B.SC.,
ZOOLOGY
SYLLABUS

FROM THE ACADEMIC YEAR
2023 - 2024

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

CONTENTS

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**B.Sc., Zoology**
Programme Code:	
Duration:	**UG - 3 Years**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

	PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes:	**PSO1 – Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations **PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that complies with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

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PG.Department of zoology

S.NO	PART	SEM	SUB.CODE	PAPER	HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		
								INTERNAL	EXTERNAL	TOTAL
I SEMESTER										
1	Part-I	I	23ULT1/23ULH1	LC-1- Tamil Paper-I /Hindi Paper-I	6	3	3	25	75	100
2	Part-II	I	23ULE1	ELC-1- English Paper-I	6	3	3	25	75	100
3	Part-III	I	23UZO1	CC-I- Invertebrata	5	5	3	25	75	100
4	Part-III	I	23UZO2P	CC-II- Invertebrata Practical	5	5	3	40	60	100
5	Part-IV	I	23UZOSEF1	Foundation Course-I Introduction to Zoology	2	2	3	25	75	100
6	Part-IV	I	23USE1	SEC-1Skill Enhancement Course –I Soft- Skill and Industry Awarness - I	2	2				
II SEMESTER										
7	Part-I	II	23ULT2/23ULH2	LC- II Tamil Paper-II /Hindi Paper-II	6	3	3	25	75	100
8	Part-II	II	23ULE2	ELC-II – English Paper-II	6	3	3	25	75	100
9	Part-III	II	23UZO3P	CC-III-Chordata	5	5	3	25	75	100
10	Part-III	II	23UZO4P	CC-1V – Core Practical-II	5	5	3	40	60	100
11	Part-III	II	23UBTGE1	GE-I Generic Elective Course-I Botany Paper	3	4	3	25	75	100
12	Part-III	II	23UBTGE2P	GE-II Generic Elective Course-II Botany	2	2				100
13	Part-IV	II	23USE2	SEC-I1Skill Enhancement Course –II Soft- Skill and Industry Awarness - II	2	2	3			100
14	Part-IV	II	23UZONMC1	Skill Enhancement Course Nan Mudhalvan Course -I	2	2	3			100
III SEMESTER										
15	Part-I	III	23ULT3/23ULH3	LC-III - Tamil Paper-III /Hindi Paper-III	6	3	3	25	75	100

16	Part-II	III	23ULE3	ELC-III- English Paper-III	6	3	3	25	75	100
17	Part-III	III	23UZO5	CC-V – Cell Biology & Genetics	5	5	3	25	75	100
18	Part-III	III	23UZO6P	CC-VI - Core Practical-III	5	5	3	40	60	100
19	Part-III	III		Generic Elective Course-(Allied Chemistry) Practical Theory	4	3	3			100
20	Part-		23UZOSE4	Soft Skill Common Paper	1	1				
21	Part-IV		23UZONMC2	Skill Enhancement Course Nan Mudhalvan Course -II	2	2				
22	Part-IV			Environmental studies	1	-				
				IV SEMESTER						
23	Part-I	IV	23ULT4/23ULH4	LC-IV - Tamil Paper-IV /Hindi Paper-IV	6	3	3	25	75	100
24	Part-II	IV	23ULE4	ELC-IV – English Paper-IV	6	3	3	25	75	100
25	Part-III	IV	23UZO7	CC-VII – Developmental biology	5	5	3	25	75	100
26	Part-III	IV	23UZO8P	CC-VIII Core Practical-IV	5	5	3	40	60	100
27	Part-III	IV		Generic Elective Course - 4	3					100
28			23UZOGE3	Allied Chemistry Theory						
29			23UZOGE4	Allied Chemistry Practical						
30	Part-	IV	23UZONMC3	Skill Enhancement Course Nan Mudhalvan Course -III	2					100
31	Part-IV	IV	23UVEGS	Value Education & Gender Studies	2	2	3	25	75	100
32	Part-IV		23UES	Environmental studies	1	2	3	25	75	100
				V SEMESTER						
33	Part-III	V	23UZO9	CC-IX –Environmental Biology and Evolution	5	4	3	25	75	100
34	Part-III	V	23UZO10	CC-X – Animal Physiology	5	4	3	25	75	100

36	Part-III	V	23UZO11P	CC-XII Core Practical-V	5	4	3	25	75	100
37	Part-III	V	23UZO12	Project Viva						
38	Part-III	V	23UZOE1A / 23UZOE1B	Discipline Specific Course Animal behavior / Bio instrumentation	4	3	3	25	75	100
39	Part-IV	V	23UZOE2A / 23UZOE2B	Discipline Specific Course Wild life Conservation and Management / Economic Zoology	4	3	3	25	75	100
40	Part-IV	V	23UZONMC4	Skill Enhancement Course Nan Mudhalvan Course -IV	2	2				
41	Part-IV	V	23UIT	Summer Internship / Industrial Training	-	2				
VI SEMESTER										
43	Part-III	VI	23UZO13	CC-XIII – Animal Biotechnology	6	4	3	25	75	100
44	Part-III	VI	23UZO14	CC-XIV –Immunology & Microbiology	6	4	3	25	75	100
45	Part-III	VI	23UZO15P	CC-XV – Practical – VI	6	4	3	25	75	100
46	Part-IV	VI	23UZOE3A / 23UZOE3B	Discipline Specific Elective Course - Nano biology / Ornamental Fish Farming and management	5	3	3	40	60	100
47	Part-IV	VI	23UZOE4A / 23UZOE4B	Discipline Specific Elective Course - Human Reproductive biology / Bio composting for Entrepreneurship	5	3	3	40	60	100
48	Part-IV	VI	23UZONMC5	Skill Enhancement Course Nan Mudhalvan Course -V	2	2	3	25	75	100
49	Part-IV	VI	23UEA	Extension Activity	-	1	3	25	75	100
Total					180	140				4900

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	• Thelowestlevelofquestionsrequirestudentstorecallinformationfromthecoursecontent • Knowledgequestionsusuallyrequirestudentstoidentifyinformationinthetextbook.
Understanding (K2)	• Understandingoffactsandideasbycomprehendingorganizing, comparing, translating, interpolatingandinterpretingintheirownwords. • Thequestionsgobeyondsimplerecallandrequirestudentstocombinedatatogether
Application (K3)	• Studentshavetosolveproblemsbyusing/applyingaconceptlearnedintheclassroom. • Students must use their knowledge to determineaexactresponse.
Analyze (K4)	• Analyzingthequestionisonethatasksthestudentstobreakdownsomethingintoitscomponentparts. • Analyzingrequiresstudentstoidentifyreasonscausesormotivesandreachconclusionsorgeneralizations.
Evaluate (K5)	• Evaluationrequiresanindividualtomakejudgmentonsomething. • Questionstobeaskedtojudgethevalueofanidea,acharacter,aworkofart,orasolutiontoaproblem. • Studentsareengagedindecision-makingandproblem–solving. • Evaluationquestionsdonothavesinglerightanswers.
Create (K6)	• Thequestionsofthiscategorychallengestudentstogetengagedincreativeandoriginalthinking. • Developingoriginalideasandproblemsolvingskills

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background • Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates

		designing of statistical models in the respective sectors
IV	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners / Honors degree**		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

SEMESTER – I- B.Sc., ZOOLOGY

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO01	**INVERTEBRATA**	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To understand the basic concepts of lower animals and observe the structure and functions.
CO2	To illustrate and examine the systemic and functional morphology of various group of invertebrates.
CO3	To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity.
CO4	To compare and distinguish the general and specific characteristics of reproduction in lower animals.
CO5	To infer and integrate theparasitic and economic importance of invertebrate animals

UNIT	Details	No. of Hours	Course Objectives
I	**Protozoa:** Introduction to Classification, taxonomy and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study - ***Paramecium*** - Parasitic protozoans (*Entamoeba*, *Trypanasoma*&*Leishmania*) - Economic importance Nutrition in protozoa - Host-parasitic interactions in *Entamoeba* and *Plasmodium*-Locomotion in protozoa	12	CO1
II	**Porifera:** General characters and classification up to Classes. Type study - **Ascon**- Canal system in sponges and Skeleton in sponges. **Coelenterata:** General characters and classification up to classes – Type study - ***Obelia***- Corals and coral reefs - Polymorphism in Coelenterata, Ecnomic importance in Mesenteries in Anthozoa, and Economic importance of corals and coral reefs.	12	CO2
III	**Platyhelminthes:**Platyhelminthes, Aschelminthes& Annelida Characters & classification (up to class) - Platyhelminthes, Aschelminthes& Annelida with example. Type study – ***Fasciola hepatica, Ascaris lumbricoides, Megascolex,*** General topics:Nematode parasites & their adaptations, Coelom &coelomoducts, Metamerism in Annelida, Filter feeding in Polychaetes.	12	CO3
IV	**Arthropoda:** General characters and classification of Phylum Arthropoda up to Classes. Detailed study: ***Penaeus***	12	CO4

	***indicus*.** Affinities of *Peripatus* – Larval forms in Crustacea – Organization of Centipede and Millipede Mouth parts of Insects, Inscts Pollination and parasites. Insects association with a human diseases; Mosquitoes, Housefiy ,Bedbug, human head louse.		
V	**Mollusca and Echinodermata**. Characters & classification (up to class) - Mollusca and Echinodermata with examples. Type study:Pila globosa, Starfish (Asterias). General topics: Foot and Torsion in Gastropods, Cephalopods as an advanced Mollusc, Economically important Mollusca, Water vascular system in Echinodermata – Larval forms of Echinoderms.	12	CO5
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the basic concepts of invertebrate animals and recall its structure and functions.	PO1
CO2	Illustrate and examine the systemic and functional morphology of various groups of invertebrata.	PO1, PO2
CO3	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	PO4, PO6
CO4	To compare and distinguish the various physiological processes and organ systems in lower animals.	PO4, PO5, PO6
CO5	Infer and integrate the parasitic and economic importance of invertebrate animals.	PO3, PO8

Text Books
(Latest Editions)

1.	Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3.	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.
4	Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrtes 9th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut, 1004 pp.
5.	Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book Depot, Chennai. 400pp.
6.	Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA : Thomson-Brooks/Cole, 928pp.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1.	Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002).

	The Invertebrates: A New Synthesis, III Edition, Blackwell Science	
3.	Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson	
4.	Hyman L.H, 1955. The invertebrates - Vol. I to Vol. VII – Mc Graw Hill Book Co.	
5	Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Miffin and ELBS, London.	
6	Bhamrah,H.S. and Kavitha Junea, 2002. A text book of Invertebrates. Alilnol Publications Private Limited, 4374/4B.Ansari Road, Dayaganj, New Delhi.	
7	Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.	
8	Srivastava, M.D.L and Srivastava, 1969. A text book of Invertebrate Zoology, U.S-Central Book Depot, Allahabad.	
9	Verma, A. Invertebrates: Protozoa to Echinodermata. Narosa Publishing House Private Limited.35-36 Greams Road, Thousand Lights, Chennai.	
10	Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams.	
Web Resources		
1.	https://www.nationalgeographic.com/animals/invertebrates/	
2.	https://bit.ly/3kABzKa	
3.	https://www.nio.org/	
4.	https://greatbarrierreef.org/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S	S	M	S	S	S	M	S
CO 2	M	S	M	S	S	S	M	S
CO 3	M	S	M	S	S	S	M	M
CO 4	S	M	S	S	S	M	M	S
CO 5	S	M	S	S	M	S	S	S

S-Strong M-Medium L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	INVERTEBRATA LAB COURSE	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To identify the different groups of invertebrate animals by observing their external characteristics.
CO2	To understand the organs, organ system and their functions in lower animals.
CO3	To get knowledge about the different modes of life and their adaptation based on the environment.
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.

UNIT	Details	No. of Hours	Course Objectives
I	**Major Dissection:** Cockroach: Circulatory system, Nervous system, Reproductive system. Leech: Nervous System, Reproductive system. Earthworm: Nervous System, Reproductive system. *Pila globosa*: Nervous system. Prawn: Nervous system (including Appendages).	12	CO1
II	**Minor Dissection:** Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts. *Pila globosa*: Digestive system (Including radula). Freshwater Mussel: Digestive system.	12	CO2
III	**Mounting:** Earthworm: Body setae; Pineal setae. *Pila globosa*: Radula. Freshwater muscle: Pedal ganglia.	12	CO3
IV	**Mounting:** Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.	12	CO4

	Spotters:(i).Protozoa: Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax **(ii). Porifera:** Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule **(iii). Coelenterata:** Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula **(iv). Platyhelminthes:** Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus, Taenia solium, Schistosoma haematobium **(v). Nemathelminthes:** Ascaris(Male & Female), Drancunculus, Ancylostoma, Wuchereria **(vi). Annelida:** Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva **(vii). Arthropoda:** Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. **(viii). Mollusca:** Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva **(ix). Echinodermata:** Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Identify and label the external features of different groups of invertebrate animals.	PO1
CO2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.	PO1, PO2
CO3	Differentiate and compare the structure, function and mode of life of various groups of animals.	PO4, PO6
CO4	To compare and distinguish the dissected internal organs of lower animals.	PO4, PO5, PO6
CO5	Prepare and develop the mounting procedure of economically important invertebrates.	PO3, PO8

Text Books (Latest Editions)	
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai

2.	Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.	
3.	Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp.	
4.	Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications.	
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand, 4 97pp.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science.	
2.	Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition. Holt Saunders International Edition.	
3.	Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson	
4.	Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home.	
5.	Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut	
Web Resources		
1.	https://nbb.gov.in/	
2.	http://www.agshoney.com/training.htm	
3.	https://icar.org.in/	
4.	http://www.csrtimys.res.in/	
5.	http://csb.gov.in/	
	https://iinrg.icar.gov.in/	
	https://www.nationalgeographic.com/animals/invertebrates/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	

Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	M	S	M	M	S	S	S
CO 2	M	S	M	S	S	S	M	S
CO 3	S	M	S	S	S	S	M	S
CO 4	S	M	S	S	S	M	M	S
CO 5	M	S	S	S	M	S	S	S

S-Strong M-Medium L-Low

FOUNDATION COURSE

Skill Enhancement Course

INTRODUCTION TO ZOOLOGY

Objectives

- To Identify the external features of different groups of invertebrate animals.
- To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida Arthropoda, Mollusca and Echinodermata

- To understand the organs, organ system and their functions in lower animals
- To acquire a basic knowledge about the principal layers of atmosphere,and the impact of pollution of atmosphere
- To acquire knowledge about the applied fields of Zoology

Unit 1

Systematic and binomial system of nomenclature: Taxonomy, systematic, classification and nomenclature, Systematics: Kingdom Protista- Salient features, examples; Kingdom Animalia-Introduction to different Phyla: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Classification of Chordata.

Unit 2

Animal Physiology and Biochemistry: Introduction to organ systems-Digestive, Respiratory system , Circulatory system, Urinogenital system , Nervous system , Endocrine systems,Reproductive system, Muscular and Skeletal systems.

Unit 3

General structure of Cell: Ultrastructure of Prokaryotic and Eukaryotic cell. Different cell organelles - Endoplasmic reticulum - Golgi bodies – Mitochondria - Lysosome - Nucleus and Nucleolus. Chromosome - Structure of DNA and RNA

Unit 4

Environmental Biology: Principal layers of atmosphere- Exosphere, Thermosphere, Mesosphere, Statosphere, Troposphere. Lithosphere Hydrosphere and Biosphere Environmental issues - Global warming, Green house effects and Acid rain.

Unit 5

Applied Zoology: Aquaculture- Pisciculture, Prawn culture and Pearl culture, Sericulture, Apiculture, Lac culture, Vermiculture and Poultry farming.

	Course Outcomes	
Course Outcomes	On completion of this course, students will;	
CO1	To understand the fundamental concept of invertebrates and vertebrates.	
CO2	To understand and recall the basic structure and to know the different cell organelles in a cell.	
CO3	To understand the basic principal and different layers of atmosphere and ecosystems.	
CO4	To understand various systems in human body and biochemistry of a cell are able to correlate and understand human physiology.	
CO5	To develop knowledge about different culture methods and gain knowledge economic zoology.	

Text Books (Latest Editions)	
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995. A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
3.	Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.
4.	Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.
5.	David B.V and T.J Kumaraswami. 1998. Elements of Economic entomology. Popular Book Depot
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science.
2.	Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) Essential Cell Biology 5th Edn.,(paperback) W.W. Norton & Company p.864

3.	Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.	
4.	Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp.	
5.	David B.V and T.J Kumaraswami. 1998. Elements of Economic entomology. Popular Book Depot.	
Web Resources		
1.	https://nbb.gov.in/	
2.	http://www.agshoney.com/training.htm	
3.	https://icar.org.in/	
4.	http://www.csrtimys.res.in/	
5.	http://csb.gov.in/	
	https://iinrg.icar.gov.in/	
	https://www.nationalgeographic.com/animals/invertebrates/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	M	S	S	S	S	M	S
CO 2	M	S	S	S	S	S	M	S
CO 3	S	S	S	S	M	S	S	S
CO 4	S	S	S	S	M	S	S	S
CO 5	S	S	S	S	M	S	S	S

S-Strong M-Medium L-Low

SEMESTER - II

Course Code CC3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CHORDATA	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To understand the structures and distinct features of Phylum Chordata.
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.
CO3	To understand the economic importance of vertebrates
CO4	To know about the adaptations of vertebrates
CO5	To understand the evolutionary position of different groups of vertebrates

UNIT	Details	No. of Hours	Course Objectives
I	**General Characters and Classification of Phylum Chordata**: Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (*Balanoglossus*), Urochordata (*Ascidia*), Cephalochordata (*Amphioxus*).	12	CO1, CO2
II	**Prochordates and Agnatha**: Characteristics of subphylum vertebrata, Classification of Vertebrata upto Class level, Agnatha (*Petromyzon*), - Pisces (*Scoliodon sorrakowah*) General characters and classification, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance.	12	CO1, CO2, CO4, CO5
III	**Amphibia** : General characters and classification - Origin of Amphibia - Type study - *Rana hexadactyla* - Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.	12	CO1, CO2, CO3, CO4, CO5
IV	**Reptilia** : General characters and classification - Type study – (*Calotes versicolor (endoskeleton of Varanus*) - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification	12	CO1, CO2, CO4, CO5
V	**Aves and Mammalia :** Ayes: General characters and classification – Type study - *Columba livia* - Origin of birds, Flight adaptations, Migration. Mammalia: General	12	CO1, CO2, CO4, CO5

	characters and classification - Type study - Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.		
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.	PO1
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.	PO1, PO2
CO3	Analyze, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5
CO4	Correlate the different modes of life and parental care among different vertebrates.	PO3, PO5, PO6
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO2, PO3, PO5, PO8

Text Books
(Latest Editions)

1.	Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
3.	Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.
4.	Ganguly, Sinha,. Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.
5.	Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
2.	Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
3.	Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.
4.	Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003, 477 pp.

5.	Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp.	
6.	Pough H. Vertebrate life, VIII Edition, Pearson International.	
7.	Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan &Co., New York, 587 pp.	
8.	Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.	
Web Resources		
1.	http://tolweb.org/Chordata/2499	
2.	https://www.nhm.ac.uk/	
3.	https://bit.ly/3Av1Ejg	
4.	https://bit.ly/3kqTfYz	
5.	https://biologyeducare.com/aves/	
6.	https://www.vedantu.com/biology/mammalia	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	S	S	M	S	S	M	S
CO 2	M	S	S	S	M	S	S	M
CO 3	S	S	M	S	S	S	S	S
CO 4	S	S	S	S	S	M	S	S
CO 5	S	S	S		S	S	S	S

S-Strong M-Medium L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CHORDATA LAB COURSE	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To understand the structures and distinct features of phylum chordata.
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.
CO3	To understand and compare the structure of various internal organs in different classes of vertebrates.
CO4	To know about the classification, adaptations and affinities of chordate animals.

UNIT	Details	No. of Hours	Course Objectives
I	**Dissections**:Frog (Demo)/Fish:Externalfeatures,Digestivesystem, Arterialsystem,Venoussystem,5thCranialnerve,9thand10thcranial nerves, Male and female urinogenital system.	12	CO1
II	**Mounting**: Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).	12	CO2
III	**Osteology**:Frog:Skullandlowerjaw,Vertebralcolumn,Pectoral girdle,Pelvicgirdle,Forelimb,Hindlimb.Chelonia-Anapsidskull,Pigeon - skull and lower jaw, synsacrum.	12	CO3
IV	**SpecimenandSlides**:**(i) Hemichordata:** Balanoglossus, Tornaria larva **(ii). Protochordata:** Amphioxus, Amphioxus T.S. through pharynx **(iii). Cyclostomata:** Petromyzon, Myxine, Ammocoetus larva **(iv). Pisces:** Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid **(v). Amphibia:** Ichthyophis, Amblystoma, Siren, Hyla, Rachophous,Bufo,Rana, Axolotal larva **(vi). Reptilia :** Draco, Chemaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. **(vii). Aves:** Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down **(viii).**	12	CO4

	Mammalia: Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog		
V	**Embryology**:StagesinthedevelopmentofAmphioxus,Frogand Chick- Placentain shark and mammals.	12	CO5
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.	PO1	
CO2	Explain the structural organization of various organs and systems in different classes of vertebrates.	PO1, PO2	
CO3	Analyse, compare and distinguish the morphological features and developmental stages of chordates	PO4, PO6	
CO4	Dissect and explain various organs and internal systems in different vertebrates and correlate its function.	PO4, PO5, PO6	
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO3, PO8	
Text Books (Latest Editions)			
1.	Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.		
2.	VermaP.S,2000.AManual ofPracticalZoology:Chordates,S.ChandLimited, 627pp.		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.		
2.	Young, J,Z., 1972. The life of vertebrates. OxfordUni. London.		
Web Resources			
1.	https://www.youtube.com/watch?v=b04hc_kOY10		
2.	https://bit.ly/3CzTEy8		
3.	http://tolweb.org/Chordata/2499		
4.	https://www.nhm.ac.uk/		
5.	https://bit.ly/3Av1Ejg		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test	25 Marks	
	Assignments		
	Seminars		
	Attendance and Class Participation		
External Evaluation	End Semester Examination	75 Marks	
	Total	100 Marks	
Methods of Assessment			

Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	S	S	M	S	S	M	S
CO 2	M	S	S	S	M	S	S	M
CO 3	S	S	M	S		S	S	S
CO 4	S	S	M	S	S	M	S	S
CO 5	S	S	S	S	S	M	S	S

S-Strong M-Medium L-Low

ALLIED ZOOLOGY

ANIMAL DIVERSITY AND ECONOMIC ZOOLOGY

OBJECTIVES:

Animal diversity which is an essential topic for biologists to know the distribution, taxonomy and phylogeny of animal

.To enlighten the primitive forms of invertebrates and vertebrates distribution.

To help our students to understand the status and mode of living of different forms of animals.

To give awarness to our students in various cultural aspects of zoology which will help them to design their future.

UNIT-I

INVERTEBRATA: Outline Classification & General characters of Protozoa and Colenterata

Type study **:** *Hydra vulgaris*

General topics **:** Parasitic Protozoans – *Plasmodium vivax, Trypanosoma gambiense*

UNIT-II

General characters of Aschelminthes and Annelida

Type study **:** *Ascaris lumbricoides*

General topics **:** Parasitic adaptation in Wuchereria bancrafti ,leech (Hirudinia)

-

UNIT-III

General characters of Arthropoda and Echinodermata

Type study **:** Cockroach – (*Periplaneta americana*)

General topics . Larval forms of Echinodermata
Crustacean parasites

UNIT-IV

Vertebrata : Outline Classification and general characters of reptiles, birds and mammals

Type study **:** Rabbit*(Oryctolagus cuniculus)*

General topics **:** Aquatic mammals - Identification of poisonous and non poisonous snakes.

UNIT-V -Economic Zoology

Apiculture **:** Species of honey bees and Honey extraction)

Aquaculture : Indian major carps and Ornamental fish culture (gold fish, black molly and guppies, angel fish, tiger fish).

Sericulture : Mulberry and non mulberry silk worms of India, Uses of silk & by products of silk industry.

Vermiculture :Vermicomposting- preparation of vermibed- nutrient aspect of vermicompost.

TEXT BOOKS:

1.Ganga and Sulochana chetty 2010 – An Introduction to Sericulture .Oxford and IBH publishing Co

REFERENCES:

1. Ayyar, C.K.andT.N.Ananthakrishnan1992. A manual of zoology Vol- I (Invertebrate)

2. Jorden, .L. and P.S. Verma.1995. Chordate Zoology and Elements of animal physiology. S.Chand & Co.

3. David B.V and T.J Kumaraswami. 1998. Elements of Economic entomology. Popular Book Depot.

Course Outcomes:

CO Number	CO Statement
CO1	Familiar with General characters of Protozoa And Coelenterata
CO2	Familiar with General characters of Aschelminthes and Annelida
CO3	Familiar with General characters of Arthropoda and Echinodermata
CO4	Familiar with Outline Classification and general characters of reptiles, birds and mammals
CO5	Familiar with Apiculture ,Aquaculture Sericulture and Vermiculture .

Mapping course outcomes with Programme outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	M	L	L
CO2	S	M	M	M	M	M	L
CO3	S	S	S	S	S	S	L
CO4	S	L	L	M	M	S	M
CO5	M	L	L	L	S	M	M

*S - Strong; M - Medium; L- Low

ALLIED ZOOLOGY PRACTICAL

OBJECTIVES:

Animal diversity which is an essential topic for biologists to know the distribution, taxonomy and phylogeny of animal

.To enlighten the primitive forms of invertebrates and vertebrates distribution.

To help our students to understand the status and mode of living of different forms of animals.

To give awarness to our students in various cultural aspects of zoology which will help them to design their future

INVERTEBRATA:

VIRTUAL DISSECTION

Frog **:** Digestive System& Nervous Systems

Prawn **:** Digestive System& Nervous Systems

DISSECTION

Cockroach - Digestive System& Nervous Systems

MOUNTING

Cockroach **:** Mouth parts

Prawn **:** Appendages

SPOTTERS AND SLIDES

Protozoa

- Paramecium Entire and Paramecium conjugation
- Trypanosoma and Entamoeba

Porifera

- Sycon,Gemmule and Spicules

Coelenterate

- Hydra,Physalia,Obelia medusa and Sea anemone

Platyhelminthes

- Liverfluke, Ascaris (Male & Female) Tapeworm Entire, Scolex, proglottids and Redia Larva

Annelida:

- Nereis Entrie, Parapodium, Heteronereis, Trochophore larva, Chaetopterus and Leech

Arthropoda

- Penaeus , Peripatus, Limulus, Hermit Crab and Sea anemone

Mollusca

- Unio, Chiton and Sepia

Echinodermata

- Starfish, Bipinnaria Larva and Sea Urchin

CHORDATA:

Prochordata:

- Amphioxus and Ascidian

Fishes

- Shark ,Echinus, Exocoetus and Hippocampus

Amphibia

- Bufo, Hyla , and Icthyophis

Reptilia

- Naja Naja, Viper, Draco and Chemaeleon

Aves

- Pigeon, Different types of Feathers

Mammalia

- Rabbit and Bat

Dentition

- Rabbit and Man

Course Outcomes:

CO Number	CO Statement
CO1	Evaluate General characters of theNervous Systems & Digestive System of Cockroach
CO2	Evaluate General characters of theNervous Systems & Digestive System of prawn
CO3	Familiar with the mounting ofMouth partsof Cockroach
CO4	Familiar with the mounting of Appendages of Prawn
CO5	Evaluate General characters of the representative animals of invertebrate and chordate phylums

Mapping course outcomes with Programme outcomes							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	M	L	L
CO2	S	M	M	M	M	M	L
CO3	S	S	S	S	S	S	L
CO4	S	L	L	M	M	S	M
CO5	M	L	L	L	S	M	M

*S - Strong; M - Medium; L- Low

TEXT BOOKS:

1. P.S.Verma: Advanced Practical in Zoology (S.Chand & Co).
2. K.Vijaraman and K.Palanivel: Cheymurai vilangial (Tamil book) : A complete Book (Chimeera)

Course Code CC4	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	CELL BIOLOGY AND GENETICS	Core	Y	-	-	-	4	4	25	75	100

Learning Objectives	
CO1	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
CO2	To understand how these cellular components are used to generate and utilize energy in cells.
CO3	To understand the cellular components underlying mitotic cell division.
CO4	To apply the knowledge of cell biology to selected examples of changes or losses in cell function.

UNIT	Details	No. of Hours	Course Objectives
I	**History of Cell Biology** History - Cell theory – Viruses and Bacteria -Types and Structure - Ultra structure of Animal cell -Tools and Techniques – Homogenization and Centrifugation. Histological techniques – Staining, Cytoplasmic and Nuclear Stains. Microscopes – Compound, Electron and - Light.	12	CO1, CO2
II	**Cell components** - Plasma Membrane - Structure - Models – Functions, Ultrastructure, Composition and Function of Cytoplasm, Endoplasmic reticulam, Ribosomes, Golgi Complex, Lysosomes, Centrioles and Mitochondria**.** Nucleus and Nucleolus - Ultrastructure, Composition and Functions - Nucleolus Cycle - DNA and RNAs.	12	CO1, CO2, CO4, CO5
III	**Cell Divisions and Cell Cycle** - Amitosis, Mitosis and Meiosis and their Significance - Cancer, Biology – Characteristics of cancer cells, types, Ageing of Cells – Apoptosis and Stem cell studies.	12	CO1, CO2, CO3, CO4, CO5
IV	**Mendelian Inheritance:** Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid cross, Interaction of genes: Complete and Incomplete dominance, complementary genes, supplementary genes, lethal genes. **Inheritance:**ABO blood groups - shell coiling, kappa particles; sex linked inheritance –colour blindness and hemophilia in man.	12	CO1, CO2, CO4, CO5

V	**Molecular and Microbial Genetics:** Gene mutation: types, molecular basis of mutation. Human genetics: Karyotype and ideogram; sex determination - Barr body Pedigree analysis, Eugenics, Euphenics, and Euthenics. Recombination in bacteria – Conjugation, Transformation and transduction. Transposable elements technique - operon model.	12	CO1, CO2, CO4, CO5
	Total	**60**	

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	To understand and recall the basic structure, origin,Cell types and microscope.	PO1
CO2	To integrate and assess the development of the cell organelles and cellular basis of organization.	PO1, PO2, PO3
CO3	To analyse and differentiate organisms of cell division and cancer biology.	PO3, PO4, PO5
CO4	Understand the basis of inheritance of genes.	PO2, PO3, PO5, PO6, PO8
CO5	Explain the role of cellular processes and genetic elements which contribute the evalution.	PO3, PO4, PO5, PO6, PO7, PO8

Text Books
(Latest Editions)

1.	Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.
2.	Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.
3.	VeerBala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250 001.
4.	Verma, P.S. and V. K.Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S.Chand & co., New Delhi - 110 055, 567 pp.
5.	Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.
6	Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.
7	Lewin B., 2008. Genes IX, Jones and Bartlett publishers.
8	Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1.	Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) Essential Cell Biology 5th Edn.,(paperback) W.W. Norton & Company p.864.
2.	Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.
3.	Challoner J. (2015) The Cell: A visual tour of the building block of life, The

	University of Chicago Press and Ivy Press Ltd., p.193.
4.	Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi – 110007, 495 pp
5.	Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.
6.	DeRobertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Info med, Hong Kong, 734pp.
7.	Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.
8.	Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609 pp.
9.	Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd., p. 923
10.	Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.
11.	Loewy, A.G. and P.Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., NewDeihi - 110 020, 516 pp.
12.	Mason K.A., Losos J.B. and Singer S.R. (2011) Raven and Johnson's Biology. 9th Edn. Mc Graw Hill publications. p.1406.
13.	Powar, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay - 400 004, 368 pp.
14.	Swansen, C.P. and P.L.Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New Delhi - 110 001, 373 pp.
15.	Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education. p.1080.
16	Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.
17	Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.
18	Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.
Web Resources	
1.	http://www.microscopemaster.com/organelles.html
2.	https://bit.ly/3tXwDSB
3.	https://bit.ly/3tWNpRX
4.	https://bit.ly/3AuYR9M
5	https://go.nature.com/2XE8V1q
6	https://bit.ly/3zoTt6B
7	https://bit.ly/2XAm7oa
8	https://bit.ly/2XEbhxi
9	https://bit.ly/3AB4bso
10	https://bit.ly/39pZSE4
11	https://www.genome.gov/genetics-glossary/Sex-Linked
12	https://www.vedantu.com/biology/mutagens
Methods of Evaluation	

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	S	M	M	M	S	S	S
CO 2	S	S	S	S	S	S	S	S
CO 3	S	S	S	S	S	S	S	S
CO 4	S	S	M	S	S	M	S	S
CO 5	M	M	M	S	S	S	M	S

S-Strong M-Medium L-Low

LAB COURSE- III- CELL BIOLOGY AND GENETICS

Objectives

- This course facilitates to understand the structure at molecular level and function of prokaryote and eukaryote cell.
- To enlighten the students about the structures and functions of cellular organelles and types of cell division.
- To understand the fundamental concepts of genetics, the principles and mechanism of inheritance
- To understand the fundamental concepts of the origin and evolutionary process oforganisms
- To under the functional concepts of genetics, human related genetic problems, inborn errors and genetic counseling

CELL BIOLOGY

- 1.Buccal smear - Preparation of squamous epithelial cells in man
- 2.Onion root tip - Squash preparation to study different stages of mitosis
- 3.Blood smear of Man

Spotters

Tissue - Epithelial, Muscle types, types of Neurons, Micrometer, Camera Lucida.

GENETICS:

- Identification of Blood Group and Rh Factors.
- Identification andRecording of Mendelian traits in humans.
- Drosophila mutants, male and female identification.
- Pedigree analysis, Karyotypes of normal male and female.
- Klinefelter's syndrome, Turner's syndrome and Down's syndrome

Spotters

- a)Drosophilla male and female
  b) Models for DNA, RNA, tRNA Structure and DNA replication.

TEXT BOOKS:

1. Verma, P.S, and Agarwal, V.K. (1998) Concept of Cell Biology, S.Chand & Co Ltd., New Delhi.

2. Power, C.B., 1989 Essentials of Cytology, Himalaya Publishing House.

3. M.L. Gupta and M.L.Jangir, (2011). Cell Biology, Fundamental and applications Agrobios publishers (P) Ltd.
4. Cell and Molecular biology – N.Arunpandi Student publications New Delhi 1

REFERENCES

1.De Robertis, E.D..P. and De Robertis, E.M.F. (1987), Cell and Molecular Biology, VIII

Ed. Lea and Febiger, Philadelphia.

2.Cooper, J.M., Hausman, R.E. 2009. The Cell. Sinauer Associates, Inc., USA

Course out comes

CO Number	CO Statement
CO1	To impart knowledge about the prokaryotic and eukaryotic cell, its complex organization, and the unified role it plays for the ultimate sustainability of the organisms
CO2	Familiar with the mounting ofOnion root tip - Squash preparation
CO3	Familiar with the mounting ofBuccal smear - Preparation of squamous epithelial cells in man
CO4	Understand the core principles of genetics, the historical background, genetic crosses, basic laws governing the pattern of qualitative characters, linkage and crossing over.
CO5	Understand the general concepts of cell biology,geneticsand Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities

Mapping with Programme Outcomes*							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	M	S	S	S	S	S
CO2	S	S	S	S	S	M	M
CO3	S	S	M	S	S	L	S
CO4	M	M	L	M	L	M	M
CO5	S	S	M	L	S	M	L

*S-Strong; M-Medium; L – Low

SEMESTER -IV

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Developmental Biology	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	To create an awarenessto the students about the theories, concepts and basics of Developmental Biology.										
CO2	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.										
CO3	To make an awareness of the induction, organizers and development of extra embryonic structures.										
CO4	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing										
CO5	To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students										

UNIT	Details	No. of Hours	Course Objectives
I	**Gametogenesis & Fertilization** Basic concepts of developmental biology. Structure& types of Spermatozoa, Mammalian egg - Egg membranes. types of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.	12	CO1
II	**Blastulation& Gastrulation** Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation – types of blastula. Morphogenetic movements - Gastrulation of frog & chick.	12	CO2
III	**Organogenesis** Development of Brain, Eye and Heart in frog. Development of Nervous system in chick . Foetal membranes in chick..Development of Pro, MesoMetanephric kidneys.Placentation in Mammals.	12	CO3
IV	**Applied Embryology** Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis –	12	CO4

	Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo		
V	**Human embryology** Reproductive organs, Menstrual cycle and menopause - Pregnancy – trimesters – development. Erythroblastosis foetalis -Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology – Embryo transfer – Amniocentesis.	12	CO5
		60	

Course Outcomes		
CO1	To describe and illustrate the significance of cellular processes in embryonic development.	PO1
CO2	To relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.	PO1, PO2
CO3	To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.	PO4, PO6
CO4	To distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.	PO4, PO5, PO6
CO5	To justify and validate the role of environment and genetics in influencing embryonic development	PO3, PO8

Text Books
(Latest Editions)

1.	Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India
2.	Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India.
3.	Verma, P.S., Agarwal, V. K.2010.Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1.	Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA.
2.	Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK.

3.	Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA.	
4.	Russ Hodge 2010. Developmental Biology, Facts on File, Inc., New York, USA.	
5.	Carlson, Bruce, M. 2009. Human embryology and Developmental Biology, Elsevier, Philadelphia, USA	
Web Resources		
1.	https://www.ncbi.nlm.nih.gov/books/NBK10052/	
2.	https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html	
3.	https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468	
4.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	S	M	S	S	S	S	S
CO 2	M	S	S	M	S	S	S	S
CO 3	S	M	S	S		S	S	M
CO 4	S	M	S	S	S	M	S	M
CO 5	S	M	S	S	M	S	S	S

S-Strong M-Medium L-Low

LAB COURSE- IV – DEVELOPMENTAL BIOLOGY

Objectives:

- Developmental Biology is an experimental science, which provides understanding of the processes of early embryonic development,
- To analyze the mechanisms of development by experimental manipulation of developing embryos and to review current developments in the field of embryology

DEVELOPMENTAL BIOLOGY:

- Frog: Observation of frog's developmental stages – Egg, cleavage, Gastrulation and yolk plug and tadpole stages
- Observation of the developmental stages of chick embryo 24 Hrs, 48 Hrs and 72 Hrs
- Identification of different stages in oesterous cycle
- Slides: T.S. of Mammalian Sperm & Ovary
- Frog /Bull – sperm motility,
- cleavage pattern
- blastula, gastrula
- placentation of mammals

Text Books:

1. Beril., N. J.1974. Developmental Biology. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2. Berry.A.K.2007. An Introduction to Embryology, Emkay Publications, New Delhi-51.

Reference Books:

1. Arumugam.N. 1998. Developmental Biology, Saras Publications,
2. Balinsky, B.I. 1981. An Introduction to Embryology. W.B. Saunders Company. Philadelphia.
3. S.Banerjee, Development Biology, Dominant Publishers, New Delhi
4. Verma, P.S. And Agarwal V.K. 2005. Chordate Embryology (Developmental Biology)

S. Chand&Company Ltd., New Delhi.

5. Veer balarastogi, Developmental biology, Kedarnath Ram nath publishers, meerut.

6. Rastogi, V.B and Jayaraj, M.S. 2002. Developmental Biology KedarNath Ram Nath, Meerut.
7. Twymann, R.M. 2003. Developmental Biology. Viva Books Private Ltd., New Delhi.

COURSE OUT COMES

CO Number	CO Statement
CO1.	Evaluate The mechanisms involved in Enumeration of Blood Group and Rh Factors
CO2.	Analyse and Identification andRecording of Mendelian traits in humans
CO3.	Analysis and Observation of the developmental stages of chick embryo 24 Hrs, 48 Hrs and 72 Hrs
CO4.	Familiarize with the Qualitative test for proteins, lipids and carbohydrates
CO5.	Familiarize with the data analysis.and representation methods used in statistics

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S	S	S	M	S	S	M	S
CO 2	M	S	S	S	M	S	S	M
CO 3	S	S	M	S		S	S	M
CO 4	S	S	M	S	S	M	M	S
CO 5	S	S	M	S	S	M	S	S

S-Strong M-Medium L-Low

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO9	**ENVIRONMENTAL BIOLOGY AND EVOLUTION**	Core	Y	-	-	-	4	5	25	75	100

Learning Objectives	
CO1	To understand the structure and functions of the ecosystem.
CO2	To explain the relationship between biotic and abiotic factors in an ecosystem.
CO3	To know the causes and effects of climate change and habitat loss.
CO4	To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.

UNIT	Details	No. of Hours	Course Objectives
I	**Ecosystem** : Concept of an ecosystem-Structure and function of an ecosystem, Biotic and abiotic factors: light, Temperature-Food chains, food webs, energy flow and ecological pyramids- Types of ecosystem - Forest, Grassland ,Desert and Aquatic ecosystems (pond, estuaries).	12	CO1
II	**Population , Community and Environmental pollution:** Density, Groups, natality, Mortality - indices, control of human population . Biogeochemical cycles. :nitrogen, phosphorous. Environmental pollution: Definition- cause, effects and control measures of: - Air, Water pollution,	12	CO2
III	**Environmental Stresses and Management**: - Bio indicator and biomarkers. Biodegradation and bioremediation **Biodiversity Conservation**: In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Chipko Movement - National Biodiversity Authority. Awareness, Programme, environmental Protection act and. Environmental ethics.		CO3
IV	**Evolution:**	12	CO4

	History of evolution. origin of life, Urey-Miller experiment, Morphological, physiological, embryological, and Paleontological evidences		
V	**Theories of Evolution**: Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's - Mutation theory – Animal colouration and Mimicry Isolating mechanisms - speciation-.. Geological time scale , Evoultion of man..	12	CO5
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the fundamental structure and functions of the ecosystem.	PO1
CO2	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.	PO1, PO2
CO3	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.	PO4, PO6
CO4	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.	PO4, PO5, PO6
CO5	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.	PO3, PO8

Text Books (Latest Editions)	
1.	Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University.
2.	Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.
3.	Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.
4.	Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Odum E.P.1983. Basic Ecology, Saunders, New York
2.	Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.
3.	Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.

Web Resources	
1.	https://bit.ly/2VYWOM5

2.	https://bit.ly/2VZQFiT	
3.	https://bit.ly/3kqdXYA	
4.	https://bit.ly/39rvvgt	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO10	**ANIMAL PHYSIOLOGY**	Core	Y	-	-	-	4	5	25	75	100

Learning Objectives	
CO1	To familiarise students with the principles and basic facts of Animal Physiology
CO2	To give students an insight about the molecular and cellular basis of physiological functions in animals.
CO3	To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.
CO4	To make the students aware about how the structure-function relationships and its synchronisation with the molecular signals.

UNIT	Details	No. of Hours	Course Objectives
I	**Nutrition** – types and mechanism –autotrophic, heterotrophic, importance of carbohydrates, proteins and lipids. Minerals and Vitamins their deficiency. **Respiration** – types, Mechanism of respiration, haemoglobin, Transportation of gases, Bohr effect,	12	CO1
II	**Circulation and Excretion** **Circulation** - Blood- composition and functions, Mechanism of clotting, Structure of human Heart –pace maker – Cardiac cycle – ECG **Excretion** – Structure of human kidney, Nephron structure & mechanism of urine formation,.	12	CO2
III	**Muscle and Nerve** **Muscle -** Ultra structure, types and properties, Muscle contraction mechanism. **Nerve Physiology –** Neurons – structure and types- Impulse propagation, synaptic transmission, neurotransmitters - Reflex action, Nerve disorder – Alzheimer's disease.	12	CO3
IV	**Sense organs** Structure of eye, Physiology of vision, - Eye defects – myopia, hyperopia, , astigmatism, cataract. Structure of ear and mechanism of hearing - Olfactory, gustatory and tactile sense organs.	12	CO4

V	**Reproductive Physiology** Endocrine glands involved in reproduction – Hormones involved in adolescence Puberty, pregnancy, parturition, lactation. Birth control and its types.	12	CO5
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	beabletoexplainhowthevariousorgansystemsarecoordinatedand controlled.	PO1	
CO2	beabletolistthefunctionsofvariousorgansinrelationtophysiologicalprocess.	PO1, PO2	
CO3	be able todeveloptheideaofmultilevelcontrollingandfeedbackmechanisminrelationto various physiological functions.	PO4, PO6	
CO4	beabletounderstandthebasicphysiologicalprocessrelated toadaptation,metabolism and majorrequirements.	PO4, PO5, PO6	
CO5	be able to correlate and understand human physiology.	PO3, PO8	
Text Books (Latest Editions)			
1.	Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.		
2.	Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp		
3.	Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.		
4.	Parameswaran, Ananta krishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p.		
5.	Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp.		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.		
	Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.		
	Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.		
2.	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.		
3.	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise,		

	Agra - 282 003, 966 pp.	
4.	Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi.	
5.	Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp.	
6.	Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.210 pp	
7.	Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Sons, Inc. 1232 pp.	
	Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 pp.	
Web Resources		
1.	https://microbenotes.com/category/biochemistry/	
2.	https://www.stem.org.uk/resources/collection/3931/animal-physiology	
3.	https://animalphys4e.sinauer.com	
4.	https://nptel.ac.in/courses/102/104/102104042/	
5.	https://biochem.oregonstate.edu	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO11P	**ANIMAL PHYSIOLOGY, EVOLUTION AND ENVIRONMENTAL BIOLOGY LAB COURSE**	Core	Y	-	-	-	4	5	25	75	100

Learning Objectives	
CO1	To demonstrate an understanding of core ecological principles, and define scientific principles and concepts as related to environmental studies and sustainability.
CO2	To understand the physiological processes those regulate body functions.
CO3	To strive to demonstrate the role of experimentation in developing our understanding of living animals.
CO4	To attain knowledge of important biomolecules such as carbohydrates, lipids, amino acids, proteins and enzymes.
CO5	Measure and interpret experimental data and demonstrate laboratory skills in animal physiology and ecology.

	Details	**No. of Hours**	**Course Objectives**
	Animal Physiology: 1. Dissolved O_2 consumption by fish. 2. Qualitative test for ammonia, urea and uric acid. **Spotters:** Stethoscope Sphygmomanometer Electro cardiogram (ECG) Spectrophotometer Colorimeter		CO1
	Evolution: **Animal of evolutionary significance**: 1.Peripatus 2.Archaeopteryx **Homologous organ**: Fore limbs of Frog and Whale **Analogous organ** : Wings of insects and Birds **Coloration** :1.Chaemeleon, 2.Lycodon **Mimicry**: a) Leaf insect and Stick insect b) Viceroy and monarch butterfly **Spotters:** 1.Limulus 2.Nautilus		CO2

	3.Ammonite 4.Trilobite		
	Environmental Biology: 1. Estimation of carbon di oxide. 2. Estimation of Salinity. 3. Estimation of Calcium **Spotters:** Reflex condenser, BOD incubator, Thermometer, pH meter, Sechi disc.		CO3
	Total		
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	List and recall the basic equipment used in physiology and ecology lab and develop skill about quantitative determination of biomolecules and quantitative analysis of blood.	PO1	
CO2	Demonstrate the instruments, discuss the clinical importance and its applications, and explain the principle of bioinstruments.	PO1, PO2	
CO3	Understand and identify the chemical composition of major and minor nutrients and analyse Physio - chemical parameters that regulate metabolism.	PO4, PO6	
CO4	Evaluate and Examine the various parameters of haematology and biochemistry and Identify the nitrogenous waste products of animals.	PO4, PO5, PO6	
CO5	Summarise the effect of various physical and chemical factors on enzyme activity/. Compile the changes in various physiological parameters in man and other animals using various tools and techniques.	PO3, PO8	
Text Books (Latest Editions)			
1.	Widmaier, E.P., Raff, H. and Strang, K.T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP.		
2.	Bishop, ML.,Fody, E.P., Schoeff, LE. 2010. Clinical Chemistry: Principles, Procedure, correlations. Wolters Kluwer, Inida, 298 PP.		
3.	Burtis, C.A. and Ashwood, E.R. 2008. Tietztext book of Fundamentals of clinical chemistry and molecular diagnostics, Elsevier, Philadelphia.		
4.	Tortora G.J.&Derrickson B.., 2016. Principles of Anatomy and Physiology, John Wiley and Sons, Inc. 1232 PP.		

5.	Agarwal R A., Anil K Srivastava.,Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 PP.	
6.	Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.	
7.	Michael, P, 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.	
8.	APHA, 1992. Standard Methods for the examination of water and waste water, American Public Health association, Washington D.C.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi., 928 PP.	
2.	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 PP.	
3.	Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London.,342 PP.	
4.	Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 PP.	
5.	Wilson, J.A. 1984, Principles of Animal Physiology, Macmillan Publishing., 426 PP.	
6.	Eugenia, 2008. Environmental Biotechnology and cleavers Bioprocesses, London.	
7.	Ramesh, R & M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.	
Web Resources		
1.	https://bit.ly/3hNyeFN	
2.	https://www.medicinenet.com/alp_test/article.htm	
3.	https://vlab.amrita.edu/?sub=3&brch=63	
4.	https://www.asbmb.org/education/online-teaching/online-lab-work	
5.	https://open.umn.edu/opentextbooks/textbooks/687	
	https://bit.ly/3lO29yP	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	

Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

ANIMAL BEHAVIOUR

Learning Objectives

1. To learn the origin and development of animal behaviour and to understand the influence of genetics, environment on animal behaviours.
2. To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis.
3. To Compare innate and learned behavior and differentiate between various mating system.
4. To impart the knowledge about visual and auditory communication; courtship, mate choice, and mating systems; social behavior and social systems; and animal personality.
5. To discuss how movement and migration behaviors are a result of natural selection.

Unit I: Genetics and Behaviour : Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, , Darwinian fitness.

Unit II: Evolution and Social Behaviour: Sexual selection and strategy. Animal perception, Neural control of behaviour, Sensory processes and perception.

Unit III: Animal and the Environment: Coordination and Orientation, Homeostasis and behaviour. Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning.

Unit IV: Understanding Complex Behaviour: Instinct and learning. Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making., non-verbal communication in human, , Intelligence, tool use and culture.

Unit V: Chronobiology: Organization of circadian system in multi cellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila;. Clock function (dysfunction).

Text Books

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh,1990.ATextBookofAnimalBehaviour,AnomolPublication,293pp.
3. HoshangS.GundeviaandHareGovingSingh,1996.AnimalBehaviour,S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. BiologicalRhythms. NarosaPublishingHouse, Delhi.

Suggested Readings

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

Web Resources

1. https://www.ncbs.res.in/content/animal-behaviour
2. https://bit.ly/3i6wUxR
3. https://www.behaviour.univie.ac.at/
4. https://www.ru.nl/bsi/

Course Outcomes (COs)

1. Recall and record genetic basis and evolutionary history of behaviour.
2. Classify movement and migration behaviors and explain environmental influence upon behaviour.
3. Analyze and identify innate, learned and cognitive behavior and differentiate between various mating systems.
4. Assess complexity involved in behavioural traits and evaluate hormones and their role in aggression and reproduction.
5. Discuss the rhythmicity of behavioural expressions and the scientific concepts in behavior and behavioral ecology.

BIOINSTRUMENTATION

Course outcomes

1. To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
2. To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
3. To study the working principle of different bioinstrumentation and their applications.
4. To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.

Unit I:Good Laboratory Practices : Guide lines, Laboratory symbols; Cleaning and sterilization of lab ware and reagents; handling and care of laboratory animals; Laminar flow hood: types and use ,preparation of solutions of a particular molarity and percentage; Buffers: definition and preparation of buffers, pH meter; Safety and ethical issues in laboratory settings

Unit II: Microscopy - Light microscope, SEM, TEM, Atomic force microscope;; Fluorescence activated cell sorting; X-ray crystallography.

Unit III: Centrifugation - working principle and types of centrifugation; Spectrophotometry; Mass spectrometry; Chromatography - principle and types of chromatography: Paper chromatography, HPLC, and TLC

Unit IV: Biomedical Instrumentation : ESR measurement, haemoglobin measurement, blood pressure, blood flow, ECG, cardiac pacemakers; X- ray imaging, CT scan; Ultrasound imaging; medical applications of laser; Biosensors - glucose biosensor, alcohol biosensor, , environmental biosensors, , DNA biosensor.

Unit V: Molecular Techniques : Isolation of DNA from animal tissue, Electrophoresis of DNA and proteins; Polymerase chain reaction; ELISA; Immunofluorescence; Fluorescent in situ hybridization; Southern and Western blotting.

Text Books

1. SabariGhosal and Anupama Sharma Avasthi, 2018. Fundamentals of Bioanalytical Techniques and Instrumentation, 2nd Ed., Phi Learning Pvt. Ltd., New Delhi, India.
2. Veerakumari L., 2015. Bioinstrumentation, MJP Publishers, Chennai, India.
3. Prakash Singh Bisen, Anjana Sharma, 2012. Introduction to Instrumentation in Life Sciences, CRC Press, Taylor & Francis Group, New York, USA.
4. Gupta P.C., 2010. Biological Instrumentation and Methodology (Tools & Techniques), S. Chand & Company Limited, New Delhi, India.
5. Ghatak K. L., 2010. Techniques and Methods in Biology, Phi Learning Pvt. Ltd., New Delhi, India.

Suggested Readings

1. Sue Carson, Heather Miller, Melissa Srougi and Scott Witherow, 2019. Molecular Biology Techniques: A Classroom Laboratory Manual, Academic Press, New York, USA.
2. Aysha Divan, Janice Royds, 2013. Tools and Techniques in Biomolecular Science, Oxford Univeristy Press, UK.
3. Gordon M.H., Macrae R., 2012. Instrumental Analysis in the Biological Sciences, Blackie & Son Ltd., UK
4. Leonard Davis, Mark Dibner and James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., New York, USA.
5. Wilson, K.M. and Walker, J.M., 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.

Web Resources

1. https://bit.ly/3i5flym
2. https://pbiol.rsb.org.uk
3. https://www.nature.com/subjects/biological-techniques
4. https://www.ibiology.org

Course outcomes (COs)

1. To describe and explain the steps in the use of various biological instrumentation that are used in the study of different animal specimens.
2. To relate the applications of biological techniques and employ them for the study of cells, tissues and genetic material.
3. To correlate and appraise the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
4. To compare the working principle of different bioinstrumentation and to summarize their applications.
5. To devise experiments and justify them with the understanding of the underlying principles of bioinstrumentation that are ecofriendly, ethical and have national and global relevance.

WILDLIFE CONSERVATION AND MANAGEMENT

Learning Objectives

1. To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.
2. To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations.
3. To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.
4. To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of endangered species.
5. To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.

Unit I: Biodiversity Extinction and Conservation Approaches :

Perspectives and Expressions. Identification and prioritization of Ecologically sensitive area (ESA). Regional and National approaches for biodiversity conservation.

Unit II: Theory and Analysis of Conservation of Populations :

Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity. Population viability analysis-conceptual foundation. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species.

Unit III: National and International Efforts for Conservation :

International agreements for conserving marine life, Convention on wetlands of International Importance (Ramsar convention), Conservation of Natural Resources. Overview of conservation of Forest &Grassland resources. CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972.

Unit IV: Wildlife in India:

Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves. Community Reserve and conservation Reserves.

Unit V: Management of Wildlife:

Distribution, status. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wild life Trade & legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics.

Text Books:

1. Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York, p 478.
2. Aaron, N.M.1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.
3. Dasmann R F, 1964. Wildlife Biology, John Wiley & Sons, New York, p 231.
4. Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun.
5. Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi.
6. Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science.
7. Caughley.G and Sinclaire, A.R.E 1994 Wildlife ecology and management. Blackwell Science.
8. Woodroffe R, Thirgood, S. and Rabinowitz A. 2005.People and Wildlife, Conflict or Co exsistence? Cambridge University.
9. Sinha, P.C. 1998. Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi.
10. Singh, S.K, 2005. Text Book of Wildlife Management. IBDC, Lucknow.

Suggested Readings

1. Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
2. Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
3. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and SubhenduMazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India.
6. Gopal, Rajesh,1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
7. Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.

8. Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
9. Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi.
10. Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press.

Web resources

1. https://bit.ly/39oPj44
2. https://bit.ly/3lHdEYJ
3. https://bit.ly/3CwBCfY
4. https://bit.ly/3EDYr3a
5. https://bit.ly/3tVtG4U

Course outcomes (COs)

1. To understand and recall the importance of wildlife, extinction and Conservation Approaches of wildlife.
2. To integrate and assess the National, international approaches for biodiversity conservation.
3. To analyse and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.
4. To explain the role PVA models, Wildlife conservation approaches, and limitations.
5. To construct and simulate National and International strategies for Conservation, Wild life laws and ethics.

ECONOMIC ZOOLOGY

Learning Objective

1. To understand the culturing techniques and production methods of different farm animals.
2. To know the life history of animals and disease control methods used in farming.
3. To understand the concept of breeding, cross breeding and the importance of high yield varieties.
4. To know about the marketing strategies.

Unit I:Economic Entomology : Apiculture: Species of honey bees – Social organisation of honey bee – selection of bees and location for apiary – Newton's bee hive – products of bee keeping – enemies and diseases of honey bees. Sericulture: Species of silkworm – life history of mulberry silkworm – Rearing of silkworm – pests and diseases of silkworm.

Lac Culture: Introduction – Life history – Host plants – cultivation of Lac – Enemies of lac insect– Economic importance of Lac.

Unit II: Vermiculture : Introduction: Types of earthworms – ecological classifications of earthworms – Physical, chemical and biological changes caused by earthworms in the soil – Natural enemies of earthworms. Vermicomposting: vermicomposting methods – factors affecting vermicomposting –Vemiculture unit. Harvesting of vermicompost – vermicast – advantages of vermicompost – vermiwash and its applications.

Unit III: Aquaculture : Fresh water aquaculture: Carp culture – types of ponds – preparation – maintenance – harvesting and management. Integrated and composite culture. Prawn culture. Marine Aquaculture: Edible – pearl oyster culture. Ornamental fish culture: Aquarium fishes – Aquarium maintenance in home.

Unit IV: Poultry Farming : Poultry industry in India – Poultry for sustainable food production and livelihood - Commercial poultry farming – Nutritive value of egg and meat-Broiler management (Definition; Housing and equipment; Brooding, feeding and health cover of broilers; Record keeping; Broiler integration) – Layer management (Brooder; Grower and layer management; Culling of layers; Marketing of eggs and meat). Women in backyard poultry farming.

Unit V: Dairy Farming : Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common contagious diseases. Milk - Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.

Text Books

1. Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4thEd.Kalyani Publishers, New Delhi.
   Mary violet Christy, A. 2014. Vermitechnology, MJP Publishers, Chennai.
2. ICAR, 2013. Hand book of Animal Husbandry, 4th Ed., ICAR Publication, Pusa, New Delhi.
3. Awasthi, V.B., 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.
4. Vasanthraj David, B and Ramamurthy, VV., 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
5. Shukla &Upadhyay, 2014. Economic Zoology, 5th edn. Rastogi Publication, Meerut New Delhi.
6. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
7. ShailendraGhosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
8. David, B and Ananthakrishnan, T. N., 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
9. Jagadish Prasad, 2002. Principles and practices of Dairy Farm Management, 3rd Ed. Kalyani Publishers, Ludhiana.
10. Sukumar, D.E., 2002. Outline of Dairy Technology, Oxford University, New Delhi.
11. Rath, R.K., 2000. Freshwater Aquaculture. Scientific Publishers (India), Jodhpur.
12. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
13. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
14. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

Suggested Readings

1. Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.
2. Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominent, New Delhi.
3. Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India.
4. Talashikar, S.C., 2008. Earthworms in Agriculture, Agrobios, India.
5. Abishek Shukla, D ., 2 0 0 9 . A Hand Book of Economic Entomology, Vedamse Books, New Delhi .
6. Banerjee, G.C., 2006. Text book of Animal Husbandry 8thEd.Oxford and IBH Publishing Company Ltd., New Delhi.
7. Walstra, P. Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.
8. Dunham, R.A., 2004. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.

9. Donald.D Bell and William. D. Weaver, 2002. Commercial chicken meat and egg production, Springer, New York.
10. Eckles C.H. and Anthony, E.L., 2001. Dairy Cattle and milk production, Biotech. Tata McGraw Hill Publishing Co.Pvt.Ltd., New Delhi.
11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
12. ICAR, 1997. Handbook of Animal Husbandary– The Indian Council of Agricultural Research, New Delhi.
13. Banerjee G.C., 1992. Poultry, Oxford and IBH, New Delhi.
14. Jhingran, AVG, 1991. Fish and Fisheries of India. Hindustan Publishing Co. New Delhi.
15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
16. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

Web Resources

1. https://bit.ly/3tXHjk8
2. https://bit.ly/3tUTHBu
3. https://bit.ly/3hVv96q
4. https://bit.ly/39nztH1
5. https://bit.ly/3CzasVO
6. https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
7. https://bit.ly/3nYvgSF
8. http://caa.gov.in/farms.html
9. http://www.csrtimys.res.in/
10. http://www.agshoney.com/training.htm

Course Outcomes (COs)

1. To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.
2. To assess and integrate the available tools and techniques to increase the productivity in farms.
3. To analyse the pros and cons of different methods of farming and marketing strategies of products.
4. To evaluate the use of available resources in improving the breeds, vermicomposting, farm products etc..
5. To design new methods to improve farm animals with increased productivity and disease resistance and to construct new methods in vermicomposting.

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO13	**ANIMAL BIOTECHNOLOGY**	Core	Y	-	-	-	4	6	25	75	100

Learning Objectives	
CO1	To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.
CO2	To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.
CO3	To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.
CO4	To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods

UNIT	Details	No. of Hours	Course Objectives
I	**Fundamentals of Biotechnology** : Animal cell culture: Basic requirements for animal cell culture, natural and synthetic culture media, Stem cells: types. r-DNA technology: Enzymes; Vectors – pBR322, Cosmid, BAC, YAC; Host cells; Gene cloning: steps in cloning, selection of clones – chromogenic substrate, antibiotics.	12	CO1
II	**Techniques in Animal Biotechnology**: Isolation and purification: DNA; Southern blotting; DNA sequencing: Sanger method, microarray; PCR: principle, types and application; Gene library; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.	12	CO2
III	**Transgenic Animal Technology**: Transgenesis: Concept, transgenic animal models- sheep. Applications of transgenesis, Transgenic fishes: Molecular farming, and animals as bioreactors.	12	CO3

IV	**Animal Biotech and Health Care**: Medical biotechnology: Monoclonal antibodies, recombinant vaccines –hepatitis B vaccines, hormones – insulin. Molecular markers: RFLP, RAPD, DNA fingerprinting and application.	12	CO4
V	**Applications and Ethics** : Human genome project: Industrial biotechnology: Bioreactors - Basic concepts of fermentation, bioreactor design, production of ethanol Ethics: Socio ethical problems in biotechnology	12	CO5
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.	PO1	
CO2	To develop and explain the protocols for genetically manipulating cells and produce transgenic animals	PO1, PO2	
CO3	To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.	PO4, PO6	
CO4	To choose the correct methods of transgenesis and to consider their use in improving animal husbandry nationally and globally	PO4, PO5, PO6	
CO5	To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.	PO3, PO8	
Text Books (Latest Editions)			
1.	Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.		
2.	Sasidhara, R., 2015. Animal biotechnology, MJP publishers.		
3.	Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.		
4.	Dubey S. K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.		
5.	Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication.		
6.	Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi.		

7.	Sambamurthy K., Ashutosh Kar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd.	
8.	Ramdoss P.,2009. AnimalBiotechnology- Recent concepts and developments, MJP publishers.	
9.	Sathyanarayran U., 2008. Biotechnology, Books and Allied, Kolkata.	
10.	Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.	
11.	Rastogi S. C., 2007. Biotechnology: Principles and applications, Alpha Science publishers. Ranga, M.M., 2003. Animal biotechnology, Agrobios, New Delhi.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Veer Bala Rastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA.	
2.	Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.	
3.	Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA.	
4.	Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.	
5.	Ramawat, K.G and Shailey Goyal, 2009. Comprehensive biotechnology, S.Chand company, New Delhi, India.	
6.	Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley- Blackwell, UK.	
7.	Primrose S. B., 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.	
8.	Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK.	
Web Resources		
1.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/	
2.	https://www.isaaa.org/resources/publications/pocketk/40/default.asp	
3.	https://www.ncbi.nlm.nih.gov/books/NBK207574/	
4.	https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf	
5.	https://go.nature.com/3zAZmO9	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	

Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO14	**IMMUNOLOGY AND MICRBIOLOGY**	Core	Y	-	-	-	4	6	25	75	100

Learning Objectives	
CO1	To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system.
CO2	To list basic mechanisms that regulate immune responses, describe the main steps in the generation of cells and organs of the immune system.
CO3	To describe the basic mechanisms that provides innate immunity and antigen processing and presentation.
CO4	To differentiate B and T cell receptors, organs, and microenvironments of the Immune System.
CO5	To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology.

UNIT	Details	No. of Hours	Course Objectives
I	**Immunology:** **Immune Cells and Organs**: Overview of Immune System - General concepts and Haematopoiesis. Cells of the immune system - T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, Eosinophils, and basophils. Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow; Secondary Lymphoid organs - Lymph nodes and spleen. Bursa of fabricius	12	CO1
II	**Types of Immunity:** Innate Immunity; Anatomical barriers, Inflammatory response, Cells and molecules involved in innate immunity,. Adaptive immunity: Receptors and Signaling: Cytokines and Chemokines. Major Histocompatibility Complex (MHC): Inheritance of the MHC.	12	CO2
III		12	CO3

	Antigen and Antibodies: Antigens- Antigenicity and immunogenicity: Properties -foreignness, molecular size, heterogeneity. Antibodies: Structure, properties and functions of the Immunoglobulins, Hybridoma technology - production of monoclonal antibodies. **Hypersensitivity and Autoimmune Diseases**: Hypersensitivity: classification and brief description of various types. Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases.		
IV	**MICROBIOLOGY** **Introduction to microbiology -** History, scope, branches of microbiology. Contribution of Leeuwanhoek, Jenner, Pasteur, Iwanowsky. Evolution of Microbial diversity. Systematic position: 5 kingdom classification of Whittaker and 3 kingdom classification of Carl Woese. **Microscopy -** Principles of microscopy - Compound microscope (Monocular and Binocular microscopes) – Dark field, Phase contrast and Fluorescence microscopes, Electron microscopy – TEM and SEM – principle, construction, ray diagram and uses.	12	CO4
V	**Bacteriology and Virology** **Bacteriology -** Classification of bacteria. General characteristics of purple bacteria and green bacteria. Oxygenic photosynthetic bacteria- General characteristics of Cyanobacteria – external features- Types of staining. **Virology -**Virus Structure and Classification. Positive-strand RNA viruses: Picornaviruses, Togaviruses, and Coronaviruses. Negative-strand and double-strand RNA viruses: Paramyxoviruses, Rhabdoviruses, Filoviruses, DNA viruses: Parvoviruses, Polyomaviruses, Adenoviruses and Herpes viruses and Poxviruses.	12	CO5
	Total	**60**	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		

CO1	Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation.	PO1
CO2	Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations.	PO1, PO2
CO3	Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production	PO4, PO6
CO4	Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases.	PO4, PO5, PO6
CO5	Summarize immune responses against pathogens	PO3, PO8
Text Books (Latest Editions)		
1.	Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.	
2.	Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing,USA, 576 pp.	
3.	Coleman,R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc Graw Hill Education India, 357 pp.	
4.	Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp.	
5.	Rao.C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.	
2.	Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.	
3.	William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.	
4.	Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.	
Web Resources		
1.	https://www.aaaai.org/	
2.	https://www.bsaci.org/	
3.	https://www.immunology.org/	
4.	https://nptel.ac.in/courses/102/103/102103038/	
5.	https://microbenotes.com/category/immunology/	
Methods of Evaluation		

Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UZO15P	**IMMUNOLOGY, MICRBIOLOGY AND BIOTECHNOLOGY – LAB**	Core	Y	-	-	-	4	6	25	75	100

Learning Objectives	
CO1	To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system.
CO2	To list basic mechanisms that regulate immune responses, describe the main steps in the generation of cells and organs of the immune system.
CO3	To describe the basic mechanisms that provides innate immunity and antigen processing and presentation.
CO4	To differentiate B and T cell receptors, organs, and microenvironments of the Immune System.
CO5	To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology.

	Details	**No. of Hours**	**Course Objectives**
	IMMUNOLOGY 1.Total counting of RBC and WBC using by Haemocytometer 2.Differential count of WBC 3.Aggulations of reaction of VDRL,RPR,CRP **SPOTTERS** 1.Primary lymphoid organs - Thymus and bone marrow, Bursa fabricius 2.Secondary Lymphoid organs - Lymph nodes and spleen 3. Structure of antibodies (IgA, IgD, IgE, IgG, IgM)	12	CO1
	MICRBIOLOGY 1.Identification of Gram positive and negative bacteria by gram staining 2.Serial dilution technique 3.Plating techniques (pour plate and spread plate)	12	CO2

	4.Streaking techniques (Primary, secondary, tertiary and quadrant streaking and zigzag streaking,) **SPOTTERS** Autoclave, Petriplate, Inoculation Loop and Needle, Laminar flow Chamber and Hot air oven		
	BIOTECHNOLOGY- 1.Isolation of animal DNA (SSC method) 2. Isolation of plasmid DNA from bacteria **SPOTTERS** Plasmids (pBR322 and pUC18), Agarose gel electrophoresis, Southern and Western blotting, Fermentor, Eppendroff tubes, Nitrocellulose membrane	12	CO3
	Total	**60**	

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation.	PO1
CO2	Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations.	PO1, PO2
CO3	Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production	PO4, PO6
CO4	Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases.	PO4, PO5, PO6
CO5	Summarize immune responses against pathogens	PO3, PO8

Text Books
(Latest Editions)

1.	Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.
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3.	Coleman,R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc Graw Hill Education India, 357 pp.
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2.	Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.	
3.	William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.	
4.	Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.	
Web Resources		
1.	https://www.aaaai.org/	
2.	https://www.bsaci.org/	
3.	https://www.immunology.org/	
4.	https://nptel.ac.in/courses/102/103/102103038/	
5.	https://microbenotes.com/category/immunology/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
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Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

NANOBIOLOGY

Learning Objectives:

This course provides knowledge about the basic concepts of nanobiology.The learners will be able to acquire skills in the assembly, design and types of nanomaterial's and nanoparticles, They will be able to appreciate the applications of nanobiology in diverse fields.

Course outcomes (Cos)

Students will be able to:

- Understand basics of Nano-science and Nano-biology.
- Gain knowledge on nanomaterial and nanoparticles.
- Know the biological applications of nanomaterials and nanoparticles.
- Apply their knowledge in their career development in higher education, research and development.

Unit-I: Nanobiology- Definition-concepts and scope. History of nanotechnology and nanoscience in Nature; Structure and Properties of nanomaterials: size, surface charge, conductivity.

Unit-II: Synthesis and characterization of nanomaterials, Fabrication of nanostructures, Metallic nanoparticles, biopolymeric nano-structures and nanoparticles.

Unit-III: Composition and functional properties of nanostructures: Protein and peptide-based nanostructures, carbohydrate and nucleic acid based nanomaterials; Use of gold,silver and other metallic nanoparticles.

Unit-IV: Strategies to design biologically active nanostructure-based biomaterials. Interaction of nanoparticles with biomolecules to study their conformational and functional properties.

Unit-V: Biological Applications of Nanomaterials – biomaterials - Immobilized enzymes - drug delivery systems – Biosensors - Cellular imaging tools.

References

1. Pradeep, T. (2017) The Essentials: Understanding Nanoscience and Nanotechnology: McGraw-Hill Education.

2. Phoenix, D.A. and Ahmad, W (2014) Nanobiotechnology. One Central Press Ltd

ORNAMENTAL FISH FARMING & MANAGEMENT

Learning Objectives:

- To highlight the importance of ornamental fish culture in relation to entrepreneurship development.
- To enable the identification, culture and maintenance of commercially important ornamental fishes.
- To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.

Unit I:
Introduction to ornamental fish keeping.
Scope and importance of ornamental fish culture.
Domestic and global scenario of ornamental fish trade and export potential.
Commercially important ornamental fishes - Indigenous and exotic varieties.

Unit II:
Biology of egg layers and live bearers.
Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture.
Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg. Guppy).

Unit III:
Aquarium design and construction; Accessories - aerators, filters and lighting.
Aquarium plants and their propagation.
Maintenance of aquarium and water quality management.
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Unit IV
Conditioning, packing, transport and quarantine methods.
Economics, trade regulations, domestic and export marketing strategies.

Unit V
Disease and management
Ornamental fish diseases, their prevention, control and treatment methods

.

References:
1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi.
2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi.
3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi.
4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya Publishing House, New Delhi.

Web links:

1. **http://ecoursesonline.iasri.res.in/course/view.php?id=297**
2. **https://www.ofish.org/**
3. **https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/**
4. https://99businessideas.com/ornamental-fish-farming/

Course Outcome:

- The students will be able to identify, culture, maintain and market the commercially important ornamental fishes.
- The knowledge and skills gained on the different aspects of ornamental fish keeping will enable the students to develop entrepreneurship potential and help in self employment.

HUMAN REPRODUCTIVE BIOLOGY

Learning Objectives:

- To enable students to understand the endocrine structures and hormones associated with the physiology of reproductive system
- To enable students to learn about the male reproductive system and accessory glands and regulation
- To enable students to learn about the female reproductive system and regulation of its function
- To enable students to comprehend about fertilization, pregnancy, parturition and lactation
- To equip students with knowledge on causes of infertility, reproductive health, assisted reproductive technology and associated ethical issues

Unit I

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, mechanism of sex differentiation; Puberty

Unit II

Histoarchitecture of male reproductive system; Testis: Cellular functions; Spermatogenesis and its hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Sperm transportation in male tract.

Unit III

Outline and histoarchitecture of female reproductive system; Ovary: oogenesis and its hormonal regulation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles and their regulation, changes in the female tract; Menopause

Unit IV

Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy. Mechanism of parturition and its hormonal regulation; Lactation and its regulation

Unit V

Infertility in male and female: causes, diagnosis and management; Sexually transmitted diseases; Modern contraceptive technologies; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, Stem Cell banks, *in vitro* fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; ethical issues.

COURSE OUTCOMES

Onsuccessfulcompletionofthecourse,studentswillbeable to

- Recall the structure and functioning of the male and female reproductive system, associated endocrinology, causes for infertility and assisted reproductive technology
- Describethestructure and physiologyfunctionsofmaleandfemalereproductivesystems.
- Explaintheroleof structures, accessory glands and hormonesassociatedwiththereproductivetractsandtheircontrol
- Explainthemechanismofsexdetermination.
- Discussage-associated physiologicalchangesinthereproductivetract
- Describephysiologicalchangesduringpregnancyandbenefitsofbreastfeeding.
- Identify causes for infertility, treatments available and ethical issues related totreatments.
- Discussadvantagesanddisadvantagesofavailablecontraceptives.
- Analyze the different techniques and associated ethical issues related to reproductive technology

BOOKS FOR REFERENCE

Cassan, A. (2005). *Human reproduction and Development (Inside the Human Body).* NewYork: ChelseaClubhouse.

Field,M.A.(1990).*SurrogateMotherhood*.Massachusetts:Harvard University.

Gardner, D. K.(2001). *Textbook of Assisted Reproductive Techniques: Laboratory andClinicalPerspectives.*London: MartinDunitz.

Gardner, D. K.(2006). In vitro Fertilization: A Practical Approach. CRC Press.

Johnson, M. H. (2018). *Essential Reproduction*. New Jersey: Wiley-Blackwell.

Jones,R.E.(2013).*HumanReproductiveBiology*.Amsterdam:Elsevier.

Neill, Jimmy D. ed (2006). Knobil and Neill's Physiology of Reproduction. Volume I. Third edn. Elsevier Academic Press.

Pinon, R. (2003). *Biology of Human Reproduction*. California: University Science Books.

BIOCOMPOSTING FOR ENTREPRENEURSHIP

Learning Objectives:

- To highlight the importance of Biocomposting for entrepreneurship in waste management.
- To enable students for setting up Biocompost units and bins for waste reduction.

Course outcomes:

- The students will gain knowledge about the process of Biocomposting.
- Students will be able to demonstrate Biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.
- To gain knowledge about the economic cost of establishing small Biocompost units as a cottage industry.

Unit – I
Biocomposting – Definition, types and ecological importance.

Unit – II
Types of Biocomposting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods.

Unit – III
Preparation of Biocompost pit and bed using different amendments.

Unit – IV
Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.

Unit – V
Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).

Practical

- Preparation procedures for Biocompost pit.
- Selection of Biocompost material, separation of Compostable and Non-compostable materials.
- Packing and marketing of Biocompost.
- Field visit to Biocomposting unit.

References

Bikas R. Pati& Santi M. Mandal (2016). Recent trends in composting technology.

Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors) 2016. Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COST Action FA 1105, www.biogreenhouse.org.