrs
	Learning Resources: 1. History of Science in India Vol. 1 by National Science Academy, Pashu Ayurveda by Pandit Bhagwan Dash 2. Mrigapakshi Shastra by Hamsadeva, Ed. by G.K. Shrigondekar 3. UGC IKS Guidelines for Higher Education, 2023 4. Science and Technology in Ancient Indian Texts by B.V. Subbarayappa	



ZOO/DSC/P/376: DEVELOPMENTAL BIOLOGY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning objectives:

- i) Understand the structure and significance of gametes in animal reproduction.
- ii) Study different types of eggs based on yolk distribution and quantity.
- iii) Learn various patterns of cleavage in animals.
- iv) Understand formation and types of blastula and gastrula stages.
- v) Study early embryonic development in amphioxus, frog, and chick.
- vi) Observe developmental stages of chick embryo through whole mounts and sections.
- vii) Learn laboratory techniques such as ex-ovo culture and temporary slide preparation.
- viii) Understand embryonic development of frog and comparative vertebrate development.
- ix) Analyze environmental effects such as temperature and salinity on development.
- x) Develop scientific observation, microscopy, practical, and reporting skills.

Learning outcomes: After completion of the course, students will be able to:

- i) Identify sperm and ovum structure of selected animals.
- ii) Classify different egg types in insect, amphioxus, frog, and hen.
- iii) Distinguish different cleavage patterns and correlate them with egg type.
- iv) Describe blastula and gastrula formation in different vertebrates.
- v) Recognize important stages of chick embryology at 24 hr, 33 hr, and 48 hr.
- vi) Interpret whole mount slides and sectional views of chick embryos.
- vii) Perform ex-ovo culture and temporary preparation of chick embryo.
- viii) Explain developmental stages of frog embryo.
- ix) Evaluate the influence of environmental factors on embryonic development.
- x) Apply developmental biology techniques in research, hatchery, IVF, and reproductive sciences.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	- Study of sperm smear and ovum (any one animal). Demonstration - Types of eggs (insect, amphioxus, frog and hen) D - Types of cleavages (Radial, Spiral, Rotational, Bilateral, Holoblastic equal, Holoblastic unequal, Meroblastic superficial) D	20 Hrs
II	- To study the types of blastulae (amphioxus, frog and hen) - To study the types of gastrulae (amphioxus, frog and hen) D - Study of whole mount slides of chick embryology – 24h, 33hr	20 Hrs

	and 48 hr D To study the sections of chick embryo--24hr, 33hr and 48 hr D	
III	- Ex-ovo culture of chick embryo. (To prepare slide of chick embryo at laboratory) E - Temporary preparation of chick embryo. E - Study of embryo and early developmental stages of frog. D - Study of influence of temperature/ salinity on animal development. E • OR - Visit to IVF center/cryopreservation center/ Egg incubation center. E	20 Hrs
	Learning Resources: 1) Developmental Biology – Scott F. Gilbert 2) Principles of Development – Lewis Wolpert 3) An Introduction to Embryology – B.I. Balinsky 4) Chordate Embryology – P.S. Verma & V.K. Agarwal 5) Developmental Biology – T. Subramoniam 6) A Textbook of Embryology – Ramesh Gupta 7) Experimental Embryology – J. Needham 8) Vertebrate Embryology – M. Veer Bala Rastogi 9) Essentials of Developmental Biology – Jonathan Slack 10) Animal Development and Embryology – S.N. Prasad	

**ZOO/DSC/P/377: EVOLUTION AND ANIMAL BEHAVIOUR
(PRACTICAL)**

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning objectives:

- i) Understand important concepts and evidences of organic evolution.
- ii) Study connecting links and transitional forms in animal evolution.
- iii) Differentiate homology and analogy through suitable specimens and examples.
- iv) Learn adaptive modifications in animals according to habitat and mode of life.
- v) Solve problems based on Hardy-Weinberg law and population genetics.
- vi) Understand macroevolution through examples such as Darwin's finches.
- vii) Study evolutionary trends in horses, elephants, and human ancestors.
- viii) Understand basic principles of animal behaviour and ethology.
- ix) Observe social behaviour, migration, grooming, nesting, and taxis responses in animals.
- x) Develop field observation skills through visits to zoo, sanctuary, or national park.

Learning outcomes: After completion of the course, students will be able to:

- i) Identify important connecting links such as *Peripatus*, *Dipnoi*, and *Coelacanth*.
- ii) Distinguish homologous and analogous organs with suitable examples.
- iii) Explain adaptive features in turtle, *Draco*, *Exocoetus*, bat, and parrot.
- iv) Apply Hardy-Weinberg law to simple genetic problems.
- v) Interpret evidences of evolution from embryology, fossils, morphology, and comparative anatomy.
- vi) Describe macroevolution using Darwin's finches as an example.
- vii) Explain evolutionary history of elephant, horse, and human beings.
- viii) Analyze various behavioural patterns such as nesting, grooming, migration, and geotaxis.
- ix) Prepare and interpret ethograms using standard behavioural tools and techniques.
- x) Conduct field studies and prepare scientific reports based on animal observations.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Evolution • Museum Study of connecting links: <i>Peripatus</i>, <i>Coelacanth</i> Fish, <i>Dipnoi</i> fishes. • Study of homology and analogy from suitable specimens and pictures • Study of animal adaptations in: Turtle, <i>Draco</i>, <i>Exocoetus</i>, Bat and Parrot. • Problems on Hardy-Weinberg Law	20 Hrs

II	• Macroevolution using Darwin finches (pictures) • Study of evidences of evolution- embryological, paleontological, and morphology and comparative anatomy. • Study of evolution of Elephant , Horses (Pictures) • Study of successive stages of evolution of man : a) Australopithecus b) <i>Homo erectus</i> c) <i>Homo neanderthalis</i> d) Cro-Magnon man e) <i>Homo sapiens</i>.	20 Hrs
III	Animal Behaviour • To study nests and nesting behaviour of the birds and social insects. • To study geotaxis behaviour in earthworm. • Study of different tools, techniques and methods used in preparing ethogram. • To study the migration & types of migratory birds. • To study grooming behaviour in monkey / Birds. • Field study by visiting Zoo / National Park / Bird sanctuary.	20 Hrs
	Learning Resources: 1. Mark Ridley. Evolution. 3rd Edition. Blackwell Publishing. (2004). 2. Mathur, Tomar, Singh. Evolution and Behaviour. Rastogi Publication, Merrut. 3. Strickberger. Evolution. Prentic Hall. (2002). 4. Theodore H., Jr Eaton. Evolution. 1st Edition. W. W. Norton Publication. (1970). 5. Organic Evolution, 1991 T.S. Gopal krishanan, Itta Sambashivarab Publ. House. 6. Evolutionary Biology, 1990, Mohan P. Arora, Himalaya Publi. House, Delhi. 7. Evolution, 1968, E. O. Dodson, Reinhold Publ. Crop., New York. 8. The origin of species, 1959, Charles Darwin, New American Library, New York Practical 1. David McFarland, Animal Behaviour, Pitman Publishing Limited, London,UK - Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour,Cambridge, University Press,UK. 2. Reena Mather. 2011. Animal Behaviour, Rastogi Publications 3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA. 4. McFarland, D. (1985) Animal Behaviour, Pitman Publishing Limited, London, UK 5. M.P. Arora, Animal Behavior, Himalaya Publication New Delhi. 1. Rubenstein, D. (2022) Animal Behavior, XIIth Edition, Sinauer Associates, Oxford - University Press, UK. 2. Gadagkar, R. (2021) Experiments in Animal Behaviour: Cutting-Edge Research at Trifling Cost, Indian Academy of Sciences.	

ZOO/DSE/T/350: PARASITOLOGY		
Total Credits : 02		Total Contact Hours : 30 Hrs Maximum Marks : 50
Learning Objectives: i) To understand the basic and general concepts of Parasitology. ii) To study major types of parasites of medical and veterinary importance. iii) To develop understanding of food and water borne diseases. iv) To prepare the experts in the field of medical and veterinary parasitology Learning Outcomes: By the end of the course students will be able to: i) Explain parasite and its relation to global public health. ii) Describe about parasites, host and their relationship. iii) Have knowledge about various types of parasites and their life cycles.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction to Parasitology, Parasites and Health • Scope and historical landmarks in Parasitology • Parasitism: Definition and concept, Origin and evolution of parasites. • Types of parasites. • Types of hosts: Definitive and intermediate, Primary and secondary, Specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental, Vectors. • Parasite and Global Public Health, Global burden of infectious diseases. • Biology, epidemiology and control of waterborne and foodborne parasites.	10 Hrs
II	Clinical Parasitology and Control. • Protozoan parasites of medical & veterinary importance: Morphology, Pathogenicity and Control of <i>Entamoeba sp.</i>, <i>Balantidium sp.</i>, <i>Leishmania sp.</i>, and <i>Coccidia</i>. • Study of medically and veterinary important helminth Parasites : <i>Fasciola hepatica</i>, <i>Taenia saginata</i>, <i>Trichuris trichiura</i>. • Approaches to control of parasitic diseases: General control of Endo and Ectoparasites: Chemical, Biological, Physical, Mechanical, Cultural and Legislative. • Strategies-planning and control: Malaria, Human Schistosomiasis, Strongyloidiasis, Filariasis, Tape worms.	10 Hrs
III	Biology and Pathogenicity of insect Parasites. • Arthropods of public health importance. • Classification of medically important arthropods, • Role of insect as a vector.(Biological and mechanical transmission.) • Morphology, life history, diseases/ harm caused and the control of following:	10 Hrs

	• Parasitic Siphonoptera - Rat flea , • Parasitic Anupleura - Lice, • Mallophaga. - Bird lice. • Parasitic Diptera - mosquito and flies , • Hemiptera- bugs. • Parasitic Arachnida – Tick, Mite.	
	Learning Resources: 1. Infectious Disease Epidemiology: theory and practice. 2nd edition. Nelson & Williams (Eds.). 2007. 2. A good additional online text: Global Burden of Disease and Risk Factors. Disease Control Priorities Project. It is available at: http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=gbd.TOC&depth=2 3. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co. 4. Reingold, A.L. Outbreak Investigations – A Perspective. Emerging Infectious Diseases 1998; 4(1): 21-27. 5. Modern Parasitology Ed FEG Cox, Blackwell Science 6. Foundations of parasitological (2009): GD Schmidt and LS Roberts. McGraw Hill Higher Education. 7. Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. and P. Daszak. Global trends in emerging infectious diseases. Nature 2008; 451(21): 990-993 8. Applied parasitology - Hiware, Jadhav and Mohekar 9. Helminth, Arthropod and Protozoa of domesticated animal - Solbsy E.J.W 10. Chatterjee K. D. (1969) -Parasitology (Protozoology and Helminthology) 11. Text book Medical Parasitology of Jaypee Brothers, - Panikar C.K.J (1988) Medical Publishers, New York. 12. Bio- Chemistry and physiology of protozoa -Hutner and Lwoff II Ed. Vols I and II 13. Protozoan Parasites of domestic animals and man – Levine. 14. Cestode Fauna. – Sunita Borde, Sushil Jawale, Amol Thosar and Arun Gaware , Kailas Publication 15. Smyth J.D. – Animal Parasitology 16. Cheng T.C. – General Parasitology	

ZOO/DSC/T/351:FISHERY SCIENCE - II Total Credits : 02 Total Contact Hours : 30 Hrs Maximum Marks : 50		
Learning Objectives: i) Understand fish farm design and management ii) Learn fish culture systems and biology of fishes iii) Know breeding methods, hatchery practices , and fish diseases Course Outcomes: After completion of the course, students will be able to – i) Apply fish farm management techniques ii) Use different fish culture methods effectively iii) Perform breeding, hatchery management, and disease control		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Fish Farm and its Management: - Design and construction of fish farm, types of ponds (Nursery, rearing and stocking ponds) - Management of fish farm: control of aquatic weeds, control of aquatic weeds, weed fishes, predatory fishes, aquatic insects, soil quality analysis, application of lime, application method and schedule of fertilizers, natural and artificial food of fishes, culture of fish food organisms.	10 Hrs
II	Culturable fishes and types of fish culture: - Biology of culturable fishes - Monoculture and polyculture - Monosex culture - Sewage fed fisheries - Cage and pen culture - Biofloc technology	10 Hrs
III	Fish Breeding: - Natural breeding of fishes - Induced breeding by hypophysation - Bundh breeding - Synthetic hormones used in induced breeding Hatcheries and their Management - Hatching hapa, Glass jar hatchery, CIFE D80 Model, CIFE D-81 model, Chinese hatchery	10 Hrs

	• Fish Diseases: symptoms of fish diseases, fungal, bacterial, viral, protozoan and worm diseases	
	Learning Resources: 1) A Hatchery Manual for Common, Chinese and Indian Major Carps/VG.Jhingran & R.S. V.Pullin,Asian Development Bank, Manila, Philippines. 2) An introduction to fishes/S.S. Khanna, Surjeet Publications, 3) Handbook of Fish Farming/ S.C. Agarwal, Narendra Publishing House, Delhi. 4) Handbook of Fish Diseases and Diagnosis/ F.A.Saha & M.H. Balkhi, Narendra Publishing House, Delhi. New Delhi 5) Inland Fisheries/V.B. Sakhare, Daya Publishing House, New Delhi. 6) Applied Fisheries/V.B.Sakhare, Daya Publishing House, New Delhi. 7) www.ras-aquaculture.com	

ZOO/DSE/T/352:APPLIED ENTOMOLOGY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives :

- i) Understand the concept, definition, and categories of insect pests.
- ii) Learn the economic importance of insect pests in agriculture and public health.
- iii) Classify insect pests based on host range, feeding habits, and plant parts attacked.
- iv) Study major pests of field crops, oilseed crops, vegetables, fruits, and stored grains.
- v) Understand identification characters, life cycle, and damage symptoms of important pests.
- vi) Gain knowledge of pests affecting human health such as mosquitoes, houseflies, lice, fleas, and bed bugs.
- vii) Learn different pest management strategies including cultural, mechanical, biological, and chemical control methods.
- viii) Understand eco-friendly pest control measures such as plant extracts and biopesticides.
- ix) Familiarize with plant protection appliances and safe handling practices.
- x) Develop awareness regarding environmental safety, pesticide hazards, and sustainable pest management.

Course Outcomes: After completion of the course, students will be able to –

- i) Define pest and classify insect pests on different biological and economic bases.
- ii) Identify major insect pests of agricultural crops and stored products.
- iii) Explain life cycle, mode of infestation, and nature of damage caused by pests.
- iv) Recognize common human insect pests and their public health importance.
- v) Apply suitable control measures for important agricultural and household pests.
- vi) Differentiate among cultural, mechanical, biological, and chemical pest control methods.
- vii) Describe the role of predators, parasitoids, pathogens, and biopesticides in pest management.
- viii) Operate and identify commonly used plant protection appliances.
- ix) Understand safety precautions during pesticide application.
- x) Evaluate environmental and health impacts of pesticides and promote sustainable pest control practices.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction to Insect Pests: • Definition of pest and insect pest, Categories: (Major, minor, key, sporadic pests), Economic importance of pests. Classification of Insect Pests: • Based on Host plant: Monophagous, Oligophagous and Polyphagous pests. • Based on feeding habits: (Chewing insects, Piercing and sucking insects and Boring insects) • Based on Plant Parts attacked: Root, stem, leaf, flower, fruit, seed pests	10 Hrs

II	Major Crop Pests and their management: (Identification, Life cycle, Nature of damage and control measures) • Pests of Field Crop: Pest of Jawar, Pest of Cotton, Pest of sugarcane • Pests of oilseed plant: Mustard aphids and Groundnut pests • Pests of Vegetable Crops: Brinjal shoot and fruit borer, Cabbage butterfly • Pests of Fruit Crops: Pest of Mango, Pests of citrus • Pests of Store grain: Rice weevil and rice moth, flour beetles, pulse beetle • Human insect pests: Mosquitoes, Houseflies, Bed bugs, Lice and Fleas.	10 Hrs
III	Pest management: • Cultural Method, Mechanical control, Biological control (predators, parasitoids and pathogens (Bt, NPV, fungi)) • Chemical control: Contact, Stomach, Fumigants, Systemic insecticide. • Eco-friendly Management: Plant part extracts, biopesticide • Plant protection appliances: dusters, Knapsack, Pneumatic, hand compression • Safety precautions. • Environmental and Health Aspects: Pesticide impact on environment and non-target organisms, Human health hazards and Sustainable pest management.	10 Hrs
	Learning Resources: 1. Entomology & Pest Management. Pedigo L. P. Prentice Hall, India 1996. 2. General & Applied Entomology, Nayar K. K. & T. N. Ananthkrishnan & B. V. Davis, Tata McGraw Hill Publication, New Delhi. 3. Insects. M. S. Mani, National Book Trust, India, 2006. 4. Insects & Mites of Crops in India. M. R. G. K. Nair – by ICAR, New Delhi. 5. The Science of Entomology. W. S. Romosor and J. G. Stoffolano, McGraw Hill Publication, 1988. 6. Agricultural Insect Pests of India and their Control, Dennis S. Hill, Cambridge University Press. 7. Applied Entomology. Vol. I & II. K. P. Srivastava. Kalyani Publication, Ludhiana, New Delhi. 8. Principles of Insect Pest Management. G. S. Dhaliwal and Ramesh Arora, Kalyani Publications, Ludhiana. 9. Pest Management and Pesticides: Indian Scenario. Editor- B. Vasantaraj David, Namrutha Publications, Madras (Chennai). 10. Concepts of Insect Control. Ghosh M. R. Wiley Eastern Ltd. New Delhi. 11. Destructive and useful Insects, their habit and Control, 1973. C.L. Metcalf and W. P. Flint, Tata McGraw Hill Publications, New Delhi.	

ZOO/DSE/P/376:PARASITOLOGY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives :

- i) To develop skills in identification of parasites of medical and veterinary importance
- ii) To understand life cycles and host-parasite relationships
- iii) To train students in diagnostic techniques and specimen preparation
- iv) To impart knowledge of parasite control and public health importance

Course Outcomes: After completion of the course, students will be able to –

- i) Identify major protozoan, helminth, and arthropod parasites using slides, specimens, and charts
- ii) Describe diagnostic morphological features of different parasites and their life stages
- iii) Illustrate and interpret life cycles of important parasites and understand their transmission routes
- iv) Perform basic parasitological techniques such as slide preparation, staining, and microscopic observation
- v) Apply knowledge of preventive and control measures for parasitic diseases in humans and animals
- vi) Conduct basic field surveys, collect data, and prepare reports related to parasitic diseases

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Study of different types of parasites (Protozoa, Helminthes and Insect) using permanent slides. • Study of different important Ectoparasites of various vertebrate hosts. • Study of different important endoparasites of various vertebrate hosts. • Study of hemoflagellates from vertebrate blood.	20 Hrs
II	• Collection and preservation methods of scolex or segments for taxonomic studies. • Preservation, staining, mounting and identification of Helminth parasite. • Examination of fecal sample of sheep, goat and chicken for parasitic infection. • Study of hemoflagellates from vertebrate blood. • Preparation of blood smear, staining and identification of Haemosporina. •	20 Hrs
III	• Study of different mosquito vectors of protozoan parasites. • Techniques for collection, fixation, preservation, mounting and	20 Hrs

	identification of different nematodes from different hosts. • Collection, preservation and identification of veterinary and medically important insects and arachnids. • Study of different types of mouthparts of vectors. • Submission of permanent slides at the time of examination.	
	Learning Resources: 1) Diagnostic Medical Parasitology – Lynne Shore Garcia. 2) Medical Parasitology: A Self-Instructional Text – Ruth Leventhal & Russell F. Cheadle. 3) Foundations of Parasitology – Larry S. Roberts, John Janovy Jr. & Steve Nadler. 4) Veterinary Clinical Parasitology – Anne M. Zajac & Gary A. Conboy. 5) Veterinary Parasitology – M.A. Taylor, R.L. Coop & R.L. Wall. 6) Medical Entomology for Students – Mike Service. 7) Human Parasitology – Burton J. Bogitsh, Clint E. Carter & Thomas N. Oeltmann. 8) Practical Guide to Diagnostic Parasitology – Lynne Shore Garcia & Lawrence R. Ash. 9) Atlas of Human Parasitology – Lawrence R. Ash & Thomas C. Orihel. 10) Textbook of Medical Parasitology – K.D. Chatterjee.	

ZOO/DSC/P/377: FISHERY SCIENCE – II (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives:

- i) To develop skills in identification and classification of commercially important fishes, plankton and parasites
- ii) To understand basic water quality analysis essential for fish culture
- iii) To gain hands-on experience in fish breeding techniques, fecundity estimation and field exposure to fish farms

Course Outcomes: After completion of the course, students will be able to –

- i) Students will be able to identify Indian major carps, exotic carps, catfishes, plankton and fish parasites accurately.
- ii) Students will perform water quality tests and interpret results for aquaculture
- iii) Students will acquire practical skills in fish pituitary extraction, fecundity estimation methods and understand real-time fish farm operations.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Identification, classification and culturable significance of Indian major carps, exotic carps and catfishes	20 Hrs
II	• Identification of freshwater plankton • Water analysis: Estimation of dissolved oxygen, chlorides, alkalinity and hardness	20 Hrs
III	• Collection and identification of fish parasites and worms • Removal of fish pituitary gland and preparation of pituitary extract • Estimation of fish fecundity by gravimetric, volumetric and Von Bayer method. • A visit to fish farm and fish processing centre (compulsory).	20 Hrs
	Learning Resources: 1. An introduction to fishes/S.S. Khanna, Surjeet Publications, New Delhi 2. Handbook of Fish Farming/ S.C. 2.Agarwal, Narendra Publishing House, Delhi. 3. Handbook of Fish Diseases and Diagnosis/F.A.Saha & M.H. Balkhi, Narendra Publishing House, New Delhi 4. Biology of Inland Fishes/V.B.Sakhare, Discoovery Publishing House, New Delhi. 5. Methodology for Water Analysis/Kodarkar et al., Indian Association of Aquatic Biologists, Hyderabad.	

ZOO/DSE/P/378:APPLIED ENTOMOLOGY (PRACTICAL)

Total Credits : 02

Total Contact Hours : 60 Hrs

Maximum Marks : 50

Learning Objectives:

- i) Understand the identification characters of economically important insect pests affecting crops, stored grains, and humans.
- ii) Study the nature of damage caused by insect pests and assess their economic importance.
- iii) Learn different methods of pest prevention, management, and control.
- iv) Acquire practical knowledge of insect mouthparts and their relation to feeding habits.
- v) Understand the role of insect vectors in transmission of diseases.
- vi) Gain skill in collection, pinning, spreading, labeling, and preservation of insects.
- vii) Familiarize themselves with pest control appliances used in agriculture.
- viii) Develop awareness regarding organic farming and eco-friendly pest management methods.
- ix) Improve scientific observation, reporting, and specimen handling skills.
- x) Promote practical application of entomological knowledge in agriculture and public health.

Course Outcomes: After completion of the course, students will be able to –

- i) Identify major pests of field crops, oilseed crops, vegetable crops, fruit crops, and stored grains.
- ii) Explain the symptoms of pest infestation and economic losses caused by insects.
- iii) Recommend suitable control measures including cultural, biological, and chemical methods.
- iv) Distinguish different types of insect mouthparts and relate them to feeding behavior.
- v) Describe the role of insect vectors in spreading diseases such as malaria, dengue, plague, etc.
- vi) Use common pest control appliances and spraying equipment efficiently.
- vii) Collect and preserve agriculturally important insect species scientifically.
- viii) Understand principles of organic agriculture and sustainable pest management.
- ix) Apply entomological knowledge for crop protection and human welfare.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Study of following insect pests with respect to marks of identification, nature of damage, economic importance and control measures. (D) • Pests of Field Crop • Pests of oilseed plant • Pests of Vegetable Crops • Pests of Fruit Crops • Pests of Store grain	20 Hrs

II	• Study of following pests with respect to marks of identification, nature of damage, economic importance and control measures. (D) Human insect pests • Study of Mouthparts of insects. • Study of charts/models of disease transmission of insect vectors. • Compulsory submission of at least Ten Insect Pests/ Photographs/ Sketches. (E) •	20 Hrs
III	• Study of pest control appliances (as per theory course). (D) • Compulsory field visit to Organic Agriculture farm, report writing and submission. (2 P). • Collection, pinning, spreading and preservation of 5 agriculturally important pest species of insects and submission of specimens and report. (2P)	20 Hrs
	Learning Resources: 1) Applied Entomology – V.B. Awasthi 2) Agricultural Entomology – T.V. Prasad 3) A Textbook of Applied Entomology – K.P. Srivastava 4) Elements of Economic Entomology – B.V. David & T. Kumaraswami 5) General and Applied Entomology – K.K. Nayar, T.N. Ananthakrishnan & B.V. David 6) Handbook of Agricultural Entomology – R. Pradhan 7) Insect Pest Management – D. Dent 8) Medical Entomology for Students – Mike Service 9) Integrated Pest Management – A.R. Horowitz & I. Ishaaya 10) Introduction to Insect Pest Biology – L.P. Pedigo	

ZOO/Mn/T/350: AVIAN BIOLOGY

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives

- i) To understand the biology, diversity, and adaptations of birds
- ii) To study anatomy, physiology, and behaviour of birds
- iii) To develop practical skills in avian studies and poultry science
- iv) To impart applied knowledge in poultry management and conservation

Course Outcomes: After successful completion of the course, students will be able to:

- i) Understand evolutionary origin of birds
- ii) Classify birds based on morphological features
- iii) Identify adaptive features of birds
- iv) Explain functional anatomy of birds
- v) Understand physiological adaptations for flight
- vi) Describe reproduction and development
- vii) Analyze behavioural patterns
- viii) Understand migration mechanisms

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Origin, Evolution & Classification of Birds • Origin of birds; evolution from reptiles • General characters of Class Aves • Flightless birds and flying birds Morphology & Adaptations • External morphology of birds • Types of beaks and feet with adaptive significance • Feathers: types, structure, and functions • Adaptations for flight (morphological)	10 Hrs
II	Anatomy & Physiology • Digestive system and feeding adaptations • Respiratory system and air sacs	10 Hrs
III	Reproduction & Development • Egg formation and structure • Fertilization and development • Parental care in birds	10 Hrs

	Behaviour & Migration • Bird behaviour (nesting, feeding, courtship) • Bird migration: types and factors • Navigation in birds • Social behaviour	
	Learning Resources: 1. Handbook of Bird Biology – Irby J. Lovette & John W. Fitzpatrick 2. Ornithology – Frank B. Gill 3. Biology of Birds – Colin G. Scanes 4. Avian Biology (Vol. I–VI) – D. S. Farner & J. R. King 5. The Origin and Evolution of Birds – Alan Feduccia 6. Bird Ecology and Conservation – William J. Sutherland 7. Bird Migration – Thomas Alerstam 8. Avian Physiology – Paul D. Sturkie	

ZOO/Mn/T/351: PET ANIMAL CARE & MANAGEMENT

Total Credits : 02

Total Contact Hours : 30 Hrs

Maximum Marks : 50

Learning Objectives

- i) To understand basic principles of pet animal care and management.
- ii) To identify common pet animals and their breeds.
- iii) To learn housing, feeding, and hygiene practices for pets.
- iv) To understand behaviour and handling of pet animals.
- v) To gain knowledge of common diseases and preventive healthcare.
- vi) To develop skills in grooming and routine care of pets.
- vii) To understand vaccination schedules and veterinary care.
- viii) To promote animal welfare and ethical handling practices.

Course Outcomes: After successful completion of the course, students will be able to:

- i) Understand principles of pet care, management, and welfare.
- ii) Identify different pet animals and their breeds.
- iii) Apply proper feeding, housing, and hygiene practices.
- iv) Handle pets safely and interpret their behavior.
- v) Recognize common diseases and suggest preventive measures.
- vi) Demonstrate basic grooming and healthcare practices.
- vii) Understand vaccination and veterinary management.
- viii) Apply ethical and welfare standards in pet management.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	• Introduction to Pet Animals 1. Types of pets 2. Importance of pets 3. The best kid-friendly dog breeds in India 4. Vaccination and deworming 5. Puppy food and feeding practices 6. Tips on care of pets during Diwali 7. Common health problems in dogs 8. Health issues to dog owners	10 Hrs

II	• Care and Management of Cats as Pet 1. Selection of cat breed 2. Food and feeding 3. Vaccination and deworming 4. Common diseases and infections in cats 5. Health issues to cat owners - Cat scratch disease	10 Hrs
III	• Care and Management of Guinea Pigs as Pets 1. Introduction, biology and husbandry of guinea pigs 2. Feeding and management 3. Infectious diseases in guinea pig • Care of Pet Rabbits at Home 1. Some basic facts about rabbit 2. Diet and nutrition in pet rabbits 3. Common rabbit myths	10 Hrs
	Learning Resources: 1. A hand book of pet care management - Ranjan, Amit (2012) 2. The Complete Book of Pets & Petcare - David Alderton 3. Dogs their Care and Treatment - Chakrabarti Amlendu (2014) 4. The Book of Indian Dogs - S. Theodore Baskaran (2017) 5. Handbook of Dogs and Cats for Care and Treatment - Dr Tej Pratap Yadav (2023) 6. Complete Cat Care - DK (2014) 7. Complete Cat Care Manual - Andrew Edney, Bruce Fogle (2006) 8. Persian Cats as Pets - Lolly Brown (2022) 9. Keeping Pet & Aviary Birds - David Alderton (2019) 10. Preventative Health Care for Pet Birds - Greg Burkett (2020) 11. Complete Guide to Bird Care - David Alderton (2003) 12. The Ultimate Encyclopaedia of Caged Aviary Birds - David Alderton (2000) 13. The Simple Guide to Freshwater Aquarium - David E. Boruchowitz (2001)	

(ZOO/OJT/P/376)

OJT/ Internship / Research Project / Field Project Evaluation:

a) OJT (On Job Training) / Internship:

- i) Each student will be required to prepare a detailed plan within a week of joining the agency for OJT/internship, which will be submitted to concerned Department Advisor.
- ii) Each student will be required to maintain the diary in which daily/weekly activities will be recorded. This will be sent to Agency mentor and Department Advisor on weekly basis.
- iii) At the end of the OJT / Internship the student will prepare a write up on achievement of the goals mentioned in the detailed plan.
- iv) At the end of the OJT / internship student will submit a report in about 15 to 20 pages.

Formative Continuous Internal Assessment (CIA) of OJT / Internship:

The CIA of OJT shall be conducted by the university department/ affiliated college for 40% of the maximum marks allotted for course. Two CIA, each of 20% marks shall be conducted at different phases, First, CIA after 10-15 days and Second CIA after 25-30 days of summer break.

The outline of distribution of marks for continuous assessment for OJT work shall be as under.

Table V : Distribution of marks for continuous internal assessment for OJT work

Sr. No.	Particulars	CIA (I) Week: 10-15 days of Summer break	CIA (II) Week :25-30 days of Summer break	Total Marks
1	Plan of OJT/internship including goal of internship	10 Marks	--	10 Marks
2	First 10- 15 days report of the activity with Presentation	05 Marks	----	05 Marks
3	Second 25-30 days report of the activity with Presentation		05 Marks	05 Marks
4	Progress (written) Report of OJT/Internship with Presentation	--	10 Marks	10 Marks
5	Presentation and viva	--	10 Marks	10 Marks
	Total	15 Marks	25 Marks	40 Marks

Summative (Semester End Examination) Assessment of OJT / Internship:

Summative (Semester-end) examination shall be conducted by university in the 5th week of the summer break for 60 % of the maximum marks allotted for the course. The examination shall be jointly done by two examiners, one from the same college / university department as internal examiner and other from other college or university department or industry organization appointed by university as external examiner.

Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar

FACULTY OF SCIENCE AND TECHNOLOGY

Question Paper pattern

Sub- Zoology

Paper Name-

Time: 1 Hour.

B.Sc – V / VI Sem

Paper code-

Maximum Marks: 30

N.B. (i) Part 'A' is compulsory.

(ii) Attempt any four questions from Part 'B'.

(iii) Draw neat labelled diagrams wherever necessary.

PART A

Q. 1 Attempt the following. (MCQ/ Fill in the blanks/ Answer in sentence).

10 Marks

- 1)
- 2)
- 3)
- 4)
- 5)

PART B (Full length questions) (Attempt any four)

Q. 2

05 Marks

Q. 3

05 Mark

Q. 4

05 Marks

Q. 5

05 Marks

Q. 6 Short notes

a)

03 Marks

b)

02 Marks

Q. 7 Short notes

a)

03Marks

b)

02Marks

(Note : In a given structure it should cover entire course curriculum both in part A and Part B)