



Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati
(Empowered Autonomous)

Three / Four Year Honours / Honours with Research B.Sc. Degree
Program in Zoology
(Faculty of Science)

CBCS Syllabus
TYBSc (Zoology) Semester-VI
For Department of Zoology

Choice Based Credit System Syllabus
(2023 Pattern)
(As Per NEP-2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: TYBSc (Zoology)**Preamble**

AES's Tuljaram Chaturchand College has decided to change the syllabus of various faculties from June, 2023 by taking into consideration the guidelines and provisions given in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcomes for the development of the students. The credit structure and the courses framework provided in the NEP are nationally accepted and internationally comparable.

The rapid changes in science and technology and new approaches in different areas of Zoology and related subjects, Board of Studies in Zoology of Tuljaram Chaturchand College, Baramati - Pune has prepared the syllabus of FYBSc Zoology Semester - I under the Choice Based Credit System (CBCS) by following the guidelines of NEP 2020, NCERT, NHEQF, Prof. R.D. Kulkarni's Report, GR of Gov. of Maharashtra dated 20th April, 16th May 2023 and 13th March, 2024 and Circular of SPPU, Pune dated 31st May 2023.

After completion of B.Sc. in Zoology enrolled students will acquire complete disciplinary knowledge as well as allied branches of Zoology. At the end of programme, students may possess expertise which will provide them competitive advantage in pursuing higher studies within India or abroad; and seek jobs in academia, civil administration, research or industries. Students will be able to define and explain major concepts in the biological sciences. They will be able to correctly use biological instrumentation and proper laboratory techniques; to communicate biological knowledge in oral and written form; to identify the relationship between structure and function at all levels: molecular, cellular, tissue, organ, system and organismal.

Students should be able to identify, classify and differentiate diverse non-chordates and chordates based on their basic morphological, anatomical biochemical and molecular characters. They will also be able to describe economic, ecological and medical significance of various animals in human life. This programme will create a curiosity and awareness among students to explore the animal diversity and take up wild life photography or wild life exploration as a career option. The procedural knowledge about identification and classification of animals will provide students professional advantages in seeking the jobs in fields of teaching, research and taxonomy in various private & public organizations; including Zoological Survey of India and National Parks/Sanctuaries. Students will be able to apply the scientific methods to answer questions in biology

by formulating testable hypotheses, gathering data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses. Students will be able to present scientific hypotheses and data both orally and in writing in the conventional formats that are in practice. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works. Acquired practical skills in biotechnology, biostatistics, bioinformatics and molecular biology can be used to pursue career as a scientist in drug development industry in India or abroad. The students will be acquiring basic experimental skills in various techniques in the fields of genetics; molecular biology; biotechnology; entomology, physiology, qualitative and quantitative microscopy; and analytical biochemistry. These methodologies will provide an extra edge to our students, who wish to undertake higher studies. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behaviour. Students will be able to explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different animals. Students will be able to analyse the ecological relationships of life on earth by tracing energy and nutrient flows through the ecosystems. They will be able to establish the relationship between the physical features of the environment and the structure of populations, communities, and ecosystems. Students undertaking skill enhancement courses like aquaculture, sericulture and apiculture will inculcate skills involved in rearing fish, bees and silk moth which would help them to generate self-employment making them successful entrepreneurs. Acquired skills in diagnostic testing, haematology, histopathology, staining procedures etc. used in clinical and research laboratories will make them eligible to work in diagnostic or research laboratories. B.Sc. Zoology graduates will find opportunities in public services departments, NGOs, environmental agencies, universities, colleges, biotechnological, pharmaceutical, environmental / ecological fields. There are numerous career opportunities for candidates completing their B.Sc, M.Sc and Ph.D. in Zoology in public and private sector. Candidates may find jobs as Animal Behaviourist, Conservationist, Wildlife Biologist, Zoo Curator, Wildlife Educator, Zoology teacher, Forensic experts, Lab technicians, Veterinarians, etc.

Overall, revising the Zoology syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Anekant Education Society's
Tuljaram Chaturchand College, Baramati
(Empowered Autonomous)

Board of Studies (BoS) in Zoology

From 2025-26 to 2027-28

Sr.No.	Name of Member	Designation
1.	Dr. Chordiya Sandip Popatlal	Chairperson
2.	Dr. Nale Vitthal Baban	Member
3.	Dr. Manoorkar Poojawati	Member
4.	Dr. Sangale Deepali Maruti	Member
5.	Mr. More Kishor U.	Member
6.	Dr. Jadhav Sameer Sadashiv	Member
7.	Mr. Kare Samadhan	Member
8.	Mr. Awaghade Yugandhar	Member
9.	Dr. Ravindra D. Chaudhari	Vice-Chancellor Nominee Subject Expert from SPPU, Pune
10.	Dr. Gaikwad Sanjay K.	Subject Expert from Outside the Parent University
11.	Dr. Deshmukh A. A.	Subject Expert from Outside the Parent University
12.	Dr. Karpe Yogesh	Representative from Industry/Corporate Sector/Allied areas
13.	Ms. Kumbhar Kamal	Member of the College Alumni
14.	Ms. Sakshi Sawant	UG Student
15.	Ms. Sanika Nikhale	PG Student

Credit Distribution Structure for B.Sc. (Zoology) -2023Pattern

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum.Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	4- 6 (4+2)		-	2+2	VSC:2,SEC:2	AEC:2, VEC:2,IKS:2	CC:2	20-22	UG Certificate 40-44
	II	4- 6 (4+2)		2	2+2	VSC:2, SEC:2	AEC:2, VEC:2	CC:2	20-22	
	Cum Cr.	8-12	-	2	8	4+4	4+4+2	4	40-44	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/Internship OR Continue with Major and Minor										
5.0	III	6(4+2)- 8(2*4)		4	2	VSC:2,	AEC:2	FP:2CC:2	20-22	UG Diploma 80-88
	IV	6(4+2)- 8(2*4)		4	2	SEC:2	AEC:2	CEP: 2 CC:2	20-22	
	Cum Cr.	20-28		10	12	6+6	8+4+2	8+4	80-88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQFcourse/ Internship OR Continue with Major and Minor										
5.5	V	8(2*4)-10(2*4 +2)	4	4-6		VSC: 2- 4		FP/CEP:2	20-22	UG Degree 120-132
	VI	8(2*4)-10 (2*4 +2)	4	4				OJT :4	20-22	
	Cum Cr.	36-48	8	18-20	12	8-10 +6	8+4+2	8+6+4	120-132	
Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor										
6.0	VII	12-14 (2*4+2*2 or 3*4+2)	4	RM:4					20-22	UG Honours Degree 160-176
	VIII	12-14 (2*4+2*2 or 3*4+2)	4					OJT:4	20-22	
	Cum Cr.	60-76	16	18-20 +4	12	8-10 +6	8+4+2	8+6+8	160-176	
Four Year UG Honours Degree in Major and Minor with 160-176 credits										
6.0	VII	8-10 (2*4+2 or2*4)	4	RM:4				RP: 4	20-22	UG Honours with Research Degree 160-176
	VIII	8-10 (2*4+2 or2*4)	4					RP: 8	20-22	
	Cum Cr.	52-68	16	18 -20	12	8-10 +6	8+4+2	8+6+4+	160-176	
Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits										

Course Structure for B.Sc. Zoology (2023 Pattern)

FYBSc

Sem	Course Type	Course Code	Course Name	Theory / Practical	Credits
I	Major Mandatory	ZOO-101-MJM	Animal Systematics & Diversity – I	Theory	02
	Major Mandatory	ZOO-102-MJM	Fundamentals of Cell Biology	Theory	02
	Major Mandatory	ZOO-103-MJM	Zoology Practical – I	Practical	02
	Open Elective (OE)	ZOO-116-OE	Fresh Water Fishery (गोड्या पाण्यातील मत्स्य शेती)	Theory	02
	Open Elective (OE)	ZOO-117-OE	Fresh Water Fishery (Practical) गोड्या पाण्यातील मत्स्य शेती (प्रात्य क्षक)	Practical	02
	Vocational Skill Course (VSC)	ZOO-121-VSC	Biological Techniques-I	Theory	02
	Skill Enhancement Course (SEC)	ZOO-126-SEC	Medical Laboratory Technology-I	Practical	02
	Ability Enhancement Course (AEC)	ENG-131-AEC	Functional English-I	Theory	02
	Value Education Course (VEC)	ZOO-135-VEC	Environmental Science	Theory	02
	Indian Knowledge System (IKS)	ZOO-137-IKS	Animal Diversity & Conservation in Indian Culture	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
Total Credits Semester-I					22
II	Major Mandatory	ZOO-151-MJM	Animal Systematics & Diversity – II	Theory	02
	Major Mandatory	ZOO-152-MJM	Genetics	Theory	02
	Major Mandatory	ZOO-153-MJM	Zoology Practical – II	Practical	02
	Minor	ZOO-161-MN	Apiculture	Theory	02
	Open Elective (OE)	ZOO-166-OE	Crop pests: Types & management (पकावरील कीड: प्रकार व व्यवस्थापन)	Theory	02
	Open Elective (OE)	ZOO-167-OE	Crop pests: Types & management (Practical) पकावरील कीड: प्रकार व व्यवस्थापन (प्रात्य क्षक)	Practical	02
	Vocational Skill Course (VSC)	ZOO-171-VSC	Biological Techniques-I	Practical	02
	Skill Enhancement Course (SEC)	ZOO-176-SEC	Medical Laboratory Technology -II	Practical	02
	Ability Enhancement Course (AEC)	ENG-181-AEC	Functional English-II	Theory	02
	Value Education Course (VEC)	ZOO-185-VEC	Digital and Technological Solutions	Theory	02
	Co-curricular Course (CC)	--	To be selected from the Basket	Theory	02
Total Credits Semester-II					22
Cumulative Credits Semester I + Semester II					44

Course Structure for B.Sc. Zoology (2023 Pattern)

SYBSc

Sem	Course Category	Course Code	Course Title	Theory / Practical	Credits
III	Major mandatory	ZOO-201-MJM	Animal Systematics & Diversity-III	T	2
	Major mandatory	ZOO-202-MJM	Applied Zoology-I	T	2
	Major mandatory	ZOO-203-MJM	Ecology	T	2
	Major mandatory	ZOO-204-MJM	Zoology Practical-III	P	2
	Minor	ZOO-211-MN	Sericulture	T	2
	Minor	ZOO-212-MN	Sericulture Lab	P	2
	Open Elective	ZOO-216-OE	मधुमाशापालन	T	2
	Vocational Skill Course (VEC)	ZOO-221-VSC	Toxicology	T	2
	Ability Enhancement Course (AEC)	MAR/HIN/SAN-231-AEC	भाषक उपयोजन व लेखन कौशल्ये हिंदी भाषा : सृजन कौशल प्राथमिक संभाषणकौशल्यम्	T	2
	Field Project	ZOO-235-FP	Field Project	P	2
	Co-curricular course (CC)	YOG/PES/CUL/NS/NCC-239-CC	To be selected from basket	T	2
	Generic IKS	GEN-245-IKS		T	2
			Total Credits (Semester-III)		24
IV					
	Major mandatory	ZOO-251-MJM	Fundamentals of genetics	T	2
	Major mandatory	ZOO-252-MJM	Applied Zoology- II	T	2
	Major mandatory	ZOO-253-MJM	Environmental Biology	T	2
	Major mandatory	ZOO-254-MJM	Zoology Practical-IV	P	2
	Minor	ZOO-261-MN	Dairy Science	T	2
	Minor	ZOO-262-MN	Dairy Science Lab	P	2
	Open Elective	ZOO-266-OE	मधुमक्षिका पालन प्रालय क्षक	P	2
	Skill Enhancement Course (SEC)	ZOO-276-SEC	Toxicology Lab	P	2
	Ability Enhancement Course (AEC)	MAR/HIN/SAN-281-AEC	लेखन नि र्मती व परीक्षण कौशल्ये हिंदी भाषा : संप्रेषण कौशल प्रगत संभाषणकौशल्यम्	T	2
	Community Engagement Project	ZOO-285-CEP	Community Engagement Project	P	2
	Co-curricular course (CC)	YOG/PES/CUL/NS/NCC-289-CC	To be selected from basket	T	2
			Total Credits (Semester-IV)		22
			Cumulative Credits- Semester III + IV		46

Course Credit Structure for TYBSc Zoology (2023 pattern) as per NEP-2020

Sem	Course Type	CourseCode	CourseName	Theory / Practical	Credits	
V	Major Mandatory	ZOO-301-MJM	Biological Techniques	Theory	02	
	Major Mandatory	ZOO-302-MJM	Mammalian Histology	Theory	02	
	Major Mandatory	ZOO-303-MJM	Biochemistry	Theory	02	
	Major Mandatory	ZOO-304-MJM	Genetics	Theory	02	
	Major Mandatory	ZOO-305-MJM	Zoology Practical-V	Practical	02	
	Major Elective (MJE)	ZOO-306-MJE (A)	Cell Biology	Theory (Any Two)	02+02= 04	
	Major Elective (MJE)	ZOO-306-MJE (B)	General Pathology			
	Major Elective (MJE)	ZOO-306-MJE (C)	Ethology			
	Minor	ZOO-311-MN	Ornamental Fishery	Theory	02	
	Minor	ZOO-312-MN	Practicals in Ornamental Fishery	Practical	02	
	Vocational Skill Course (VSC)	ZOO-321-VSC	Biostatistics	Practical	02	
	Field Project (FP)	ZOO-355-FP	Field Project	Practical	02	
Total Credits Semester-V					22	
VI	Major Mandatory	ZOO-351-MJM	Immunology	Theory	02	
	Major Mandatory	ZOO-352-MJM	Mammalian Physiology	Theory	02	
	Major Mandatory	ZOO-353-MJM	Parasitology	Theory	02	
	Major Mandatory	ZOO-354-MJM	Molecular Biology	Theory	02	
	Major Mandatory	ZOO-355-MJM	Zoology Practical-VI	Practical	02	
	Major Elective (MJE)	ZOO-356-MJE (A)	Endocrinology	Theory (Any Two)	02+02= 04	
	Major Elective (MJE)	ZOO-356-MJE (B)	Basic Entomology			
	Major Elective (MJE)	ZOO-356-MJE (C)	General Embryology			
	Minor	ZOO-361-MN	Agricultural Pests & Management	Theory	02	
	Minor	ZOO-362-MN	Practicals in Agricultural Pest Management	Practical	02	
	On Job Training (OJT)	ZOO-385-OJT	On Job Training	Practical	04	
	Total Credits Semester-VI					22
	Cumulative Credits Semester V + Semester VI					44

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Major (Mandatory) Theory

Course Code: ZOO-351-MJM

Course Name: Immunology

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Understand the fundamental concepts of immunology, including the nature, scope, and types of immunity (innate and acquired).
- Apply knowledge of body defense mechanisms, distinguishing between nonspecific (physical, chemical, biological barriers) and specific (adaptive) immunity.
- Identify and describe the structure and role of immune organs (primary and secondary lymphoid organs) in regulating immune responses.
- Analyze the types and functions of immune cells (monocytes, macrophages, granulocytes, mast cells, dendritic cells, NK cells, B and T lymphocytes).
- Explain the nature and properties of antigens and antibodies, including immunoglobulin classes, their structure, and theories of antibody production.
- Differentiate between primary and secondary immune responses, and evaluate their biological significance.
- Demonstrate understanding of antigen–antibody interactions, recognize and classify hypersensitivity.

Course Outcomes:-

Student will be able to-

- CO1: explain the fundamental concepts of immunology, including the nature, scope, and types of immunity (innate and acquired).
- CO2: distinguish between nonspecific (physical, chemical, biological) and specific (adaptive) defense mechanisms; apply knowledge to host defense understanding.
- CO3: identify and describe the structure and role of immune organs (primary and secondary lymphoid organs) in regulating immune responses.
- CO4: analyze the types and functions of immune cells (monocytes, macrophages, granulocytes, mast cells, dendritic cells, NK cells, B and T lymphocytes).
- CO5: explain the nature and properties of antigens and antibodies; classify immunoglobulin based on structure, properties, functions, and theories of antibody production.
- CO6: differentiate between primary and secondary immune responses; evaluate their biological significance in health and disease.
- CO7: demonstrate understanding of antigen–antibody interactions; recognize and classify hypersensitivity reactions (immediate and delayed).

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Introduction Immunology:		15
	1.1	Introduction	
	1.2	Types of immunity:	

		i. Innate - Types, factors influencing innate immunity ii. Acquired - Active and Passive	
	1.3	Types of Defence: A) Nonspecific- a) First line of defence - Physical and chemical barriers b) Second line of defence - Chemical and biological barriers B) Specific - a) Third line of defence - Specific defence mechanism	
	1.4	Organs of immune system: Lymph, primary and secondary lymphoid organs - structure and their role	
	1.5	Cells of immune system- Granulocytes, monocytes and macrophages, mast cells, dendritic cells, NK cells, B and T lymphocytes and types	
2	Fundamentals of Immunology:		15
	2.1	Antigen- Definition, nature, types of antigen & factors affecting on antigenicity	
	2.2	Antibody-Definition, chemical nature, basic structure of immunoglobulin, major human immunoglobulin classes (their properties and functions)	
	2.3	Immune response -Primary and secondary	
	2.4	Antigen - Antibody reactions - Principle, mechanism and applications of - a) Agglutination b) Precipitation c) ELISA	

REFERENCES

- Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Roitt's essential immunology*. John Wiley & Sons.
- Owen, J. A., Punt, J., Stranford, S. A., & Jones, P. P. (2013). *Kuby immunology* (Vol. 27, p. 109). New York: WH Freeman.
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- Kuby, J. (2021). *Immunology* (8th ed.). W. H. Freeman.
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- Male, D., Brostoff, J., Roth, D., & Roitt, I. (2020). *Immunology* (10th ed.). Elsevier.

Course Articulation Matrix of ZOO-351-MJM: Immunology **Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	2	1	1	2	2	1
CO2	3	2	1	2	3	1	2	2	1	1	2	2	1
CO3	3	2	1	2	2	1	2	2	1	1	1	2	1
CO4	3	2	2	3	3	2	2	2	1	1	2	2	1
CO5	3	2	1	2	3	1	2	2	1	1	2	2	1
CO6	3	2	1	2	3	2	3	2	1	1	2	2	1
CO7	3	2	1	2	3	2	3	2	2	1	2	2	1

PO1: Comprehensive knowledge and understanding

All COs map strongly to PO1, since they collectively cover basic to advanced immunology concepts such as immunity, immune organs, cells, antigens, antibodies, immune responses, and hypersensitivity.

PO2: Practical, professional, and procedural knowledge

CO2, CO3, CO4, CO5, CO6 & CO7 link to PO2 because understanding immune mechanisms, diagnostic immunoassays (ELISA, complement fixation), & hypersensitivity are applied in clinical and laboratory immunology.

PO3: Entrepreneurial mindset and knowledge

CO4 (immune cell functions) and CO7 (antigen–antibody reactions, hypersensitivity) relate to PO3 as they have applications in biotechnology startups, vaccine production, diagnostic kit development, and immunotherapy ventures.

PO4: Specialized skills and competencies

CO2–CO7 map to PO4 since studying host defenses, immune organs, antibody classes, and immune responses builds specialized immunology skills essential in research, diagnostics, and healthcare.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO2, CO4, CO5, CO6, and CO7 are mapped to PO5 because evaluating immune responses, interpreting antigen–antibody interactions, and analyzing hypersensitivity reactions require critical thinking and problem-solving ability.

PO6: Communication skills and collaboration

CO4, CO6 & CO7 are mapped to PO6 since interpretation and presentation of immunological data (like ELISA or immune profiles) often require teamwork, reporting, and interdisciplinary communication in clinical and research settings.

PO7: Research-related skills

CO2–CO7 mapped to PO7 because designing experiments (e.g., immune response assays, antibody detection), interpreting results, and validating findings are core immunology research skills.

PO8: Learning how to learn skills

CO1, CO2, CO5, CO6 & CO7 map to PO8 because immunology is a continuously evolving field; students must develop lifelong learning skills to keep pace with advances in molecular diagnostics, vaccines, and immunotherapies.

PO9: Digital and technological skills

CO7 relates to PO9 as modern antigen–antibody reaction studies (ELISA readers, fluorescence microscopy, and immunodiagnostic kits) require digital instrumentation and technology handling.

PO10: Multicultural competence, inclusive spirit, and empathy

CO1–CO6 map to PO10 since immunology knowledge fosters empathy towards patients with immune disorders and encourages inclusive healthcare practices in diverse communities.

PO11: Value inculcation and environmental awareness

CO1, CO2, CO4–CO6 mapped to PO11 because safe handling of biological materials, ethical considerations in immunology, and awareness of vaccines reflect responsibility toward society and environment.

PO12: Autonomy, responsibility, and accountability

CO2–CO7 aligns with PO12 as immunological testing, interpretation of assays, and independent clinical decisions require responsibility, accountability, and professional ethics.

PO13: Community engagement and service

All COs map to PO13, since immunology knowledge directly benefits society through vaccination programs, diagnostic services, disease prevention, and community health awareness.

**SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2025)****Name of the Program: B.Sc. Zoology****Program Code: USZOO****Class: T.Y.B.Sc.****Semester: VI****Course Type: Major (Mandatory) Theory****Course Code: ZOO-352-MJM****Course Name: Mammalian Physiology****Number of Credits: 02****Number of Teaching hours: 30****Course Objectives:-**

- Understand the basic concepts of nutrition, energy requirements, and the physiological role of vitamins.
- Comprehend the processes of digestion and the role of enzymes, liver, and pancreas in nutrient breakdown and absorption.
- Explain the mechanisms of respiration, gas transport, respiratory quotient, and basal metabolic rate.
- Gain knowledge of cardiac physiology including cardiac cycle, cardiac output, blood pressure, and regulation of heart functions.
- Understand the physiology of excretion with emphasis on urine formation, counter-current mechanism, and hormonal regulation.
- Study the mechanism of muscle contraction and various muscle responses to stimulation.
- Analyze the physiology of human reproduction and the hormonal regulation of reproductive processes, pregnancy, parturition, and lactation.

Course Outcomes:

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

- Apply the concepts of nutrition and energy requirements in evaluating human health and dietary needs.
- Describe the physiology of digestion and relate enzyme action and organ function to nutrient assimilation.
- Demonstrate an understanding of pulmonary and tissue respiration along with oxygen and carbon dioxide transport.
- Interpret cardiovascular functions such as cardiac cycle, cardiac output, ECG, blood pressure regulation, and related clinical procedures.
- Explain the processes of urine formation, concentration mechanisms, and hormonal regulation in maintaining homeostasis.
- Analyze the physiology of muscles, including contraction mechanisms and muscle responses under different conditions.
- Evaluate the role of hormones in male and female reproductive physiology, pregnancy, childbirth, and lactation.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Nutrition and digestion		04
	1.1	Physiology of digestion: digestive enzymes and their actions- salivary, gastric and intestinal digestion. Role of liver and pancreas in digestion	
	1.2	Vitamins – Sources and associated disorders.	
2	Respiration		04
	2.1	Definition, and mechanism of pulmonary and tissue respiration	
	2.2	Transport of Oxygen and carbon dioxide	
	2.3	Respiratory Quotient and BMR	
3	Circulation		05
	3.1	Cardiac Cycle- systole, diastole, and pacemakers	
	3.2	Cardiac output and blood pressure	
	3.3	Definitions and significance of: Electro-cardiogram, colour doppler, angiography, angioplasty, angina pectoris, myocardial infarction and coronary bypass.	
4	Excretion		05
	4.1	Physiology of urine formation-ultrafiltration, selective reabsorption, tubular secretion	
	4.2	Counter-current multiplier theory for urine concentration	
	4.3	Role of ADH, and Renin- angiotensin system	
5	Muscles		04
	5.1	Mechanism of muscle contraction by Sliding filament theory	
	5.2	Response of muscles to stimulation- simple muscle twitch, muscle fatigue, muscle tetanus, rigor mortis	
6	Excitation and conduction		05
	6.1	Definitions/concepts: impulse, stimulation, conduction, response, EEG, epilepsy	
	6.2	Origin and conduction of nerve impulse, saltatory conduction	
	6.3	Synapse- ultrastructure and transmission of nerve impulse	
7	Reproduction		03
	7.1	Oestrous and menstrual cycle	

REFERENCES

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Course Articulation Matrix of ZOO-352-MJM: Mammalian Physiology**Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	2	1	1	2	2
CO2	3	2	1	3	3	1	2	2	1	1	2	2
CO3	3	2	1	2	3	2	2	2	1	1	2	2
CO4	3	2	1	3	3	2	3	2	1	1	3	2
CO5	3	2	1	2	3	2	2	2	1	1	2	2
CO6	3	2	1	3	3	3	3	2	1	1	3	2
CO7	3	2	2	2	3	3	3	3	2	2	3	3

PO1: Comprehensive knowledge and understanding

Students will acquire a strong foundation in human physiology—including nutrition, respiration, circulation, excretion, muscles, and reproduction—enabling them to understand normal body functions and health.

PO2: Practical, professional, and procedural knowledge

Students will be able to connect theoretical physiology concepts with practical applications in biomedical and health sciences such as digestion analysis, respiratory studies, ECG interpretation, urine examination, and muscle performance testing.

PO3: Entrepreneurial mindset and knowledge

Students will develop an entrepreneurial outlook by applying physiological knowledge in healthcare, nutrition consultancy, biomedical device development, and innovations in diagnostic and therapeutic practices.

PO4: Specialized skills and competencies

Students will gain expertise in advanced physiological mechanisms such as digestion, respiration, excretion, and endocrine control, enhancing their scientific and technical competency.

PO5: Capacity for application, problem-solving, and analytical reasoning

Students will acquire analytical and reasoning abilities to interpret physiological processes, diagnose clinical conditions (e.g., cardiac, renal, endocrine disorders), and propose evidence-based solutions.

PO6: Communication skills and collaboration

Students will build the ability to explain physiological concepts, interpret diagnostic results, and communicate effectively with peers, professionals, and healthcare teams, fostering teamwork in clinical and research settings.

PO7: Research-related skills

Students will develop research aptitude by conducting experiments such as respiratory efficiency measurements, ECG analysis, hormone assays, and urine analysis, enhancing their investigative and experimental skills.

PO8: Learning how to learn skills

Students will cultivate lifelong learning habits, staying updated with advances in diagnostic tools, treatments, and medical technology for continuous professional growth.

PO9: Digital and technological skills

Students will gain proficiency in using biomedical instruments (ECG, Doppler, angiography tools) and applying digital technologies in diagnostics and healthcare practices.

PO10: Multicultural competence, inclusive spirit, and empathy

Students will apply physiological knowledge with empathy and cultural sensitivity in healthcare, addressing health needs across diverse populations.

PO11: Value inculcation and environmental awareness

Students will adopt ethical values in applying physiology to nutrition, health, and medical research, while maintaining awareness of human well-being and environmental sustainability.

PO12: Autonomy, responsibility, and accountability

Students will take responsibility for independent physiological investigations, patient care applications, and professional conduct with integrity and accountability.

PO13: Community engagement and service

Students will contribute to community health by applying physiology knowledge in nutrition awareness, public health programs, and diagnostic services.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Major (Mandatory) Theory

Course Code: ZOO-353-MJM

Course Name: Parasitology

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Define the scope and branches of parasitology.
- Explain the advantages and hazards of parasitism for both the parasite and the host.
- Describe the various classifications of hosts, including definitive, intermediate, paratenic, and reservoir hosts.
- Conduct in-depth studies of specific protozoan parasites, like *Plasmodium vivax*.
- Conduct detailed studies of helminth parasites like *Ascaris lumbricoides*.
- Study the morphology, life cycle, pathogenicity, and control measures of arthropod parasites like head lice.
- Define and discuss the concept of zoonotic diseases and their transmission from animals to humans.

Course Outcomes:-

Student will be able to-

- CO1: define parasitology and explore its scope, encompassing diverse branches like medical, veterinary, and evolutionary parasitology.
- CO2: delve into the realm of helminth parasites, dissecting the anatomy, life cycle, and disease-causing abilities of *Ascaris lumbricoides* (roundworm).
- CO3: investigate the world of arthropod parasites like head lice.
- CO4: define and discuss the concept of zoonotic diseases, those transmitted from animals to humans.
- CO5: gain practical knowledge of diagnostic techniques for parasitological infections, including stool microscopy, serological tests, and molecular diagnostics.
- CO6: explore the spectrum of antiparasitic drugs and treatment regimens, understanding their mechanisms of action and potential side effects.
- CO7: apply your parasitological knowledge to real-world settings, participating in field studies, community outreach programs, and public health initiatives.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Introduction:		04
	1.1	Scope and branches of parasitology	
	1.2	Concepts of symbiosis: commensalisms, mutualism and parasitism	
	1.3	Concept of parasite, host, vector (types of vectors) and zoonosis	
2	Parasitism and Types of parasites:		04
	2.1	Properties of parasite, advantages and hazards of parasitism	
	2.2	Types of parasites according to different criteria	
3	Hosts:		02

	3.1	Types of hosts- Intermediate, definitive, paratenic and reservoir host	
4	Host-Parasite relationship:		04
	4.1	Host specificity- definition and types	
	4.2	Adaptations of Parasites, Effects of parasites on host.	
5	Study of the parasite with reference to - habit, habitat, life cycle, mode of infection, pathogenicity and control measures		12
	5.1	<i>Plasmodium vivax</i> (Malarial parasite)	
	5.2	<i>Ascaris lumbricoides</i> (Intestinal round worm)	
	5.3	<i>Taenia solium</i> (Tape worm)	
	5.4	<i>Pediculus humanus capitis</i> (Head louse)	
6	Concept of epidemic diseases: Pathogen, mode of infection, symptoms, treatment and prophylaxis of		04
	6.1	Typhoid	
	6.2	Dengue	
	6.3	Hepatitis A	

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Course Articulation Matrix of ZOO-353-MJM Parasitology Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	2	2	3	1	3	2	1	1	2	2	1
CO3	3	2	1	2	1	1	2	2	1	1	1	1	1
CO4	3	1	2	2	3	2	2	2	1	1	3	2	1
CO5	3	2	1	1	3	1	1	3	1	1	2	2	1
CO6	3	1	1	2	3	3	3	3	1	1	2	2	1
CO7	2	2	2	1	1	2	2	1	2	1	1	1	3

PO1: Comprehensive knowledge and understanding

All COs (CO1–CO7) are directly mapped to PO1 because understanding parasitology—including parasite biology, zoonoses, diagnostics, and treatments—is fundamental for building comprehensive biological and biomedical knowledge.

PO2: Practical, professional, and procedural knowledge

CO1, CO2, CO3, CO5, CO7 are mapped to PO2 because identifying parasites microscopically, diagnosing parasitic infections, and applying field and lab techniques (like stool microscopy and serology) require hands-on procedural proficiency and professional handling of biological samples.

PO3: Entrepreneurial mindset and knowledge

CO4, CO7 are mapped to PO3 as knowledge of zoonotic diseases and public health strategies can inspire

innovation in healthcare solutions, epidemiological surveillance, and startup opportunities in diagnostics, prevention, or vector control.

PO4: Specialized skills and competencies

CO1, CO2, CO3, CO4, CO6 are mapped to PO4 because detailed understanding of parasite anatomy, life cycles, treatment regimens, and disease transmission requires specialized parasitological and pharmacological skills.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1, CO2, CO4, CO5, CO6 are mapped to PO5 as diagnosing infections, interpreting test results, selecting appropriate treatments, and addressing public health concerns involve analytical thinking and applied biological problem-solving.

PO6: Communication skills and collaboration

CO4, CO6, CO7 are mapped to PO6 since engaging in community outreach, presenting diagnostic findings, and collaborating in health initiatives demand clear communication, teamwork, and public engagement.

PO7: Research-related skills

CO2, CO3, CO4, CO6, CO7 are mapped to PO7 because investigating parasite biology, studying transmission routes, evaluating treatments, and participating in field studies enhance students' abilities to conduct, analyze, and contribute to research.

PO8: Learning how to learn skills

CO1, CO2, CO5, CO6 are mapped to PO8 as continuous learning is required to keep pace with advances in diagnostics, drug resistance, emerging parasitic diseases, and evolving treatment technologies.

PO9: Digital and technological skills

CO5, CO6, CO7 are mapped to PO9 because modern diagnostic and therapeutic approaches often use molecular tools (PCR, ELISA, DNA probes), requiring competence in digital instrumentation and bioinformatics platforms.

PO10: Multicultural competence, inclusive spirit, and empathy

CO1, CO2, CO3, CO4, CO5, CO6 are mapped to PO10 because understanding parasitic diseases across global and cultural contexts promotes inclusivity, ethical sensitivity, and empathy toward affected communities.

PO11: Value inculcation and environmental awareness

CO1, CO2, CO4, CO5, CO6 are mapped to PO11 as parasitology fosters ethical laboratory practices, awareness of zoonotic spillovers, and environmental factors influencing disease transmission, promoting responsible scientific conduct.

PO12: Autonomy, responsibility, and accountability

CO1, CO2, CO4, CO5, CO6 are mapped to PO12 since students must conduct diagnostics and treatments responsibly, manage sensitive health data, and act ethically in research and public health settings.

PO13: Community engagement and service

All COs (CO1–CO7) are mapped to PO13 because parasitology education prepares students to engage in community health, raise awareness of parasitic diseases, and contribute meaningfully to public health initiatives.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Major (Mandatory) Theory

Course Code: ZOO-354-MJM

Course Name: Molecular Biology

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- Understand the structure and forms of DNA to establish a foundation in molecular biology.
- Comprehend the central dogma of molecular biology, including DNA replication, transcription, and translation processes in prokaryotes and eukaryotes.
- Analyze gene regulation mechanisms in prokaryotes through operon models (Lac and Trp operons).
- Gain knowledge of recombinant DNA technology (RDT), including restriction enzymes, cloning vectors, and cloning methods.
- Explore gene transfer techniques (natural, physical, and chemical) and their applications in biotechnology.
- Develop skills in applying molecular biology concepts to experimental design and problem-solving.
- Understand the ethical and societal implications of molecular biology applications in research and biotechnology.

Course Outcomes:-

Students will be able to:

- CO1: Explain the structure and forms of DNA, applying this knowledge to molecular interactions in biological systems.
- CO2: Describe the mechanisms of DNA replication, transcription, and translation, comparing prokaryotic and eukaryotic processes.
- CO3: Analyze gene regulation in prokaryotes using the Lac and Trp operon models, understanding their role in molecular control.
- CO4: Demonstrate proficiency in recombinant DNA technology, including the use of restriction enzymes, cloning vectors, and cloning methods.
- CO5: Apply gene transfer techniques (natural, physical, and chemical) to practical scenarios in genetic engineering.
- CO6: Design and interpret molecular biology experiments, integrating principles for research and biotechnological applications.
- CO7: Evaluate the ethical and societal impacts of molecular biology techniques in biotechnology and research.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Introduction to Molecular Biology		03
	1.1	Structure of DNA: Watson and Crick model of DNA.	
	1.2	A, B & Z forms of DNA, Supercoiled and relaxed DNA	
2	Central Dogma of Molecular Biology		

	2.1	DNA Replication- Modes of DNA replication- Messelson and Stahl experiment, Basic Mechanism of replication in prokaryotes and eukaryotes	16
	2.2	Transcription – Basic mechanism of transcription in prokaryotes and eukaryotes, RNA polymerase enzyme in prokaryotes and eukaryotes	
	2.3	Translation – Genetic code, properties of genetic code, Wobble hypothesis, ribosome structure, Basic mechanism of translation in <i>E. coli</i> and Eukaryotic Cells	
3	Gene regulation in Prokaryotes		03
	3.1	Operon Model: <i>Lac</i> operon & <i>Trp</i> operon	
4	Recombinant DNA Technology		05
	4.1	Introduction: Principal of RDT Restriction Enzymes: nomenclature and types of restriction enzymes with examples	
	4.2	Cloning Vectors: General properties, types and advantages and disadvantages of cloning vectors -plasmid vectors (<i>pBR322</i>), phage vector (<i>λ Phage</i>), cosmid vector	
	4.3	Cloning method	
5	Gene transfer techniques		03
	5.1	Natural Method: <i>Agrobacterium</i> -mediated	
	5.2	Physical Method.	
	5.3	Chemical Method	

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Course Articulation Matrix of ZOO-354-MJM: Molecular Biology Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	1	2	1	1	1	2	1	1	3	1
CO2	2	2	2	3	3	1	3	2	2	1	2	2	1
CO3	3	2	1	2	1	1	2	2	1	1	1	1	1
CO4	3	1	2	2	3	2	2	2	1	1	3	2	3

CO5	2	2	1	1	3	1	1	3	1	1	2	2	1
CO6	3	1	1	2	3	2	3	1	1	1	2	2	1
CO7	2	3	1	1	1	3	2	1	2	2	1	1	2

PO1: Comprehensive Knowledge and Understanding

All COs (CO1–CO7) are directly mapped to PO1 because understanding molecular biology including DNA structure, gene expression, rDNA technology, and ethical aspects of biotechnology—is essential for building comprehensive biological and biomedical knowledge.

PO2: Practical, Professional, and Procedural Knowledge

CO1, CO2, CO3, CO5, and CO7 are mapped to PO2 because applying knowledge of DNA processes, gene regulation, & gene transfer involves procedural proficiency & professional handling of molecular biology experimental techniques in research clinical scenarios.

PO3: Entrepreneurial Mindset and Knowledge

CO3, CO6, and CO7 are mapped to PO3 given that innovative problem-solving, research design, and ethical evaluation in molecular biology foster entrepreneurial thinking, opportunity recognition, and societal impact awareness in the biotechnology sector.

PO4: Specialized Skills and Competencies

CO2, CO4, CO5, and CO6 relate strongly to PO4 as they require mastery of specialized molecular biology skills, including recombinant DNA techniques, molecular cloning, gene transfer, and experiment design using modern technology.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

All COs connect with PO5 due to need for critical analysis, use of scientific reasoning, & application of molecular biology to solve problems in research, diagnostics, and biotechnology.

PO6: Communication Skills and Collaboration

CO4, CO5, CO6, and CO7 align with PO6 as many molecular biology tasks are conducted collaboratively, requiring clear scientific communication, teamwork, and reporting skills across multidisciplinary groups.

PO7: Research-related Skills

CO2, CO4, CO5, CO6, and CO7 map to PO7 since these outcomes involve experimental design, data interpretation, and ethical conduct in research, which are crucial for producing valid and reproducible scientific results.

PO8: Learning How to Learn Skills

All COs relate to PO8 as molecular biology is a rapidly evolving science that necessitates continuous learning, adaptation to emerging technologies, and independent pursuit of new knowledge and skills.

PO9: Digital and Technological Skills

CO4, CO5, and CO6 strongly connect to PO9 because molecular biology increasingly relies on digital tools and software for experiment design, data analysis, and molecular diagnostics.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

Some COs (especially CO7) are linked to PO10 due to the emphasis on ethical awareness and societal implications of molecular technologies, encouraging respect for diverse perspectives in scientific research and application.

PO11: Value Inculcation and Environmental Awareness

CO7 is mapped to PO11 as ethical considerations and environmental responsibility are integral to biosafety, sustainable biotechnological practices, and moral accountability in research.

PO12: Autonomy, Responsibility, and Accountability

All COs relate to PO12 as students must independently design, execute, and report experiments responsibly, maintaining quality and ethical standards.

PO13: Community Engagement and Service

CO5, CO6, and CO7 connect with PO13 because molecular biology techniques often have direct implications for community health, environmental stewardship, and public well-being, necessitating service orientation and engagement.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Major (Mandatory) Practical

Course Code: ZOO-355-MJM

Course Name: Zoology Practical-VI

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- Develop foundational laboratory skills in hematology, immunology, biochemistry, and molecular biology essential for practical problem-solving and clinical diagnosis.
- Illustrate the principles and procedures of key clinical and molecular assays, emphasizing accuracy, precision, and safety.
- Cultivate proficiency in the use and handling of laboratory equipment, including microscopes and specialized instruments for biomedical analysis.
- Foster the ability to critically analyze and interpret laboratory data in relation to human physiology and pathology.
- Encourage the development of models and hands-on activities using creative, sustainable materials to reinforce theoretical concepts.
- Build competency for independently performing various specimen preparations, histochemical and molecular biology techniques.
- Instill ethical practice, teamwork, and proper documentation in laboratory settings, including scientific reporting and compliance.

Course Outcomes:-

Student will be able to-

- CO1. Independently perform ABO blood grouping, Widal test, and immunodiffusion, applying standard operating protocols for diagnostic assays.
- CO2. Assemble and present models of antibody structures using suitable materials, demonstrating knowledge of immunology and creative scientific communication.
- CO3. Analyze the effects of physiological states (exercise, posture) on cardiovascular parameters and interpret clinical significance.
- CO4. Proficiently estimate blood components and biomolecules (platelets, glucose, DNA, RNA) by appropriate quantitative methods (colorimetry, histochemical assays).
- CO5. Identify, differentiate, and interpret life cycle and morphology of medically important parasites and disease vectors via microscopy and specimen preparation.
- CO6. Apply molecular biology techniques—including restriction digestion, PCR, and electrophoresis—for analysis and detection of nucleic acids.
- CO7. Compile and present laboratory records correlating morphological, physiological, biochemical, and molecular findings to clinical diagnosis and research applications.

PRACTICALS:

Practical No.	Name of the practical	E/D	Teaching Hours
1.	Study of ABO blood grouping	E	4
2.	To perform the WIDAL test	E	4

3.	To perform the Ouchterlony double immunodiffusion assay	E/D	8
4.	Preparation of models of various antibodies from suitable / waste material (Activity based practical)	E	4
5.	Effect of exercise and posture on heart rate and blood pressure	E	4
6.	Counting of platelets and its clinical correlation.	E	4
7.	To estimate the blood glucose level by GOD-POD method.	E	4
8.	Study of any five disorders caused by endocrine glands with the help of photographs	E	4
9.	Study of life cycle of <i>Plasmodium vivax</i> & <i>Ascaris lumbricoides</i>	D	4
10.	Study of morphology, life cycle and pathogenicity of head louse	D	4
11.	Study of vectors by whole mountings of mosquito and house fly	E	4
12.	To study rectal parasites of cockroach OR intestinal parasites of hen.	E	4
13.	Estimation of DNA by the DPA(Diphenylamine) Method	E	4
14.	Estimation of RNA by the Orcinol Method	E	4
15.	Restriction digestion of DNA	D	4
16.	Principle & application of the PCR	D	4
17.	Electrophoresis technique for DNA separation/detection.	E/D	4

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Course Articulation Matrix of ZOO-355-MJM: Zoology Practical VI Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	2	3	2	2	2	1	1	2	3	2
CO2	3	3	1	2	3	2	2	2	3	2	1	3	1
CO3	3	3	2	3	3	2	3	3	3	2	2	3	2
CO4	3	2	1	3	3	3	2	2	2	2	2	3	2
CO5	3	3	2	3	3	2	3	3	3	3	2	3	2
CO6	3	3	2	3	3	2	3	3	3	2	2	3	2
CO7	3	3	2	3	3	3	3	3	3	3	2	3	2

PO1 – Comprehensive Knowledge and Understanding

All COs (rated 3) align strongly because each involves both theoretical understanding (e.g., histology, genetics) and interdisciplinary integration across biology, physiology, and molecular science.

PO2 – Practical, Professional, and Procedural Knowledge

High correlation (mostly 3) as every CO directly involves hands-on experimental techniques, following procedural accuracy and ethical handling of biological samples.

PO3 – Entrepreneurial Mindset and Knowledge

Low–moderate correlation (1–2); entrepreneurial aspects are less directly relevant but supported through precision, innovation in techniques, and creative model preparation.

PO4 – Specialized Skills and Competencies

Moderate–high correlation (2–3) since learners demonstrate specialized technical skills like microscopy, chromatography, PCR, and electrophoresis.

PO5 – Capacity for Application, Analytical Reasoning and Problem Solving

High correlation (3) across all COs because interpretation of experimental results, troubleshooting, and drawing physiological correlations reflect analytical reasoning.

PO6 – Communication Skills and Collaboration

Moderate correlation (2–3). Experiments and reports encourage communication and collaborative skill-building during teamwork and presentations.

PO7 – Research-related Skills

Moderate–high correlation (2–3) as methods like PCR, DNA estimation, and Hardy–Weinberg analysis enhance research aptitude and documentation accuracy.

PO8 – Learning How to Learn Skills

Consistently moderate–high (2–3); students engage in independent analytical thinking and adaptation to newer molecular biology tools.

PO9 – Digital and Technological Skills

Present (2–3) in CO2, CO3, CO5, CO6, and CO7 through the use of spectrophotometers, micropipettes, digital electrophoresis visualization, and computational genetics.

PO10 – Multicultural Competence, Inclusion, and Empathy

Low–moderate (1–2); indirectly addressed through teamwork, inclusivity, and collaborative lab environment.

PO11 – Value Inculcation and Environmental Awareness

Moderate (2) in most COs because biosafety, lab waste disposal, and ethical use of specimens uphold environmental and moral responsibility.

PO12 – Autonomy, Responsibility, and Accountability

High (3) correlation: Students must independently plan, execute, and document experiments ensuring responsibility, precision, and accountability.

PO13 – Community Engagement and Service

Moderate (2) correlation where awareness of public health relevance (e.g., vectors, blood grouping, genetic counseling) can extend results to community benefits.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B. Sc.

Semester: VI

Course Type: Major (Elective) Theory

Course Code: ZOO-356-MJE (A)

Course Name: Endocrinology

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives: -

- Understand the fundamental principles of endocrinology, including classification of hormones, mechanisms of action, and feedback regulation.
- Acquire knowledge of the structure, secretions, and physiological roles of major endocrine glands (pituitary, thyroid, parathyroid, adrenal, pancreas, gonads).
- Analyze the hormonal regulation of growth, metabolism, reproduction, and stress responses in animals, with emphasis on human systems.
- Recognize the etiology, symptoms, and physiological basis of major endocrine disorders such as diabetes, thyroid dysfunctions, and adrenal abnormalities.
- Develop an integrated understanding of minor endocrine glands (pineal and thymus) and their role in biological rhythms and immunity.
- Explore applied aspects of endocrinology, including hormone replacement therapy, contraceptives, and clinical diagnosis of endocrine disorders.
- Gain awareness of modern perspectives in endocrinology, including endocrine disruptors and their ecological and health impacts.

Course Outcomes: -

Student will be able to-

CO1: Define and explain the scope of endocrinology; differentiate types of hormones and describe their mechanisms of action.

CO2: Describe anatomy, histology, and hormones of the pituitary, thyroid, parathyroid, adrenal, pancreatic, and gonadal systems.

CO3: Explain hormonal regulation of physiological processes such as growth, reproduction, metabolism, calcium balance, and stress adaptation.

CO4: Correlate endocrine dysfunctions (e.g., gigantism, acromegaly, goitre, Addison's disease, and diabetes mellitus) with their hormonal causes.

CO5: Demonstrate an understanding of minor glands (pineal, thymus) and their significance in circadian rhythms and immune regulation.

CO6: Apply endocrinology knowledge to medical and clinical contexts—hormone assays, replacement therapies, and contraceptive methods.

CO7: Evaluate the impact of environmental endocrine disruptors and discuss emerging trends in endocrinology and human health.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Introduction to Endocrinology		02
	1.1	Definition, scope and significance of endocrinology	
	1.2	General organization of endocrine system	
	1.3	Types of hormones (based on function and chemical nature)	
2	Pituitary Gland		05
	2.1	Anatomy of pituitary gland	

	2.2	Hormones of anterior and posterior pituitary and their functions	
	2.3	Disorders of pituitary gland (Acromegaly, Dwarfism)	
3	Thyroid and Parathyroid Glands		05
	3.1	Structure of thyroid and parathyroid	
	3.2	Hormones of thyroid glands and their functions	
	3.3	Parathyroid hormone and calcium homeostasis	
	3.4	Disorders (Goitre, Hyperthyroidism, Hypothyroidism)	
4	Adrenal Glands		04
	4.1	Structure of adrenal cortex and medulla	
	4.2	Hormones of adrenal cortex and adrenal medulla (Epinephrine, Norepinephrine)	
	4.3	Disorders (Cushing's syndrome, Addison's disease)	
5	Pancreas and Gastrointestinal Hormones		06
	5.1	Structure of pancreas (Islets of Langerhans)	
	5.2	Hormones of pancreas and their functions	
	5.3	Disorders: <i>Diabetes mellitus</i> (Type I & II), Hypoglycaemia	
	5.4	Gastrointestinal hormones – Gastrin, Secretin, (functions only)	
6	Gonadal Hormones		05
	6.1	Testis – Testosterone: secretion and functions, Inhibin: Functions	
	6.2	Ovary – Oestrogen and Progesterone: secretion and functions	
	6.3	Placental hormones (hCG, hPL, Progesterone)	
7	Pineal and Thymus Glands		03
	7.1	Pineal gland – Melatonin and its biological roles	
	7.2	Thymus – Thymosins and their immunological role	

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Course Articulation Matrix of ZOO-356-MJE (A): Endocrinology Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	2	2	3	1	3	2	1	1	2	2	1
CO3	3	2	1	2	1	1	2	2	1	1	1	1	1
CO4	3	1	2	2	3	2	2	2	1	1	3	2	1
CO5	3	2	1	1	3	1	1	3	1	1	2	2	1
CO6	3	1	1	2	3	3	3	3	1	1	2	2	1
CO7	2	2	2	1	1	2	2	1	2	1	1	1	1

PO1: Comprehensive knowledge and understanding

All COs are directly mapped to PO1 because understanding endocrine glands, hormone biosynthesis, mechanisms of action, feedback regulation, and disorders is essential for comprehensive biological knowledge.

PO2: Practical, professional, and procedural knowledge

CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO2 because identifying endocrine glands, analyzing hormonal control of metabolism, reproduction, stress, and growth, and applying diagnostic concepts in endocrinology require professional and procedural knowledge.

PO3: Entrepreneurial mindset and knowledge

CO4 & CO7 are directly mapped to PO3 because knowledge of reproductive endocrinology, stress biology, and molecular endocrinology can be applied in healthcare, diagnostics, and biotechnology entrepreneurship.

PO4: Specialized skills and competencies

CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO4 because mastering knowledge of glandular structure, hormonal pathways, reproductive biology, and feedback regulation requires specialized skills for advanced biological and biomedical research.

PO5: Capacity for application, problem-solving, and analytical reasoning

CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO5 because diagnosing endocrine disorders, analyzing hormonal imbalances, and applying feedback control principles in different physiological states require problem-solving and analytical reasoning abilities.

PO6: Communication skills and collaboration

CO4, CO6 & CO7 are directly mapped to PO6 because interpreting reproductive endocrinology, stress responses, and molecular endocrine techniques involves presenting findings and collaborating in interdisciplinary research.

PO7: Research-related skills

CO2, CO3, CO4, CO5 & CO7 are directly mapped to PO7 because studying hormone actions, endocrine physiology, and molecular techniques (PCR, blotting in endocrinology) requires analytical thinking, research methodology, and experimental validation.

PO8: Learning how to learn skills

CO1, CO2, CO5 & CO6 are directly mapped to PO8 because continuous learning in endocrinology, from classical gland physiology to modern molecular endocrinology, equips students with lifelong learning skills.

PO9: Digital and technological skills

CO7 is directly mapped to PO9 because molecular endocrinology techniques like PCR, blotting, and hormone assays require digital instrumentation and computational tools.

PO10: Multicultural competence, inclusive spirit, and empathy

CO3, CO4, CO5 & CO6 are directly mapped to PO10 because reproductive endocrinology, stress physiology, and metabolic regulation highlight ethical considerations, inclusive healthcare approaches, and empathy in research and clinical practice.

PO11: Value inculcation and environmental awareness

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because understanding endocrine disruptors, safe hormone usage, and environmental impacts of chemicals is crucial for responsible scientific practice.

PO12: Autonomy, responsibility, and accountability

CO2, CO4, CO5 & CO6 are directly mapped to PO12 because studying endocrinology involves independent understanding of glandular functions, responsible application of diagnostic knowledge, and accountability in handling hormonal data.

PO13: Community engagement and service

All COs are directly mapped to PO13 because endocrinology knowledge contributes to community health through awareness of diabetes, thyroid disorders, reproductive health, and stress management.

**SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2025)****Name of the Program: B.Sc. Zoology****Program Code: USZOO****Class: T.Y.B.Sc.****Semester: VI****Course Type: Major (Mandatory) Theory****Course Code: ZOO-356-MJE (B)****Course Name: Basic Entomology****Number of Credits: 02****Number of Teaching hours: 30****Course Objectives:-**

- Define and distinguish the scope of agricultural, medical, veterinary, and forensic entomology, highlighting their importance in various applied biological fields.
- Provide foundational knowledge of insect morphology and anatomy, including tagmosis (head, thorax, abdomen), and the structure and function of key body parts like antennae, mouthparts, compound eyes, legs, and wings.
- Explain the internal anatomy and physiology of insects, focusing on the digestive, circulatory, nervous, and reproductive systems in both male and female insects.
- Introduce the concept of pests, differentiating between various types and understanding the biological and ecological factors that categorize certain insects as pests.
- Study common household and agricultural pests, including their identification, biology, damage symptoms, and basic control strategies — specifically for crickets, cockroaches, ants, bollworms, aphids, pulse beetles, and rice weevils.
- Provide an overview of modern pest control strategies, including chemical, biological, and integrated pest management approaches.
- Introduce basic molecular diagnostic techniques, such as rapid diagnostic tests (RDT), polymerase chain reaction (PCR), and blotting techniques, emphasizing their application in entomology and pest detection.

Course Outcomes:-

Student will be able to-

CO1: Define and differentiate the branches of entomology—agricultural, medical, veterinary, and forensic and explain their practical relevance in real-world biological and environmental contexts.

CO2: Describe the external morphology and segmentation (tagmosis) of insects, and identify and explain the function of major insect body structures such as antennae, mouthparts, eyes, wings, and legs.

CO3: Illustrate and explain the internal anatomy and physiology of insects, including the digestive, circulatory, nervous, and reproductive systems, with attention to differences between sexes.

CO4: Define the concept of pests and classify insects based on their ecological and economic impact, including criteria that make certain species harmful in specific environments.

CO5: Identify common household and agricultural pests, describe their life cycles, damage symptoms, and impacts, and suggest appropriate control methods.

CO6: Evaluate various pest control strategies, including chemical, biological, and integrated pest management (IPM) approaches, and select suitable methods for specific pest problems.

CO7: Demonstrate understanding of basic molecular diagnostic tools, including RDT, PCR, and blotting techniques, and explain their applications in pest and vector detection and management

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Introduction to Entomology:		04
	1.1	Definition & scope of agricultural, medical, veterinary and forensic entomology	
2	Morphology of Insect:		10
	2.1	Head, appendages (mouthparts, antenna), ocellus and compound eye	
	2.2	Thorax, appendages (leg and wing)	
	2.3	Abdomen, appendages (cerci and style)	
3	General Anatomy of Insect:		10
	3.1	Digestive system	
	3.2	Circulatory system	
	3.3	Excretory system	
	3.4	Reproductive system	
	3.5	Nervous system	
4	Introduction to Pest & Pest Control:		06
	4.1	Concept of Pest	
	4.2	Brief study of household pests: cricket, cockroach, housefly	
	4.3	Brief study of agricultural pests: cotton bollworm, aphids, Jowar stem borer	

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Course Articulation Matrix of ZOO-356-MJE (B): Basics Entomology
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	2	2	3	1	3	2	1	1	2	2	1
CO3	3	2	1	2	1	1	2	2	1	1	1	1	1
CO4	3	1	2	2	3	2	2	2	1	1	3	2	1
CO5	3	2	1	1	3	1	1	3	1	1	2	2	1
CO6	3	1	1	2	3	3	3	3	1	1	2	2	1
CO7	2	2	2	1	1	2	2	1	2	1	1	1	3

PO1: Comprehensive knowledge and understanding

All COs are directly mapped to PO1 because understanding insect classification, anatomy, pest identification,

pest control techniques, and molecular diagnostic methods is fundamental for comprehensive biological knowledge in agricultural, medical, and forensic entomology.

PO2: Practical, professional, and procedural knowledge

CO1, CO2, CO3, CO5 & CO7 are directly mapped to PO2 because skills in identifying insect parts, dissecting insect systems, recognizing pest species, and conducting molecular diagnostic methods (RDT, PCR, blotting) are essential practical and procedural competencies in entomological and biological sciences.

PO3: Entrepreneurial mindset and knowledge

CO4 & CO7 are directly mapped to PO3 because knowledge of pest classification and molecular diagnostics can lead to entrepreneurship in fields like agricultural consultancy, integrated pest management services, forensic analysis, and biotech startups focusing on pest detection and control.

PO4: Specialized skills and competencies

CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because mastering insect morphology, internal anatomy, pest classification, and control strategies (chemical, biological, IPM) involves specialized entomological competencies critical for applied biological research and industry roles.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO5 because understanding and applying pest control methods, classifying insects based on ecological impact, and choosing appropriate control measures require analytical thinking and problem-solving abilities in real-world scenarios.

PO6: Communication skills and collaboration

CO4, CO6 & CO7 are directly mapped to PO6 because presenting pest control plans, explaining molecular diagnostic results, and collaborating in interdisciplinary entomological research promote communication, reporting, and teamwork skills.

PO7: Research-related skills

CO2, CO3, CO4, CO6 & CO7 are directly mapped to PO7 because entomological research demands skills in experimental observation, dissection, data analysis, pest behavior studies, and the application of molecular tools in ecological and forensic contexts.

PO8: Learning how to learn skills

CO1, CO2, CO5 & CO6 are directly mapped to PO8 because studying insect structure, identifying pests, and evaluating control techniques contribute to continuous learning and adaptability in agricultural and biological sciences.

PO9: Digital and technological skills

CO7 is directly mapped to PO9 because molecular biology tools like PCR, RDT, and blotting techniques require use of laboratory technology, digital tools, and instrumentation for data collection and analysis in entomology.

PO10: Multicultural competence, inclusive spirit, and empathy

CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because pest management practices, forensic applications, and environmental studies require ethical responsibility, cultural inclusivity, and consideration of diverse community needs.

PO11: Value inculcation and environmental awareness

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because understanding the ecological roles of insects and implementing responsible pest control methods promotes environmental sustainability and ethical scientific practices.

PO12: Autonomy, responsibility, and accountability

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO12 because independently identifying pests, maintaining lab safety during insect dissections, and ensuring accuracy in pest management require a strong sense of responsibility and scientific integrity.

PO13: Community engagement and service

All COs are directly mapped to PO13 because entomological knowledge applied in pest control, disease vector identification, and forensic science serves public health, agricultural sustainability, and community welfare.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Major (Mandatory) Theory

Course Code: ZOO-356-MJE (C)

Course Name: General Embryology

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- To introduce students to the fundamental principles of embryology and developmental biology.
- To provide knowledge of gametogenesis, fertilization, cleavage, blastulation, and gastrulation processes
- To explain the molecular and cellular mechanisms of growth, differentiation, morphogenesis, and induction.
- To study chick embryology as a model system for vertebrate development.
- To create awareness of developmental anomalies and teratogenesis.
- To develop analytical and observational skills through conceptual understanding of embryonic stages.
- To develop critical thinking and comparative understanding of embryological processes across different organisms, highlighting evolutionary and applied perspectives.

Course Outcomes:-

Student will be able to-

CO1: define and explain the scope, concepts, and theories of developmental biology.

CO2: describe the processes of growth, differentiation, determination, morphogenesis, and regeneration.

CO3: illustrate gametogenesis (spermatogenesis & oogenesis), structure of gametes, and types of eggs.

CO4: explain the process of fertilization, including gamete interaction, acrosome reaction, capacitation, activation of ovum, and prevention of polyspermy.

CO5: analyze cleavage patterns, blastula formation, and their significance in embryonic development.

CO6: explain gastrulation movements and the role of primary, secondary, and tertiary organizers.

CO7: describe chick embryology (hen's egg structure, cleavage, primitive streak, and staged development of embryo up to 48h).

TOPICS:

UNIT	SUB UNIT	SYLLABUS	NO. OF LECTURES
1	Introduction to embryology:		03
	1.1	Definition and scope	
	1.2	Theories of Developmental Biology: Preformation, Pangenesis, Epigenesis, Axial gradient and Germ plasm.	
2	Concepts in Developmental Biology:		02
	2.1	Growth, cell determination, differentiation, dedifferentiation, cell communication, morphogenesis, induction and regeneration	
3	Gametogenesis:		05
	3.1	Spermatogenesis: phases & spermiogenesis, Ultra structure of typical sperm.	
	3.2	Oogenesis phases: growth phase- pre-vitellogenesis, vitellogenesis Ovum: general structure Egg membranes: primary, secondary and tertiary.	

	3.3	Types of eggs – based on yolk content and its distribution	
4	Fertilization:		06
	4.1	Concept and types	
	4.2	Attraction of gametes: sperm activation, chemotaxis (fertilizin and antifertilizin), capacitation	
	4.3	Sperm penetration: acrosome reaction	
	4.4	Activation of ovum: fertilization cone, polyspermy prevention: fast block (fertilization potential) & slow block (cortical reaction)	
	4.5	Amphimixis	
5	Cleavage:		02
	5.1	Planes & types of cleavages (holoblastic and meroblastic)	
	5.2	Significance of cleavage	
6	Blastula: Definition and types		01
7	Gastrulation:		05
	7.1	Definition and basic cell movements in gastrulation: epiboly, emboly, convergence, invagination, ingression & involution	
	7.2	Organizer: primary, secondary and tertiary	
8	Chick Embryology:		06
	8.1	Structure of Hen egg	
	8.2	Fertilization and cleavage	
	8.3	Primitive streak development	
	8.4	Development of chick embryo - 24 hours, 36 hours, 48 hours	

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Course Articulation Matrix of ZOO-356-MJE (C) General Embryology **Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	2	2	3	1	3	2	1	1	2	2	1
CO3	3	2	1	2	1	1	2	2	1	1	1	1	1
CO4	3	1	2	2	3	2	2	2	1	1	3	2	1
CO5	3	2	1	1	3	1	1	3	1	1	2	2	1
CO6	3	1	1	2	3	3	3	3	1	1	2	2	1
CO7	2	2	2	1	1	2	2	1	2	1	1	1	1

PO1: Comprehensive knowledge and understanding

All COs are directly mapped to PO1 because understanding embryology—from theories and gametogenesis to fertilization, cleavage, gastrulation, and chick development—forms the foundation of comprehensive developmental biology knowledge.

PO2: Practical, professional, and procedural knowledge

CO1, CO2, CO3, CO5 & CO7 are directly mapped to PO2 because studying spermatogenesis, oogenesis, cleavage, and chick embryo stages requires observation, diagrammatic representation, and practical handling skills essential for developmental biology.

PO3: Entrepreneurial mind-set and knowledge

CO2, CO4 & CO7 are directly mapped to PO3 because understanding morphogenesis, fertilization mechanisms, and embryonic models (like chick embryo) have potential applications in poultry, reproductive biology, and biotechnology entrepreneurship.

PO4: Specialized skills and competencies

CO1, CO2, CO3, CO4 & CO6 are directly mapped to PO4 because mastering the concepts of gametogenesis, fertilization, and gastrulation requires specialized skills in embryology, microscopy, and conceptual modeling.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO5 because interpreting fertilization processes, troubleshooting experimental observations of cleavage, and analyzing gastrulation movements require problem-solving and analytical reasoning.

PO6: Communication skills and collaboration

CO4, CO6 & CO7 are directly mapped to PO6 because discussing fertilization mechanisms, explaining organizer functions, and presenting chick embryo developmental stages strengthen communication and teamwork skills.

PO7: Research-related skills

CO2, CO3, CO4, CO6 & CO7 are directly mapped to PO7 because embryology involves experimental observations, hypothesis testing, and comparative studies, which are essential for research in developmental biology.

PO8: Learning how to learn skills

CO1, CO2, CO5 & CO6 are directly mapped to PO8 because acquiring knowledge of embryological processes (cleavage, blastulation, and gastrulation) builds self-learning and lifelong learning capacity in biological sciences.

PO9: Digital and technological skills

CO7 is directly mapped to PO9 because chick embryology studies require the use of microscopes, imaging techniques, and digital visualization tools for embryonic development stages.

PO10: Multicultural competence, inclusive spirit, and empathy

CO1, CO2, CO3, CO4, CO5 & CO6 are directly mapped to PO10 because embryological studies require ethical research practices, inclusive perspectives on life sciences, and empathy towards developmental anomalies.

PO11: Value inculcation and environmental awareness

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO11 because responsible handling of embryological specimens, awareness of animal welfare, and environmental sensitivity are crucial in developmental biology.

PO12: Autonomy, responsibility, and accountability

CO1, CO2, CO4, CO5 & CO6 are directly mapped to PO12 because independent study of embryonic stages, accurate observation, and responsible documentation enhance accountability in scientific practice.

PO13: Community engagement and service

All COs are directly mapped to PO13 because developmental biology knowledge has applications in animal husbandry, healthcare, reproductive technologies, and educational outreach, benefitting the community.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Minor Theory

Course Code: ZOO-361-MN

Course Name: Agricultural Pests & Management

Number of Credits: 02

Number of Teaching hours: 30

Course Objectives:-

- To understand the fundamental concept of pests, their classification, and their economic importance in agriculture.
- To identify major insect pests of agricultural crops, study their marks of identification, life cycle, nature of damage, and suggest suitable control measures.
- To acquire knowledge of non-insect pests such as crabs, snails, slugs, birds, and squirrels, and their impact on crops.
- To explore and evaluate different pest control practices, including cultural, physical, mechanical, chemical, biological, pheromonal, and autocidal methods.
- To develop an integrated understanding of Integrated Pest Management (IPM) for sustainable agriculture.
- To gain practical knowledge of crop protection appliances such as rotary dusters, knapsack sprayers, and cynogas pumps, and understand their safe operation.
- To analyze the hazards associated with pesticides and learn the use of antidotes and safety measures for environmental and human health protection.

Course Outcomes:-

Student will be able to-

- CO1: explain the fundamental concepts of pests, their classification, and assess their economic importance in agriculture.
- CO2: identify major insect pests of agricultural crops; describe their marks of identification, life cycle, and evaluate their nature of damage with suitable control measures.
- CO3: recognize and analyze non-insect pests such as crabs, snails, slugs, birds, and squirrels, and assess their significance in crop loss.
- CO4: explain and compare different pest control practices, including cultural, physical, mechanical, chemical, biological, pheromonal, and autocidal methods.
- CO5: apply knowledge of Integrated Pest Management (IPM) to develop sustainable and eco-friendly crop protection strategies.
- CO6: demonstrate practical understanding of crop protection appliances (rotary duster, knapsack sprayer, cynogas pump) and evaluate their safe and effective use.
- CO7: analyze hazards of pesticide use; explain safety measures, antidotes, and their role in environmental and human health protection.

TOPICS:

UNIT	SUB UNITS	SYLLABUS	NO. OF LECTURES
1	Introduction to Pests		01
	1.1	Concept of pest	

	1.2	Types of pests	
2	Major insect pest of agricultural importance		14
	Marks of identification, life cycle, nature of damage and control measures of		
	2.1	Jowar stem borer	
	2.2	Red cotton bug	
	2.3	Brinjal fruit borer	
	2.4	Mango stem borer.	
	2.5	Lemon butterfly	
	2.6	Pulse beetle	
	2.7	Rice weevil	
3	Non- insect pest of agricultural importance - Crabs, Snails, Slugs, Birds and Squirrels		05
4	Pest control practices		07
	4.1	Cultural (traditional) control and physical control	
	4.2	Mechanical control and chemical control	
	4.3	Biological control	
	4.4	Pheromonal and autocidal control	
	4.5	Concept of IPM	
5	Crop protection appliances		03
	5.1	Rotary duster, knapsack sprayer	
	5.2	Hazards of pesticides and antidotes	

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5. Singh, R. (2007). *Elements of entomology*. Rastogi Publications.

Course Articulation Matrix of ZOO-361-MN: Agricultural Pests & Management Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	2	1	2	3	2	1
CO2	3	3	1	3	3	1	2	2	1	2	3	2	2
CO3	3	2	2	2	2	1	2	2	1	2	3	2	2
CO4	3	2	2	3	3	2	2	2	1	2	3	2	2
CO5	3	2	1	2	3	1	2	2	1	2	3	2	3
CO6	3	3	1	3	3	3	2	2	2	2	3	3	2
CO7	3	2	2	2	3	2	3	2	2	2	3	3	3

PO1: Comprehensive knowledge and understanding

All COs are directly mapped to PO1 because understanding pest concepts, identification of insect and non-insect pests, their life cycle, damage, and control measures form the foundation of agricultural pest management.

PO2: Practical, professional, and procedural knowledge

CO1, CO2, CO3, CO4, CO5, CO6, and CO7 are mapped to PO2 as they involve practical identification of pests, application of control practices, operation of crop protection appliances, and safety procedures in pest management.

PO3: Entrepreneurial mind-set and knowledge

CO2, CO4, CO5, and CO6 are mapped to PO3 because knowledge of pest management, control practices, IPM, and crop protection appliances can be applied in developing pest consultancy services, agri-entrepreneurship, and eco-friendly farming solutions.

PO4: Specialized skills and competencies

CO1, CO2, CO3, CO4, CO5, and CO6 are mapped to PO4 as pest identification, diagnosis of crop damage, application of control measures, and safe use of pest control equipment require specialized agricultural skills and competencies.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1, CO2, CO3, CO4, CO5, and CO7 are mapped to PO5 as they involve analyzing pest problems, differentiating between insect and non-insect pests, selecting appropriate control measures, and evaluating hazards of pesticides with logical reasoning.

PO6: Communication skills and collaboration

CO4, CO5, CO6, and CO7 are mapped to PO6 because effective pest management requires communication with farmers, agricultural workers, and extension agencies, along with collaborative approaches in implementing IPM strategies.

PO7: Research-related skills

CO2, CO3, CO4, CO5, CO6, and CO7 are mapped to PO7 because studying pest life cycles, evaluating pest control methods, testing crop protection appliances, and analyzing pesticide hazards contribute to agricultural research and innovation.

PO8: Learning how to learn skills

CO1, CO2, CO4, CO5, CO6, and CO7 are mapped to PO8 because continuous updates in pest management strategies, IPM approaches, and safety practices require independent and lifelong learning in agricultural sciences.

PO9: Digital and technological skills

CO6 and CO7 are mapped to PO9 because modern crop protection appliances and pesticide safety monitoring increasingly involve digital technologies, precision tools, and record-keeping systems.

PO10: Multicultural competence, inclusive spirit, and empathy

CO1, CO2, CO3, CO4, CO5, and CO6 are mapped to PO10 as pest management involves working with farmers from diverse cultural backgrounds, promoting inclusive agricultural practices, and developing empathy toward farming communities.

PO11: Value inculcation and environmental awareness

CO2, CO4, CO5, CO6, and CO7 are mapped to PO11 because learning about eco-friendly pest control, IPM, and pesticide hazards fosters environmental responsibility, sustainability, and safe farming practices.

PO12: Autonomy, responsibility, and accountability

CO1, CO2, CO4, CO5, CO6, and CO7 are mapped to PO12 as pest management requires independent decision-making, ethical use of pesticides, and accountability for safe agricultural practices.

PO13: Community engagement and service

All COs are directly mapped to PO13 because pest management knowledge can be applied in farmer training, agricultural extension services, rural development programs, and promoting community-based pest control initiatives.

SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020 (w. e. f. June, 2025)

Name of the Program: B.Sc. Zoology

Program Code: USZOO

Class: T.Y.B.Sc.

Semester: VI

Course Type: Minor Practical

Course Code: ZOO-362-MN

Course Name: Practicals in Agricultural Pests & Management

Number of Credits: 02

Number of Teaching hours: 60

Course Objectives:-

- Understand and recognize the typical symptoms of crop damage caused by major phytophagous insect pests.
- Identify economically important insect pests of vegetable crops (crucifers, tomato, brinjal, chilli, potato, okra, cucurbits, beans, pea, onion), and analyze their nature of damage and control measures.
- Develop skills in differentiating pest species based on morphological features and characteristic damage symptoms.
- Apply practical knowledge for preparation of herbarium of pest-damaged plant parts and preservation techniques for educational and diagnostic purposes.
- Demonstrate proficiency in pest surveillance methods, including field sampling, estimation of insect population, and use of light traps.
- Gain hands-on experience in field visits for collection, identification, and preservation of agricultural insect pests.
- Integrate theoretical knowledge with practical applications for developing eco-friendly and effective pest management strategies.

Course Outcomes:-

Student will be able to-

- CO1: recognize and explain the typical symptoms of crop damage caused by major phytophagous insect pests.
 CO2: identify key insect pests of vegetable crops and evaluate their damage symptoms and control measures.
 CO3: differentiate insect pest species based on external morphology and characteristic feeding/infestation patterns.
 CO4: demonstrate the ability to prepare and maintain herbarium of pest-damaged plant parts and apply preservation techniques.
 CO5: apply pest surveillance techniques such as sampling, insect population estimation, and operation of light traps in crop fields.
 CO6: perform field collection, identification, and preservation of agricultural insect pests with accuracy and scientific handling.
 CO7: formulate and recommend integrated, eco-friendly pest management strategies by combining theoretical knowledge with practical experience.

PRACTICALS:

Practical No.	Name of the practical	E/D	Teaching Hours
1.	Study of typical symptoms of damage caused by various phytophagous pest	D	4
2.	Identification of insect-pests of Crucifers, their nature of damage and	D	4

	control measures – Cabbage butterfly & Cabbage semilooper		
3.	Identification of insect-pests of Tomato, their nature of damage and control measures – Tomato fruit borer & Greenhouse whitefly	D	4
4.	Identification of insect-pests of Brinjal, their nature of damage and control measures – Brinjal fruit borer & Brinjal stem borer	D	4
5.	Identification of insect-pest of Chilli, their nature of damage and control measures - Chilli thrips	D	4
6.	Identification of insect-pests of Potato, their nature of damage and control measures – Potato tuber moth	D	4
7.	Identification of insect-pests of Okra, their nature of damage and control measures – Cotton leaf hopper & Cotton whitefly	D	4
8.	Identification of insect-pests of Cucurbits, their nature of damage and control measures – Fruit fly & Red pumpkin beetle	D	4
9.	Identification of insect-pests of Beans, their nature of damage and control measures – Bean fly & Plume moth	D	4
10.	Identification of insect-pests of Pea, their nature of damage and control measures – Pea pod borer & Pea leaf miner	D	4
11.	Identification of insect-pests of Onion, their nature of damage and control measures – Onion thrips & Onion maggot	D	4
12.	Preparation of herbarium of pest damaged plant parts (Activity based)	E	4
13.	Study of distribution patterns of pest in the crop fields	E/D	4
14.	Study of sampling techniques for the estimation of insect population	D	4
15.	To study the pest surveillance through light trap (Activity based)	E	4
16.	Visit to agricultural field for the collection and preservation of pest (Activity based)	E	4

REFERENCES

1. Smith, E. H. (Ed.). (2012). *Pest control strategies*. Elsevier.
2. Dent, D., & Binks, R. H. (2020). *Insect pest management*. Cabi.
3. Rajendran, T. P., & Singh, D. (2016). Insects and pests. In *Ecofriendly Pest Management for Food Security* (pp. 1-24). Academic Press.
4. Awasthi, V. B. (2017). *Agricultural Insect Pests and Their Control*. Scientific Publishers.
5. Singh, R. (2007). *Elements of entomology*. Rastogi Publications.

Course Articulation Matrix of ZOO-362-MN: Practicals in Agricultural Pests & Management **Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	3	1	1	2	1	1	3	1	1
CO2	3	3	1	3	3	1	2	2	1	1	3	2	1
CO3	3	3	1	3	3	1	2	2	1	1	2	2	1
CO4	3	3	1	3	2	2	2	1	1	1	2	3	1
CO5	3	3	2	3	3	2	3	2	2	1	3	3	3
CO6	3	3	2	3	3	2	3	2	1	1	3	3	3
CO7	3	2	2	2	3	3	3	2	2	2	3	3	3

PO1: Comprehensive knowledge and understanding

All COs are directly mapped to PO1 because recognizing pest damage, identifying insect pests, morphological differentiation, surveillance, collection, and eco-friendly pest management require strong foundational knowledge of entomology and crop protection.

PO2: Practical, professional, and procedural knowledge

CO2, CO3, CO4, CO5, and CO6 are mapped to PO2 since they involve professional skills in pest identification, herbarium preparation, preservation techniques, field collection, and pest surveillance methods essential for agricultural practice.

PO3: Entrepreneurial mind-set and knowledge

CO5, CO6, and CO7 are mapped to PO3 as pest surveillance, scientific collection, and integrated pest management strategies can foster entrepreneurship in agri-consultancy, biocontrol production, and IPM services.

PO4: Specialized skills and competencies

CO2, CO3, CO4, CO5, and CO6 are mapped to PO4 because differentiating pests, preparing herbaria, conducting surveillance, and handling field pests demand specialized entomological skills and laboratory competencies.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO1, CO2, CO3, CO5, CO6, and CO7 are mapped to PO5 as they involve applying entomological knowledge to diagnose pest problems, analyze field infestation, and recommend solutions through IPM strategies.

PO6: Communication skills and collaboration

CO4, CO5, CO6, and CO7 are mapped to PO6 because preparing pest herbaria, performing field surveys, and recommending pest management strategies require clear communication, record-keeping, and teamwork in agricultural extension.

PO7: Research-related skills

CO3, CO4, CO5, CO6, and CO7 are mapped to PO7 since morphological differentiation, specimen preservation, surveillance, and integrated pest management contribute directly to agricultural entomology research and pest management studies.

PO8: Learning how to learn skills

CO1, CO2, CO5, CO6, and CO7 are mapped to PO8 as continuous updating of pest knowledge, learning new surveillance tools, and adaptive management strategies promote lifelong learning in pest management.

PO9: Digital and technological skills

CO5 and CO7 are mapped to PO9 because pest surveillance and IPM practices increasingly require digital tools (light traps, data analysis software, GIS-based pest forecasting, etc.).

PO10: Multicultural competence, inclusive spirit, and empathy

CO7 is mapped to PO10 as recommending eco-friendly pest management requires sensitivity toward farmers' socio-economic diversity, environmental sustainability, and inclusive agricultural practices.

PO11: Value inculcation and environmental awareness

CO1, CO2, CO5, CO6, and CO7 are mapped to PO11 since pest management emphasizes ecological balance, sustainable practices, and responsible pesticide use for environmental safety.

PO12: Autonomy, responsibility, and accountability

CO4, CO5, CO6, and CO7 are mapped to PO12 because herbarium preparation, pest collection, surveillance, and IPM application require independent work, scientific responsibility, and ethical accountability.

PO13: Community engagement and service

CO5, CO6, and CO7 are mapped to PO13 because pest surveillance, collection, and IPM strategies can be directly applied in farmer awareness programs, agricultural extension services, and community-based pest management initiatives.

**SYLLABUS (CBCS) FOR T. Y. B. Sc. ZOOLOGY as per NEP 2020
(w. e. f. June, 2025)****Name of the Program: B.Sc. Zoology****Program Code: USZOO****Class: T.Y.B.Sc.****Semester: VI****Course Type: On Job Training (OJT)****Course Code: ZOO-385-OJT****Course Name: On Job Training****Number of Credits: 04****Number of Teaching hours: 120****Course Objectives:-**

- To provide hands-on experience in the discipline-specific field, enabling students to apply theoretical knowledge to practical, real-world situations.
- To develop professional competencies through direct participation in industrial, laboratory, or field-based work environments.
- To enhance technical and analytical skills required for effective problem-solving, data handling, and decision-making in the chosen area of specialization.
- To foster soft skills and workplace ethics such as teamwork, communication, punctuality, and professional responsibility during the training period.
- To familiarize students with organizational structure and functioning, helping them understand industry standards, workflow, and professional conduct.
- To encourage adaptability and independent learning through exposure to new technologies, techniques, and operational practices.
- To evaluate and reflect on learning outcomes by preparing a comprehensive presentation/report that demonstrates skill acquisition, value addition, and contribution to the training organization.

Course Outcomes:-

Student will be able to-

- CO1: to apply theoretical concepts to real-life situations through hands-on training in laboratory, industrial, or field settings.
- CO2: demonstrate improved professional competencies and technical proficiency relevant to their chosen discipline.
- CO3: capable of analyzing data, identifying problems, and implementing suitable solutions effectively during practical tasks.
- CO4: exhibit enhanced communication skills, teamwork abilities, and professional ethics essential for workplace success.
- CO5: explain the organizational setup, workflow, and operational standards followed in professional establishments.
- CO6: develop adaptability, creativity, and self-learning abilities by working with new tools, technologies, or methods in real-world environments.
- CO7: prepare and present a structured report or presentation showcasing their learning outcomes, skill development, and overall contribution during the training.

Eligibility for On-Job Training Program:

The students who have sought admission to the Graduation of science faculty, (Third Year-Semester -VI) under NEP 2020 (2023 Pattern) need to undergo compulsory 'On-Job Training Program'.

Nature of On-Job Training Program:

A student has to undergo 120 hours of practical training in suitable establishments in consultation with the concerned teacher.

Salient features of On-Job Training Program: The fundamental framework of On-Job Training Program is as below:

- The on-job training is of four credits and hundred (100) marks.
- On-Job Training will be of one hundred and twenty clock hours.
- A student has to complete on-job training in the related subject that he / she has opted in PG.
- The On-Job Training Program has to be completed in the vacation between semester II and III.
- In case of backlog, he/ she can complete the On-Job Training Program prior to appearing for the semester IV examination.
- Successful completion of the On-Job Training Program is mandatory, in case a student could not complete the On-Job Training as per prescribed standards; he/ she have to undergo the Program again in different establishment.
- A student is entitled to a 'Completion Certificate' after successful completion of the On Job Training Program.
- The On-Job Training provider establishment may select the student for regular employment depending on the skill set and nature of performance exhibited by the student.
- A student is solely responsible for his behaviour in the business establishment during the on-job training program.

Framework of the On-Job Training:

- The area in which a student has to undergo On-Job Training Program will be finalized by the concerned teacher in consultation with the On-Job Training Program providing organization.
- This will help a student to have hands - on experience of the important aspects of the Discipline Specific Special Subject chosen by him / her.
- The contents of the On-Job Training Program should be adequate and students should be able to understand various concepts and put it into practice within a time frame of 120 hours.
- On-Job Training Program is of 120 hours net.

Guidelines for Teachers:

Teachers' contribution in planning and implementation of **On-Job Training Program** is very crucial and pivotal. Teachers need to play the crucial role of a guide to make the **On-Job Training Program** a success. Meaningful execution of the **On-Job Training Program** will add a significant value not only to the skillset of students but will enhance institutional image to a significant extent. The National Assessment and Accreditation Council also emphasize **On-Job Training Program** as a part of effective curriculum delivery. The number of students undergoing **On-Job Training Program** will certainly aid colleges to secure better grades during evaluation.

Evaluation and credits:

The process of evaluation of On-Job Training Program is structured as below.

The student will prepare a plan for proposed On-Job Training Program. The plan may contain following aspects: -

Sr. No.	Particulars
1	Name of the organization where the On-Job Training is proposed to be carried out.
2	Details of the organization
3	The areas in which he/ she is planning to undergo On-Job Training.
4	Details of the various subject specific concepts learnt by the student before joining the On-Job Training.
5	Allocation of 120 hours of On-Job Training Program.
6	List of the skills that he/she is planning to acquire during On-Job Training Program.
7	A brief note on how the On-Job Training Program may benefit him/her to develop better skills in his / her subject.
8	Details of the primary discussion that the student had with any officer/ authority of the On-Job Training Program providing organization about the proposed work.
9	Proposed outcome of the On-Job Training Program

Teachers may provide suggestions to make the proposed On-Job Training Program more meaningful for the student.

During – On-Job Training Functions:

Teachers need to contact the On-Job Training providing organizations at regular intervals during the On-Job Training Program to review following matters: -

- a) Regularity / punctuality of student
- b) Behaviour / soft skills
- c) Inclination to learn new things
- d) Ability to put theory into practice
- e) Ability to take initiative for problem solving
- f) Commitment to the assigned task
- g) Overall progress and performance (Whether satisfactory or not)

Process of Evaluation- Semester VI

Methodology for Evaluation:

1. This evaluation is to be done after the student has successfully completed the On-Job Training.
2. The student will prepare a presentation based on the work performed by him/ her during the On-Job Training.
3. The parameters for evaluation are as below:-
 - a. Hard Skills learnt by the student.
 - b. Soft skills / communication skills developed by the student.
 - c. Outcome of the On-Job Training.
 - d. Feedback received from the On-Job Training Providing organization.
 - e. Value addition in the overall knowledge of the student.
 - f. Quality and contents of the presentation.
 - g. Contribution of the student towards the organization.

Format of Slide wise presentation of work performed by the student during the On-Job Training program is given below.

Slide No.	Contents
1.	Name of the organization where the On-Job Training was proposed to be carried out.
2.	Contents proposed to be learnt during the On-Job Training Program.
3.	Allocation of 120 hours of On-Job Training Program.
4.	List of the officers and the staff members of the On-Job Training Providing organization with designations.
5.	Name and designation of the officer under whom the On-Job Training was completed.
6.	Work profile assigned during the On-Job Training Program
7.	Actual work performed during the On-Job Training Program
8.	Skills learnt during the On-Job Training Program
9.	Problems faced while performing the assigned task
10.	How the problems were addressed to
11.	Contribution made towards better functioning the organization, i.e. any techniques invented to save time, manpower or money, improvised documentation process, development of a model for better customer service etc. (Optional)
12.	List of the skills required to perform the assigned task
13.	Opinion of the student about the following – 1. Utility of the On-Job Training 2. Adequacy of the time allotted for program 3. Suggestions for improvement 4. Will the program improve employability? 5. Suggestions to make the On-Job Training program more meaningful and effective 6. Overall feedback about the On-Job Training experience 7. Any other information

Students need to submit following documents at the time of final evaluation of the work performed during the On-Job Training Program:-

1. On-Job Training Completion Certificate (Format Enclosed)
2. Duly signed and completed Log Sheet stating hour wise work done. (Format Enclosed)
3. Feedback form duly signed and stamped by the On Job Training provider organization. (Format Enclosed)
4. Student Feedback form (Format Enclosed)

Evaluation of the Proposal:

- a. The student is supposed to prepare a PowerPoint Presentation covering the above aspects.
- b. The evaluation is to be done on the basis of the
 - i. Regularity and punctuality
 - ii. Actual work performed,
 - iii. Feedback by the On-Job Training providing organisation
 - iv. Nature of contribution made
 - v. Skills learnt
 - vi. Problem solving initiative taken
 - vii. Learning attitude.
- c. The evaluation panel will consist of two examiners. Industry experts may be invited to evaluate the proposal and make suggestion, if any.
- d. Total evaluation of the proposal will be of 100 marks and it carries 4 credits.
- e. Minimum marks required for passing are 40.

Evaluation:

Particulars	Marks
Duration of Training	30
Practical skills	20
Professional Conduct	10
Report based on Training	20
Knowledge assessments through oral presentation	20
TOTAL	100

Formats required for On-Job Training program:

1. Letter to On-Job Training Providing Organisation for inclusion of students.
2. Undertaking from student about his/ her behaviour to the college.
3. Undertaking from student about his/ her behaviour to the organisation.
4. Log Sheet of work performed during On-Job Training.
5. On-Job Training completion certificate.
6. Feedback from On-Job Training provider organisation.
7. Feedback from student.

Course Articulation Matrix of ZOO-385-OJT: On Job Training
Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	<u>3</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>2</u>
CO2	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>2</u>
CO3	<u>2</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>2</u>
CO4	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>
CO5	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>3</u>
CO6	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>
CO7	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>

PO1: Comprehensive Knowledge and Understanding

CO1, CO5, and CO6 are strongly mapped to PO1 as hands-on training exposes students to real-life industrial and laboratory systems, providing broad multidisciplinary knowledge integration.

PO2: Practical, Professional, and Procedural Knowledge

All COs emphasize hands-on experiential learning, professional skills, and procedural adherence, directly aiding their mapping to PO2. The focus on applying theory to practice develops their professional competency.

PO3: Entrepreneurial Mindset and Knowledge

CO2, CO3, CO6 emphasize problem analysis, critical thinking, and creative solutions during on-the-job experience, fostering an entrepreneurial and innovative approach.

PO4: Specialized Skills and Competencies

CO1, CO2, CO6 require technical skills in specific tools, technologies, and task execution essential to their work environments.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

Most COs (especially CO1, CO2, CO3, CO5, CO6) necessitate critical thinking and analytical reasoning in practical scenarios.

PO6: Communication Skills and Collaboration

CO2, CO3, CO4, CO6, CO7 strongly map here due to their focus on teamwork, communication, ethics, and workplace professionalism.

PO7: Research-related Skills

CO3, CO4, CO6, CO7 support research, reporting, and inquiry-driven skills developed through practical training and report preparation.

PO8: Learning How to Learn Skills

All COs encourage lifelong learning, especially CO1, CO2, CO6 that challenge students to adapt and self-learn in dynamic environments.

PO9: Digital and Technological Skills

CO1, CO2, CO6 require familiarity with modern workplace technology and ICT tools.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO4, CO6, CO7 promote collaboration and respect for diversity in professional settings.

PO11: Value Inculcation and Environmental Awareness

CO1, CO2, CO6 include ethics and responsible workplace behaviors.

PO12: Autonomy, Responsibility, and Accountability

Strongly supported by all COs as workplace training demands independent functioning and accountability.

PO13: Community Engagement and Service

CO5 and CO6 highlight understanding organizational impact on community and service through professional work exposure.