

B.SC.,ZOOLOGY

SYLLABUS

**FROM THE ACADEMIC YEAR
2023-2024**

**TAMILNADU STATE COUNCIL
FOR HIGHER EDUCATION, CHENNAI-600 005**

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TANSCHEREGULATIONSONLEARNINGOUTCOMES-BASEDCURRICULUMFRAMEWORKGUIDELINESBASEDREGULATIONS FORUNDERGRADUATE PROGRAMME	
Programme:	B.Sc.,Zoology
Programme Code:	
Duration:	UG-3Years
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/Teamwork: 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 interest 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. PO11 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 to embrace 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 demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviours 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. PO14: Leadership readiness/qualities: Capability for mapping out
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	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.
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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 comply 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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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 undergraduate 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)	- The lowest level of questions require students to recall information from the course content - Knowledge questions usually require students to identify information in the textbook.	
Understanding (K2)	- Understanding of facts and ideas by comprehending or organizing, comparing, translating, interpolating and interpreting in their own words. - The questions go beyond simple recall and require students to combine data together	
Application (K3)	- Students have to solve problems by using/applying a concept learned in the classroom. - Students must use their knowledge to determine an exact response.	
Analyze (K4)	- Analyzing the question is one that asks the student to break down something into its component parts. - Analyzing requires students to identify reasons, causes or motives and reach conclusions or generalizations.	
Evaluate (K5)	- Evaluation requires an individual to make judgment on something. - Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. - Students are engaged in decision-making and problem-solving. - Evaluation questions do not have single right answers.	
Create (K6)	- The questions of this category challenge students to get engaged in creative and original thinking. - Developing original ideas and problem-solving skills	

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

dgetopracticalsituations.ThestateofarttechnologiesinconductingaExplaininascientificandsystematicwayandarrivingat 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 jobmarket.

- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary andinter disciplinary nature are incorporated as Elective courses, covering conventionaltopicstothelatestDBMSandComputersoftwareforAnalytics.

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 to gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students to gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generate self-employment • Create small scale entrepreneurs • Training to girls lead to women empowerment
		• Discipline centric skill will improve the Technical knowledge 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 interdisciplinary 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 their respective sectors
IV	DBMS and Programming skill, Biostatistics,	• Exposure to industry moulds students into solution

	Statistical Control, Statistics, Operations Research	Quality Official Research	Providers - Generates Industry ready graduates - Employment opportunities enhanced
II Year 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 need 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 need of peer learners/research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
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ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS UNDER CBCS PATTERN (w.e.f.2023-24)
B.Sc., Zoology– PROGRAMME STRUCTURE

Sem .	Part	Course Code	Courses	Title of the Paper	T/P	Cr.	Hrs./ Week	Max. Marks		
								Int.	Ext.	Total
I	I	2311T	T/OL	தமிழ் இலக்கிய வரலாறு-I /Other Languages	T	3	6	25	75	100
	II	2312E	E	General English - I	T	3	6	25	75	100
	III	23BZO1C1	CC-I	Invertebrata	T	5	5	25	75	100
		23BZO1P1	CC-II	Invertebrata-Lab course	P	3	4	25	75	100
		-	Generic Elective (Allied)	Botany/Chemistry/Biochemistry/ Microbiology	T	3	3	25	75	100
		-		Allied IA Practical	P	2	2	25	75	100
	IV	23BZO1S1	SEC –I	Ornamental Fish Farming and Management	T	2	2	25	75	100
		23BZO1FC	FC	Foundation Course for Zoology	T	2	2	25	75	100
				Total		23	30	200	600	800
II	I	2321T	T/OL	தமிழ் இலக்கிய வரலாறு-2 / Other Languages -II	T	3	6	25	75	100
	II	2322E	E	General English - II	T	3	6	25	75	100
	III	23BZO2C1	CC-III	Chordata	T	5	5	25	75	100
		23BZO2P1	CC-IV	Chordata Practical	P	4	4	25	75	100
		--	Generic Elective (Allied)	Allied IB Botany/Chemistry/Biochemistry/ Microbiology	T	2	3	25	75	100
		--		Allied IB Practical	P	2	2	25	75	100
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	IV	23BZO2S1	SEC –II	Aquarium Keeping	T	2	2	25	75	100
		23BZO2S2	DSC-I	Animal Behaviour	T	2	2	25	75	100
			NMC							
				Total		23	30	200	600	800
III	I	2331T	T/OL	தமிழக வரலாறும் பண்பாடும்/ Other Languages -III	T	3	6	25	75	100
	II	2332E	E	General English – III	T	3	6	25	75	100
	III	23BZO3C1	CC-V	Cytogenetics	T	6	6	25	75	100
		23BZO3P1	CC-VI	Cytogenetics Practical	P	3	3	25	75	100
		--	Generic Elective (Allied)	Allied IB Botany/Chemistry/Biochemistry/ Microbiology	T	3	3	25	75	100
		--		Allied IB Practical	P	2	2	25	75	100
		--								
	IV	23BZO3S1	SEC-III	Biocomposting for Entrepreneurship	T	2	2	25	75	100
	IV	233AT/ 23BZO3S2	DSC-II	Adipadai Tamil/Nanobiology	T	2	2	25	75	100
			NMC							
				Total		24	30	200	600	800
IV	I	2341T	T/OL	தமிழும் அறிவியலும் / Other Languages -IV	T	3	6	25	75	100
	II	2342E	E	General English – IV	T	3	6	25	75	100
	III	23BZO4C1	CC-VII	Developmental Biology	T	4	4	25	75	100
		23BZO4P1	CC-VIII	Developmental Biology Practical	P	3	3	25	75	100
		--	Generic Elective (Allied)	Allied IB Botany/Chemistry/Biochemistry/ Microbiology	T	3	3	25	75	100
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		--		Allied IB Practical	P	2	2	25	75	100
	IV	23BZO4S1	DSC-III	Human Reproductive Biology	T	2	2	25	75	100
		234AT/ 23BZO4S2	DSC-IV	Adipadai Tamil/Wildlife Conservation and Management	T	2	2	25	75	100
		23BES4		E.V.S	T	2	2	25	75	100
			NMC							
				Total		24	30	225	675	900
V	III	23BZO5C1	CC-IX	Evolutionary Biology	T	4	5	25	75	100
		23BZO5C2	CC-X	Animal Physiology	T	4	5	25	75	100
		23BZO5C3	CC-XI	Environmental Biology	T	4	5	25	75	100
		23BZO5E1	DSE-I	Food, Nutrition and Health	T	4	5	25	75	100
		23BZO5P1	CC-XII	Eco-Physiology Practical	P	2	4	25	75	100
		23BZO5P2	CC-XIII	Evolution and Environmental Toxicology Practical	P	2	4	25	75	100
		23BVE5		Value Education	T	2	2	25	75	100
		23BZO5I/ 23BZO5IV/ 23BZO5FV		Internship/Industrial Visit/ Field Visit	PR	2	-	25	75	100
				Total		24	30	200	600	800
VI	III	23BZO6C1	CC-XIV	Animal biotechnology	T	4	6	25	75	100
		23BZO6C2	CC-XV	Microbiology and Immunology	T	4	6	25	75	100
		23BZO6E1	DSE-II	Agricultural Entomology	T	4	6	25	75	100
		23BZO6PR	CC-XVI	Project	PR	5	7	25	75	100
		23BZO6P1		Animal Biotechnology, Microbiology and Immunology Practical	P	2	3	25	75	100
	IV	23BZO6S1		Essential Reasoning and Quantitative Aptitude	T	2	2	25	75	100
	V	23BEA6		Extension Activity	P	1		25	75	100
				Total		22	30	175	525	700
				Grand Total		140	--	--	--	4800

TOL-Tamil/Other Languages,

☐ E –English

☐ CC-Core course –Core competency, critical thinking, analytical reasoning, research skill & teamwork

☐ Generic Elective AL - Allied -Exposure beyond the discipline

☐ SEC - Skill Enhancement Course - Exposure beyond the discipline (Value Education, Entrepreneurship Course,

Computer application for Science, etc.,)

DSE-Discipline Specific Elective Courses

FC-Foundation Course

* T- Theory, P-Practical

Intenship/Industrial visit/Field Visit:Marks-Internal =25(15+10)Report and Viva Voce

External =75 Report=50 Viva Voce=25

Project=Marks-Internal =25(15+10)Report and Viva Voce

External =75 Report=50 Viva Voce=25

Chairperson details: Mr.R.Navukkarasu, Sree Sevugan Annamalai College, Devakottai.

Mobile No: 7373741881

SEMESTER – I

Course Code:		Course Name	Category	L	T	P	S	C	Inst Hours	Marks		
										Int.	Ext.	Total
23BZO1C1		INVERTEBRATA	Core	Y	-	-	-	5	5	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 the parasitic and economic importance of invertebrate animals											
	Details										Course Objectives	
UNIT I	Protozoa: Introduction to Classification, taxonomy and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study - <i>Paramecium</i> - Parasitic protozoans (<i>Entamoeba</i>, <i>Trypanosoma</i> & <i>Leishmania</i>) - Economic importance Nutrition in protozoa - Host-parasitic interactions in <i>Entamoeba</i> Locomotion in protozoa Porifera: General characters and classification up to Classes. Type study Ascon Sponge (<i>Leucosolenia</i>) - Skeleton in sponges, Economic importance in Sponges Canal system in sponges - Reproduction in sponges										CO1	
UNIT II	Coelenterata : General characters and classification up to classes – Type study - <i>Obelia</i> - Mesenteries in Anthozoa - Economic importance of corals and coral reefs - Polymorphism in Coelenterates. Platyhelminthes: General characters and classification of up to classes. Type study – <i>Fasciola hepatica</i>. Parasitic adaptations. Host- parasitic interactions of Helminth parasites.										CO2	
UNIT III	Aschelminthes : General characters and classification of up to classes - Type study - <i>Ascaris lumbricoides</i>. Nematode Parasites and diseases - <i>Wuchereria bancrofti</i>, <i>Enterobius vermicularis</i>. Annelida: General characters and classification up to Classes. Type study – <i>Nereis</i> Metamerism in Annelida. Nephridium in Annelids. Coelom in Annelids „Reproduction in polychaetes.										CO3	
UNIT IV	Arthropoda: General characters and classification of Phylum Arthropoda up to Classes. Detailed study: <i>Penaeus indicus</i>. Affinities of <i>Peripatus</i> – Larval forms in Crustacea – Organization of Centipede and Millipede Insects associated with human diseases: Mosquitoes, housefly, bed bug, human head louse. Insects associated with household materials: Ants, Termites, Silver fish. Insect pests: Life cycle and types of damage to plants. Pest of rice: Rice stem borer (<i>Scirpophaga incertulas</i>) – Pest of Sugarcane: The shoot borer (<i>Chilo infuscatellus</i>) – Pest of coconut: The rhinoceros beetle (<i>Oryctes rhinoceros</i>) Principles of Integrated Pest Management.										CO4	

UNIT V	Mollusca: General characters and classification of Phylum Mollusca up to Classes. Detailed study: <i>Pila globosa</i> . Foot in Mollusca, torsion in Mollusca, Economic importance of Molluscs – Cephalopoda as the most advanced Molluscs.		CO5
	Echinodermata: General characters and classification of Phylum Echinodermata up to Classes. Detailed study: <i>Asterias</i> . Water vascular system in Echinodermata – Larval forms of Echinoderms.		
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.		PO 1
CO2	Illustrate and examine the systemic and functional morphology of various groups of invertebrates.		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, 10 th edition, Viswanathan, S., Printers & Publishers Pvt Ltd		
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12 th edn. S.Chand & Co.		
3.	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.		
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	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		

SEMESTER – I
CORE COURSE-II

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO1P1	INVERTEBRATA LAB COURSE	Core practical		-	p	-	3	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.										
SECTION	DetailS									Course Objectives	
UNIT I	Major Dissection : Cockroach: Digestive system. Circulatory system, Nervous system,. Earthworm: Nervous System, Digestive system <i>Pila globosa</i> : Nervous system, Digestive system									CO1	
UNIT II	Mounting: Earthworm: Body setae; Pineal setae. <i>Pilaglobosa</i> : Radula. Honey Bee, House fly ,Cockroach and Mosquito mouthparts. Prawn appendages.									CO2	
UNIT III	Spotters : (i).Protozoa: Amoeba, Paramoecium, Paramoecium 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), Druncunculus, Ancylostoma, Wuchereria (vi). Annelida: Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva (vii). Arthropoda: 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									CO3	
UNIT IV	Preserve any Two insect pests and prepare a report on its name,life cycle, damaging crops and management of the pests using different methods.									CO4	
UNIT V	Observation note/Record									CO5	
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									PO3, PO8	

	economically important invertebrates.	
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 and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.	
3.	Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.	
4.	Lal, S. S, 2016. Practical Zoology Invertebrate, Rastogi Publications.	
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.	
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). <i>The Invertebrates: A New Synthesis</i> , III Edition, Blackwell Science.	
2.	Barnes, R.D. (1982). <i>Invertebrate Zoology</i> , V Edition. Holt Saunders International Edition.	
3.	Barrington, E.J.W. (1979). <i>Invertebrate Structure and Functions</i> . II Edition, E.L.B.S. and Nelson	
4.	Boradale, L.A. and Potts, E.A. (1961). <i>Invertebrates: A Manual for the use of Students</i> . 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/	
SCHEME OF EVALUATION		
Dissect and display the digestive system of Pila/Dissect and display the digestive system and nervous system of Earthworm		15 Marks
Mounting Housefly mouth parts/Earthworm body setae and penial setae		10 Marks
Identify Sketch and comment on A,B,C,D &E		15 Marks
Preserve any two insect pest and submit a descriptive report about the pest ,infested plants ,types of damage and natural way of control		10 Marks
Bonafide Record of the , work done in laboratory		10 Marks
Total		60 Marks

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO1S1	Ornamental Fish Farming & Management	SEC	Y	-	-	-	2	2	25	75	100

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. Ornamental fish diseases, their prevention, control and treatment methods.
Unit IV	Conditioning, packing, transport and quarantine methods. Economics, trade regulations, domestic and export marketing strategies. Practical 1) Identification of locally available ornamental fishes - Egg layers and live bearers. 2) Identification of locally available live feed organisms.

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 aquaculture. 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.

Course Code	Course Name	Category	L	T	P	S	Inst Hours	Marks			
								CIA	Ext.	Tot.	
23BZO1FC	Foundation course for Zoology	FC	Y	-	-	-	2	2	25	75	100
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	Life and its manifestation , History of Biology-Evolution of Biology, Branches of zoology, Biodiversity -Outline Classification of Invertebrates and Vertebrates up to class level.										
Unit II	Interaction of living organisms with environment: Types of Ecosystem-Pond, Terrestrial, Forest and Land, Components of Ecosystem-Abiotic and Biotic factors, Food web, Food chain, Environment issues Conservation and Management strategies-Zoological Parks and Sanctuaries.										
Unit III	Cytology and Genome biology: Prokaryotic cells-Eukaryotic cells-Importance of cell organelles-Cancer cells-Immune cells-Stem cells- Principle resolving power & use of compound microscope, confocal microscope and electron microscope-Characteristics features-Mendel's Principles-DNA-RNA modern concept of gene-central dogma of molecular biology.										
Unit IV	Embryology and Development of Biology: Gametes (Sex cells)-Egg-Sperm-Fertilization-Cleavage-Developmental stages-Zygote-Cleavage-Morula-Blastula and Gastrula. Origin of life, Spontaneous generation theory of life, Origin of cells-Oparin coacervate theory.										
Unit V	Biochemistry and Physiology : Introduction to role of essential biological Compounds –Proteins, Carbohydrates, Lipids, Water and Vitamins. Scope of Zoology -General introduction and Application of Apiculture, Aquaculture, Sericulture, Lac culture, Vermiculture, Poultry Keeping, Dairy farming-Zoological survey of India, Central Marine Fisheries Research Institute.										

SEMESTER II

CourseCode	CourseName	Category	L	T	P	S		Inst .Ho urs	Marks		
									CIA	Exte rnal	Total
23BZO2C1	CHORDATA	Core	Y	-	-	-	5	5	25	75	100
LearningObjectives											
CO1	TounderstandthestructuresanddistinctfeaturesofPhylumChordata.										
CO2	Tounderstandandabletodistinguishthecharacteristicfeaturesofeach subphylumandclass.										
CO3	Tounderstandtheeconomicimportanceofvertebrates										
CO4	Toknowabouttheadaptationsofvertebrates										
CO5	Tounderstandtheevolutionarypositionofdifferentgroupsofvertebrates										
	Details							No.of Hours	Course Objectives		
UNIT I	GeneralCharactersandClassificationofPhylumChordata:Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (<i>Balanoglossus</i>), Urochordata (<i>Ascidia</i>), Cephalochordata(<i>Amphioxus</i>).							12	CO1,CO2		
UNIT II	Prochordates and Agnatha: Characteristics of sub phylum vertebrata, Classification of Vertebrata upto Class level,Agnatha(<i>Petromyzon</i>),-iscs (<i>Scoliodonsorrakowah</i>) General characters and classification, Origin of fishes, Affinities of Dipnoi -Typesofscscalesandfins- Accessoryrespiratoryorgans-Airbladder-Parentalcare- Migration-Economic importance.							12	CO1,CO2,C O4,CO5		
UNIT III	Amphibia:General characters andclassification-Origin of Amphibia-Type study- <i>Ranahexadactyla</i> -Adaptive features of Anura,Urodela and Apoda-Neoteny in Urodela-Parental care in Amphibia.							12	CO1,CO2, CO3,CO4, CO5		
UNIT IV	Reptilia:General characters and classification-Type study- (<i>Calotesversicolor (endoskeleton of Varanus)</i>) - Origin of reptiles and effects of terrestrialsiation, Extinctreptiles. Snakes of India.Poison apparatus and biting mechanism of poisonous snakes - Skullin reptiles as basis of classification							12	CO1,CO2,C O4,CO5		
UNIT V	AvesandMammalia:Ayes: General characters and classification – Type study - <i>Columba livia</i> - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification-Type study-Rabbit-Adaptiveradiationinmammals- Egg layingmammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.							12	CO1,CO2,C O4,CO5		
	Total							60			
CourseOutcomes											
Course Outcomes	Oncompletionofthiscourse,studentswill;										
CO1	Classify,Identifyandrecallthenameanddistinctfeaturesofdiff erentsubphylumbelongingtophylumChordata.							PO1			
CO2	Explain,andrelatetheorigin,structuralorganizationand evolutionaryaspectsofvertebrates.							PO1,PO2			
CO3	Analyze,compare and distinguishthe developmentalstagesanddescribetheimportantbiologicalpr ocess.							PO3,PO4,PO5			
CO4	Correlatethedifferentmodesoflifeandparentalcare amongdifferentvertebrates.							PO3,PO5,PO6			
	Summarisethemorphologyandecologicaladaptationsinve										

CO5		rtebratesandlistouttheeconomicimportance.					PO2,PO3,PO5,PO8	
TextBooks(LatestEditions)								
1.	Ayyar,E.K.andT.N.Ananthakrishnan,1992.ManualofZoologyVol.II (Chordata),S.Viswanathan(PrintersandPublishers)PvtLtd.,Madras,891p.							
2.	Jordan,E.K.andP.S.Verma,1995.ChordateZoologyandElementsofAnimal Physiology,10thedition,S.Chand&CoLtd.,RamNagar,NewDelhi,1151pp.							
3.	Nigam,H.C.,1983.ZoologyofChordates,VishalPublications,Jalandhar-144008,942.							
4.	Ganguly,Sinha,.BharatiGoswamiandAdhikari,2004.BiologyofanimalsVol.II -NewcentralbookAgency(p)Ltd.							
5.	Kotpal.R.L.A,ModerntextbookofZoologyVertebrates-Rastogipublications.2009							
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)								
1.	DarlingtonP.J.TheGeographicalDistributionofAnimals,R.E.KriegerPub.Co.							
2.	HallB.K.andHallgrimssonB.(2008).Strickberger’sEvolution.IVEdition. JonesandBartlettPublishersInc.							
3.	Hickman,C.P.Jr.,F.M.HickmanandL.S.Roberts,1984.IntegratedPrinciplesofZoology,7thEdition,TimesMerror/MosbyCollegePublication.St.Louis.1065 pp.							
4.	Newman,H.H.,1981.ThePhylumChordata,SatishBookEnterprise,Agra–282 003,477pp.							
5.	ParkerandHaswell,1964.TextBookofZoology,VolII(Chordata),A.Z.T,B.S. PublishersandDistributors,NewDelhi-110051,952pp.							
6.	PoughH.Vertebratelife,VIIIEdition,PearsonInternational.							
7.	Waterman,AllynJ.etal.,1971.ChordateStructureandFunction,MacMillan&Co.,NewYork,587pp							
8.	Young,J.Z.(2004).TheLifeofVertebrates.IIIEdition.Oxforduniversitypress.							
WebResources								
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							
MethodsofEvaluation								
Internal Evaluation	ContinuousInternalAssessmentTest						25Marks	
	Assignments							
	Seminars							
	AttendanceandClassParticipation							
External Evaluation	EndSemesterExamination						75Marks	
	Total						100Marks	
MethodsofAssessment								
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions							
Understand/ Comprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview							
Application (K3)	Suggestidea/conceptwith examples, Suggestformulae, Solveproblems,Observe,Explain							
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate between various ideas, Map knowledge							
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons							
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3		S	S	S	S	S		S
CO4			S	S	S	M		
CO5			S		S			S

Course Code	CourseName	Category	L	T	P	S		Inst. Hours	Marks		
									CI A	Ext ernal	Total
23BZO2P1	CHORDATA - PRACTICAL	Core	-	-	P	-	4	4	25	75	100
LearningObjectives											
CO1	To understand the structures and distinct features of phylum chordata.										
CO2	To understand and able to distinguish the characteristic features of each Sub phylum 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.										
	Details							No.of Hours	Course Objectives		
UNIT I	Dissections:Frog(Demo)/Fish: External features, Digestive system ,Arterial system, Venous system, 5 th Cranial nerve, 9 th and 10 th cranial nerves, Male and female rinogenitals system.							12	CO1		
UNIT II	Mounting:Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain(Demo).							12	CO2		
UNIT III	Osteology:Frog: Skull and lower jaw, Vertebral column, Pec toral girdle, Pelvic girdle, Forelimb, Hindlimb. Chelonia- Anapsid skull, Pigeon-skull and lower jaw, synsacrum.							12	CO3		
UNIT IV	Specimen and Slides:(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, Axolotl larva(vi). Reptilia : Draco, Chamaeleon, Gecko, Uromastix, Viperarusselli, 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). Mammalia: Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog							12	CO4		
UNIT V	Choose any commercial fish/amphibian/reptiles/bird/mammal and do a project work on the generic identification description and illustration with a note on its importance							12	CO5		
	Total							60			
CourseOutcomes											
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 invertebrates and list out the economic importance.							PO3, PO8			

TextBooks (Latest Editions)		
1.	Lal SS, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.	
2.	Verma P.S, 2000. A Manual of Practical Zoology: Chordates, S. Chand Limited, 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. Oxford Uni. 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	
S-Strong(3) M-Medium(2) L-Low(1)		

S-Strong(3) M-Medium(2) L-Low(1)

SCHEME OF EVALUATION	
I. Dissect and display the digestive system of given bony fish	20 Marks
II. Mounting - placoid/Ctenoid scales (Sketch and label the parts)	5 Marks
III. Comment on the given Osteology Specimen	5 Marks
IV. Identify Comment on the Spotters A, B, C, D & E	15 Marks
V. Choose any commercial fish/amphibian/reptiles/bird/mammal and do a project work on the generic identification description and illustration with a note on its importance	10 Marks
Observation Note/Record	20 Marks
Total	75 Marks

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO2S1	AQUARIUM KEEPING	SEC-II	Y	-	-	-	2	2	25	75	100
➤ To create knowledge on self employment opportunity of ornamental fishes ➤ To provide the knowledge of ornamental fishes and their equipment ➤ To understand the different breeding techniques of ornamental fishes											
UNIT I	Introduction and scope - Aquarium fish keeping as hobby and cottage industry. Commercial aspects like national and international market- Self employment opportunity.										
UNIT II	External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.										
UNIT III	Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry										
UNIT IV	Live fish transport-handling, feeding and forwarding techniques of fish. Fish Diseases and their control.										
UNIT V	Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Swordtails, Platy, Siamese fighter fish and Gold fish, Butterfly fish, Blue morph and Anemone fish.										
Reference Books: 1. Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi. 2. Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong. 3. O'Connell, R.F., The freshwater aquarium (1977), Arco Publishing Company, INC New York. 4. Jingran V.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi 5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi.											
Course Outcome: 1. Students to learn about different ornamental fishes and identify the diseases of them 2. To develop entrepreneur potential in the field of aquarium and get self employment.											

Course Code	Course Name	Category	L	T	P	S	Inst Hours	Marks			
								CIA	Ext.	Tot.	
23BZO2S2	ANIMAL BEHAVIOUR	DSC-I	Y	-	-	-	2	2	25	75	100
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 systems. 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, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.										
UNIT II	Evolution and Social Behaviour : Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.										
UNIT III	Animal and the Environment : Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.										
UNIT IV	Understanding Complex Behaviour : Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals : Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.										
UNIT V	Chronobiology : Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo-transduction; The physiological clock and measurement of day length; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy. 22										
Text Books 1. David McFarland, 1985. Animal Behaviour, Longman Scientific & Technical, UK. 576pp. 2. Harjindra Singh, 1990. A Text Book of Animal Behaviour, Anomol Publication, 293pp. 3. Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp. 4. Shukla, J. P. 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp. 5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, 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, MacMillan Company, London, 118pp. 4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. DeCoursey (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.²³

SEMESTER III

Course Code	CourseName	Categ ory	L	T	P	S		Inst .Ho urs	Marks		
									CIA	Exte rnal	Total
23BZO3C1	CYTOGENETICS	Core	Y	-	-	-	6	6	25	75	100
LearningObjectives											
CO1	Tounderstandthestructuresandpurposesofbasiccomponentsofprokaryoticand eukaryoticcells,especiallymacromolecules,membranesandorganelles.										
CO2	Tounderstandhowthesecellularcomponentsareusedtogenerateandutilize energyincells.										
CO3	Tounderstandthecellularcomponentsunderlyingmitoticcelldivision.										
CO4	To understand the structure and functions of nuclic acid in the cell. To comprehent the important of genetic variation in evolution,and their cumulative effect in human population and the molecular basis of variations.										
	Details							No.of Hours	Course Objectives		
UNIT I	History of Cell Biology, Tools and Techniques of Cell Biology Cell Fractionation, Homogenization, Centrifugation, Isolation of subcellular Components.Histological techniques – Staining – Vital Stains.–Cytoplasmic and Nuclear Stains.MicroTechnique Methods, Microscopes - Types - Light, Phasecontrast,SEM,TEM-Units of measurement.							12	CO1,CO2		
UNIT II	Cell components- Plasma Membrane Ultra Structure – Different Models- Functions-Ultrastructure, Composition and Function of Endoplasmic reticulum, Ribosomes, GolgiComplex, Lysosomes, Centrioles, Microtubules Microfilaments, Mitochondria and Microsomes.Nucleus - Ultrastructure, Composition andFunctions- NuclearMembrane-Nucleoplasm-Nucleolus- NucleolusCycle-DNAandRNAs .Protein synthesis and regulation							12	CO1,CO2,CO 4,CO5		
UNIT III	Cell Divisions and Cell Cycle - Amitosis, Mitosis andMeiosisandtheirSignificance-Cancer,Biology– Characteristicsofcancercells,types,theoriesonCarcinogenesis ,Ageingof Cells – Apoptosis and Stemcellstudies.							12	CO1,CO2,C O3,CO4,CO 5		
UNIT IV	Mendelian Genetics and Inheritance: Mendeliangenetics:Mendelian experiments, laws of Mendel,Monohybrid,Dihybrid,backandtestcross;Interactiono f genes: Incompletdominance,codominance,complementaryg enes,supplementarygenes,inhibitinggenes,lethalgenesandata vism.Inheritance:Polygenicinheritance- skincolour;multiplealleles- ABObloodgroupsssexlinkedinheritance– eyecolourinDrosophila,colourblindnessandhemophiliainman.							12	CO1,CO2,CO 4,CO5		
UNIT V	LinkageandCrossingOver:Linkage:Linkedgenes,completea ndincompletelinkage.Crossingover:molecularmechanismsof c rossingover,kindsofcrossingover,HumanandPopulationGen etics:Humangenetics: sex determination - Barr bodytechnique,drumstickmethod;chromosomalabnormalitiesi nhumans,Pedigreeanalysis;Eugenics, Euphenics, and Euthenics. gene pool,genefrequencyandgenotypefrequency.							12	CO1,CO2,CO 4,CO5		
	Total							60			
CourseOutcomes											

Course Outcomes	On completion of this course, students will;	
CO1	To understand and recall the basic structure, origin and development of cell organelles.	PO1
CO2	To integrate and assess the biochemical, cytological and histological tools to infer cellular basis of organization.	PO1, PO2, PO3
CO3	To analyze and differentiate organisms based on structure, composition and inter and intracellular interactions.	PO3, PO4, PO5
CO4	To explain the role of cells and cell organelles in various biological processes.	PO2, PO3, PO5, PO6, PO8
CO5	To construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.	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., 500pp.
2.	Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.
3.	Veer Bala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250001.
4.	Verma, P.S. and V.K. Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S. Chand & co., New Delhi-110055, 567pp.
5.	Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.

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, 495pp
5.	Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer

Mapping with Programme Outcomes:

	Associates Inc., Oxford University Press p.813.
6.	De Robertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Infomed, Hong Kong, 734pp.
7.	Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565pp.
8.	Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609pp.
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., New Deihi-110020, 516pp.
12.	Mason K.A., Losos J.B. and Singer S.R. (2011) Raven and Johnson's Biology. 9 th Edn. McGraw Hill publications. p.1406.

13.	Powar,C.B.,1989.EssentialofCytology,HimalayaPublishingHouse,Bombay-400004,368pp.	
14.	Swansen,C.P.andP.L.Webster,1989.TheCell,PrenticeHallofIndiaPvt.Ltd.,NewDelhi-110001,373pp.	
15.	UrryL.A.CainM.L.,WassermanS.A.,MinorskyP.V.,JacksonR.B.andReeceJ.B.(2014)CampbellBiologyinFocus.PearsonEducation.p.1080.	
WebResources		
1.	http://www.microscopemaster.com/organelles.html	
2.	https://bit.ly/3tXwDSB	
3.	https://bit.ly/3tWNpRX	
4.	https://bit.ly/3AuYR9M	
5.	https://rsscience.com/cell-organelles-and-their-functions/	
MethodsofEvaluation		
Internal Evaluation	Continuous Internal Assessment Test	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	End Semester Examination	75Marks
	Total	100Marks
Methods of Assessment		
Recall(K1)	Simple definitions,MCQ,Recall steps,Concept definitions	
Understand/ Comprehend (K2)	MCQ,True/False, Shortessays,Concept explanations,Short summary or overview	
Application (K3)	Suggestidea/concept with examples, Suggest formulae, Solve problems, Observe,Explain	
Analyze(K4)	Problem-solving questions,Finish a procedure in many steps,Differentiate betweenvariousideas,Mapknowledge	
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations	

S-Strong(3) M-Medium(2) L-Low(1)

SEMESTER-III

Course Code	Course Name	Category	L	T	P	S	Ins t.H ours	Marks			
								CI A	Ext ernal	Total	
23BZO3P1	CYTOGENETICS PRACTICAL	Core		-	P	-	3	3	25	75	100
Learning Objectives											
CO1	To encourage student to interpret the organization of genomic material and to research the theory of genetic inheritance.										
CO2	To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.										
CO3	To study the changes in genetic material and to predict and consider the consequences of those changes.										
CO4	To encourage student to report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.										
	Details						No. of Hours	Course Objectives			
UNIT I	Preparation and Identification of slides of Mitotic divisions with onion root tips. Preparation and Identification of different stages of Meiosis in Grasshopper Testes. Identification and study of different stages of Mitosis and Meiosis. Buccal epithelium (Barr body) preparation.						12	CO1			
UNIT II	Stain in gel and observation of polytene chromosome spreads in salivary glands of chironomid larva. Karyotyping (with the help of photographs) – normal male and female karyotypes and study of karyotypes of different genetic syndromes. Verification of the Mendelian laws of inheritance using coloured beads. Observation on genetic traits.						12	CO2			
UNIT III	Histochemistry and Microtechnique-Fixation and Fixatives: Types of fixatives, Chemistry of fixation, Choice of Fixatives Tissue processing: Dehydration, Clearing and Embedding Microtomy: Types of microtomes, Sectioning of Paraffin blocks Staining of paraffin sections: Principle and methods of staining. Histological stains: Haematoxylin and Eosin.						12	CO3			
UNIT IV	(1) Culturing and Handling of Drosophila: a) Media Preparation b) Cleaning and Sterilization of bottles c) Handling of Drosophila (2) Morphology and Sexual dimorphism, Study of at least five types of Drosophila, Body colour mutant- Ebony body and Yellow body. Wing mutant- Curly wing and Vestigial wing. Eye colour mutant- Bare eye, White eye, Sepia eye. Mounting of Sex Combs of Drosophila melanogaster.						12	CO4			
UNIT V	Study of flower colour in Antirrhinum/ Mirabilis. Coat colour in Mice. Comb pattern in Poultry. Blood Typing. Biometrical Computation of: Mean, Median and Mode, Variance, Standard Deviation. Problems on: Student's 't' test and Chi-square test. Genetic problems on Multiple alleles, Gene Interactions (Complementary/Supplementary/Dominant Epistasis and gene interactions). Genetic Problems on Linkage and Crossing over: 03 Prs. a) Drosophila. b) Maize. c) Human (Sex Linkage).						12	CO5			
	Total						60				
Course Outcomes											

Course Outcomes	On completion of this course, students will;	
CO1	To describe, examine and interpret the organization of genomic material and to research the theories of genetic inheritance.	PO1
CO2	To prepare samples of genetic molecules and to determine their purity, structure and characteristics.	PO1, PO2
CO3	To experiment with genomic preparations and devise Techniques to distinguish genetic material in different organisms to survey biodiversity.	PO4, PO6
CO4	To assess the changes in genetic material and to predict and consider the consequences of those changes.	PO4, PO5, PO6
CO5	To report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.	PO3, PO8
Text Books (Latest Editions)		
1.	Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.	
2.	Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.	
3.	Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.	
4.	Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.	
5.	Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.	
2.	Bancroft, J.D. and Gamble, M. (2007) Theory and Practice of Histological Techniques, 6th Edition, Churchill Livingstone.	
3.	Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.	
4.	John Kiernan (2008) Histological and Histochemical Methods: Theory and Practice, 4th edition, Cold Spring Harbor Laboratory Press.	
5.	Kerr, J. (2013) Functional Histology, Elsevier 6. Kiernan, J.A. (2008) Histological & Histochemical methods: Theory & Practice (4th Ed). Cold Spring Harbor Laboratory Press.	
6.	Leonard Davis, Mark Dabner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.	
	Luiz Carlos (2005) Basic Histology: Text and Atlas (11th Ed). McGraw Hill Medical.	
7.	Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.	
	Ross, M.H., Kaye, G.I. & Pawlina, W. (2002) Histology: A text and atlas (4 th ed). Lippincott Williams & Wilkins.	
	Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA.	
Web Resources		
1.	https://www.jove.com/	
2.	https://vlab.amrita.edu/?sub=3&brch=77	
3.	http://cbii-au.vlabs.ac.in/	
4.	https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html	

5.	https://www.ibiology.org/biology-techniques/
Methods of Assessment	
Recall(K1)	Simple definitions, MCQ, Recall steps, Concept definitions

Mapping with Programme Outcomes:

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

SCHEME OF EVALUATION	
I. Mounting of Mitotic / Meiotic / Giant chromosome Experiment to study Mendel's law using beads.	20 Marks
II. Mounting of squamous epithelial cells/Blood cells sketch and label the parts	10 Marks
III. Finding out the trait type of the Mendelian traits in Man any two	5 Marks
IV. Identify sketch and comment on pedigree chart	5 Marks
V. Identify sketch and comment on the given spotters (tree from Cell biology and two from Genetics)	15 Marks
Observation note book	20 Marks
Total	75 Marks

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

S-Strong(3) M-Medium(2) L-Low(1)

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO3S1	BIOCOMPOSTING FOR ENTREPRENEURSHIP	SEC-III	Y	-	-	-	2	2	25	75	100
LearningObjectives: ➤ TohighlighttheimportanceofBiocompostingforentrepreneurshipinwastemanagement. ➤ ToenablestudentsforsettingupBiocompostunitsandbinsforwastereduction.											
UNIT I	Biocomposting–Definition,typesandecologicalimportance.										
UNIT II	Types of Biocompostingtechnology–Fieldpits/groundheaps/tank/large-scale/batchand continuous methods.										
UNIT III	Preparation of Biocompostpitandbedusingdifferentamendments.										
UNIT IV	Applications of Biocompost in soil fertility maintenance, promotion of plant growth, valueaddedproducts,waste reduction,etc.										
UNIT V	Economicsof establishmentofasmallbiocompostunit– projectreportproposal for Self Help Group(Incomeandemploymentgeneration). Practical ➤ PreparationproceduresforBiocompostpit. ➤ SelectionofBiocompostmaterial,separation of Compostable and Non-compostable materials. ➤ PackingandmarketingofBiocompost. ➤ FieldvisittoBiocomposting unit.										
References BikasR.Pati&SantiM.Mandal(2016).Recenttrendsincompostingtechnology. VanderWurff,A.W.G.,Fuchs,J.G.,Raviv,M.,Termorshuizen,A.J.(Editors)2016.Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COSTActionFA1105, www.biogreenhouse.org .											
Courseoutcomes: ➤ ThestudentswillgainknowledgeabouttheprocessofBiocomposting. ➤ StudentswillbeabletodemonstrateBiocompostingtechniquesforvariousendapplications like solid waste management, industrial waste recycling using sugarcanebagasse,etc. ➤ Togain knowledge about the economic cost ofestablishing small Biocompost units asacottageindustry.											

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO3S2	NANO BIOLOGY	DSC-II	Y	-	-	-	2	2	25	75	100

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 nanomaterials and nanoparticles. They will be able to appreciate the applications of nanobiology in diverse fields.

UNIT I	Nanobiology-Definition-concepts and scope. History of nanotechnology and nanoscience in Nature; Structure and Properties of nanomaterials: size, surface charge, conductivity, optical properties and biocompatibility.
UNIT II	Synthesis and characterization of nanomaterials, Fabrication of nanostructures, Metallic nanoparticles, semiconductor, 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 and nanoparticles – therapeutics – biomaterials - Immobilized enzymes - drug delivery systems – Biosensors - Cellular imaging tools and diagnostics.

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.

Course outcomes (Cos)

Students will be able to:

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

SEMESTER-IV

Course Code	CourseName	Category	L	T	P	S	Inst. Hours	Marks		
								CI A	Ext ernal	Total
23BZO4C1	Developmental Biology	Core	Y	-	-	-	44	25	75	100
Learning Objectives										
CO1	To create an awareness to 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 postembryonic development and ageing									
CO5	To give an idea about teratogenesis, in vitro fertilization, stem cells and amniocentesis to the students									
	Details							No. of Hours	Course Objectives	
UNIT 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	
UNIT II	Blastulation & Gastrulation Cleavage-Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation – types of blastula. Morphogenetic movements-Gastrulation offrog & chick.							12	CO2	
UNIT III	Organogenesis Development of Brain, Eye and Heart in frog. Development of Nervous system in chick. Foetal membranes in chick.. Development of Pro, Meso & Metanephric kidneys. Placentation in Mammals.							12	CO3	
UNIT IV	Applied Embryology Organizer concept – Structure – mechanism of induction and competence. Nuclear transplantation-teratogenesis – Regeneration: types- events and factors. Embryonic stem cells & significance. Methods to culture embryo							12	CO4	
UNIT 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		
Mapping with Programme Outcomes:										
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		
	To distinguish between the different types of developmental mechanisms									

CO4	nvariousorganismsandappraisethespecies-baseddifferencesindevelopment.	PO4,PO5,PO6
CO5	Tojustifyandvalidatetheroleofenvironmentandgeneticsininfluencingembryonicdevelopment	PO3,PO8
Text Books (Latest Editions)		
1.	LewisWolpert2007.Principlesofdevelopment,3rdedition,OxfordUniversityPress,NewDelhi,	India
2.	Subramoniam,T.2003.DevelopmentalBiology,NarosaPublishingHouse,New Delhi, India.	
3.	Verma,P.S.,Agarwal,V.K.2010.ChordateEmbryology:DevelopmentalBiology, S.Chand&Company,NewDelhi.,India.	
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)		
1.	GilbertS.F.2010.DevelopmentalBiology,SinauerAssociates,Massachusetts, USA.	
2.	Balinsky,B.I.1970.IntroductiontoEmbryology,Philadelphia&London,UK.	
3.	Berril,N.J.1971.DevelopmentalBiology,McGrawHill,NewYork,USA.	
4.	RussHodge2010.DevelopmentalBiology,FactsonFile,Inc.,NewYork,USA.	
5.	Carlson,Bruce,M.2009.HumanembryologyandDevelopmentalBiology, Elsevier,Philadelphia,USA	
WebResources		
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/	
MethodsofEvaluation		
InternalEvalu ation	ContinuousInternalAssessmentTest	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75Marks
	Total	100Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
Understand/Co mprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview	
Application(K3)	Suggestidea/conceptwith examples, Suggestformulae, Solveproblems, Observe,Explain	
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate betweenvariousideas,Mapknowledge	
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations	

S-Strong(3) M-Medium(2) L-Low(1)BN

SEMESTER IV

Course Code	CourseName	Cate gory	L	T	P	S		Inst. Hour s	Marks		
									CIA	Exte rnal	Tot al
23BZO4P1	DEVELOPMENTAL BIOLOGY PRACTICAL	Core	-	-	P	-	3	3	25	75	100
LearningObjectives											
CO1	Toencouragestudentstointerprettheorganizationofgenomicmaterialandtoresearchtheoriesofgeneticinhe ritance.										
CO2	Toimpartheskillsrequiredtopreparesamplesofgeneticmoleculesandtodeterminetheirpurity,structureand characteristicsandtoanalyzegenomic preparations.										
CO3	Tostudythechangesingeneticmaterialandtopredictandconsiderthe consequencesofthosechanges.										
CO4	Toencouragestudentstoreportandjustifytheresultsofmolecularandgenetic experimentsinanaccurateandmeaningfulmanner.										
	Details							No.of Hours		Course Objectiv es	
UNIT I	Mount any one Chick embryo and comment on it-18 hours,24 hours,48 hours,72hours,and 96 hours/whole mounting of chick blastodermObservation of Eggs Frog,Chick,Mammals							12		CO1	
UNIT II	.Cleavage Blastula Gastrula,stages of Frog Mounting of Live Sperm of Vertebrata							12		CO2	
UNIT III	Studyof Placental developments in Human by Ultra sound Scan							12		CO3	
UNIT IV	Placenta of Mammals/Pig,Sheep,Rabbit and Man Effect of Thyroxin in Tadpole (Group study)							12		CO4	
UNIT V	Bonafide Record of the work done in Laboratory must be submitted while attending the Examination							12		CO5	
	Total							60			
CourseOutcomes											
Course Outcomes	Oncompletionofthiscourse,studentswill;										
CO1	Todescribe,examineandinterprettheorganizationof genomicmaterialandtoresearchtheoriesofgeneticinheritance.							PO1			
CO2	Toprepare samples of genetic molecules and to determinetheirpurity,structureandcharacteristics.							PO1,PO2			
CO3	Toexperimentwithgenomicpreparationsanddevise techniques todistinguishgeneticmaterialindifferentorganismstosurveybio diversity.							PO4,PO6			
CO4	Toassess thechangesingeneticmaterialandtopredict andconsidertheconsequencesofthosechanges.							PO4,PO5,PO6			
CO5	Toreportandjustifytheresultsofmolecularandgeneticexperimentsinanaccu rateandmeaningful manner.							PO3,PO8			
TextBooks(LatestEditions)											
1.	SuryaNandanMeena,MilindNaik,2019.AdvancesinBiologicalScience Research:APracticalApproach,AcademicPress,NewYork,USA.										
2.	MichaelPerlin,WilliamBeckerson,AdarshGopinath,2017.Cell,Genetics,and MolecularBiology:ALabManual(FirstEdition),CognellaInc.,USA.										
3.	SaxenaJ.,BaunthiyalM.,RaviI.,2015.LaboratoryManualofMicrobiology, BiochemistryandMolecularBiology,ScientificPublishers,India.										
4.	BansalM.P.,2013.MolecularBiology and Biotechnology:basicexperimental protocols,TheEnergyandResourcesInstitute(TERI),NewDelhi,India.										
5.	ChaitanyaK.V., 2013. Cell and molecularbiology: A Lab Manual, Phi LearningPvt.Ltd.,NewDelhi,India.										
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)											

1.	Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.
2.	Bancroft, J.D. and Gamble, M. (2007) Theory and Practice of Histological Techniques, 6th Edition, Churchill Livingstone.
3.	Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique And Specialized Applications, John Wiley & Sons, USA.
4.	John Kiernan (2008) Histological and Histochemical Methods: Theory and Practice, 4th edition, Cold Spring Harbor Laboratory Press.
5.	Kerr, J. (2013) Functional Histology, Elsevier 6. Kiernan, J.A. (2008) Histological & Histochemical methods: Theory & Practice (4th Ed), Cold Spring Harbor Laboratory Press.
6.	Leonard Davis, Mark Dabner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.
	Luiz Carlos (2005) Basic Histology: Text and Atlas (11th Ed). McGraw Hill Medical.
7.	Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.
	Ross, M.H., Kaye, G.I. & Pawlina, W. (2002) Histology: A text and atlas (4th ed). Lippincott Williams & Wilkins.
	Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA.

Web Resources

1.	https://www.jove.com/
2.	https://vlab.amrita.edu/?sub=3&brch=77
3.	http://cbii-au.vlabs.ac.in/
4.	https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html
5.	https://www.ibiology.org/biology-techniques/

Methods of Assessment

Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
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Mapping with Programme Outcomes:

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

SCHEME OF EVALUATION

I. Mounting of Live Sperm of Vertebrata/ Mount any one of the Chick embryo and comment on it	20 Marks
II. Observation of Egg-Chick or Frog	5 Marks
III. Identify Sketch and Comment on the Placenta	5 Marks
IV. Identify sketch and comment on Chick Embryo Stage	10 Marks
V. Identify sketch and comment on the given spotters A, B, C, D and E	15 Marks
Observation note book	20 Marks
Total	75 Marks

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

S-Strong(3) M-Medium(2) L-Low(1)

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO4S1	HUMAN REPRODUCTIVE BIOLOGY	DSC-III	Y	-	-	-	2	2	25	75	100

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–hypophyseal–gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation; Puberty
UNIT II	Outline and histology of male reproductive system; Testis: Cellular functions; Spermatogenesis and its hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory gland functions; Sperm transport in male tract; Andropause
UNIT III	Outline and histology 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 diagnosis, foeto–maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation
UNIT V	Infertility in male and female: causes, diagnosis and management; Sexually transmitted Infections; Modern contraceptive technologies; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, Stem Cell banks, <i>in vitro</i> fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; ethical issues; Consanguinity; Fetal Loss and Birth Defects; Adoption

BOOKS FOR REFERENCE

Cassan, A. (2005). *Human reproduction and Development (Inside the Human Body)*. New York: Chelsea Clubhouse.

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

Gardner, D. K. (2001). *Textbook of Assisted Reproductive Techniques: Laboratory and Clinical Perspectives*. London: Martin Dunitz.

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). *Human Reproductive Biology*. 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.

COURSE OUTCOMES

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

- Recall the structure and functioning of the male and female reproductive system, associated endocrinology, causes for infertility and assisted reproductive technology
- Describe the structure and physiology function of male and female reproductive systems.
- Explain the role of structures, accessory glands and hormones associated with the reproductive tracts and their control
- Explain the mechanism of sex determination.
- Discuss age-associated physiological changes in the reproductive tract
- Describe physiological changes during pregnancy and benefits of breastfeeding.
- Identify causes for infertility, treatments available and ethical issues related to treatments.
- Discuss advantages and disadvantages of available contraceptives.
- Analyze the different techniques and associated ethical issues related to reproductive technology

Course Code	Course Name	Category	L	T	P	S		Inst Hours	Marks		
									CIA	Ext.	Tot.
23BZO4S2	WILD LIFE CONSERVATION AND MANAGEMENT	DSC-IV	Y	-	-	-	2	2	25	75	100

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 dimension 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 of 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). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation.
UNIT II	Theory and Analysis of Conservation of Populations: Stochastic perturbations-Environmental, Demographic, spatial and genetics to stochasticity. Population viability analysis-conceptual foundation, uses of PVA models. 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, National and State Biodiversity Action Plans and other Forests and Environmental Acts.
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, cores and Buffers, Nodes and corridors. 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, p478.
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, p231.
4. Justice Kuldeep 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 Sinclair, A.R. E 1994 Wildlife ecology and management. Blackwell Science.
8. Woodroffe R, Thirgood, S. and Rabinowitz A. 2005. People and Wildlife, Conflict or Coexistence? 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, p547.
2. Rodgers W A, 1991. Techniques for Wildlife Census in India-A Field

Manual: Technical Manual-TM-2. WII.

3. Saharia VB, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and Subhendu Mazumdar, 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/3IHdEYJ>
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 Approach 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 of PVA models, Wildlife conservation approaches, and limitations.
5. To construct and simulate National and International strategies for Conservation, Wildlife laws and ethics.

SEMESTER-V

CourseCode	CourseName	Category	L	T	P	S		Inst. Hours	Marks			
									CIA	External	Total	
23BZO5C1	EVOLUTIONARY BIOLOGY	Core	Y	-	-	-		4	5	25	75	100
Learning Objectives												
CO1	Evolutionary biology is a branch of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time.											
CO2	This course helps to understand the important processes, principles, and concepts of evolution.											
CO3	To provide adequate information on the Lamarckism-Neo Lamarckism–Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project.											
CO4	To explain the importance of the fossil records in evolutionary studies, and the role of phylogenetic studies in the wider context of biodiversity and conservation.											
CO5	In this course, we will apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases.											
UNIT	Details							No. of Hours	Course Objectives			
UNIT I	Inorganic and organic evolution-History of evolutionary thought, Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes.							12	CO1			
UNIT II	Lamarckism-Neo Lamarckism-Darwinism-Neo Darwinism and modern synthetic theory-De Vrie’s Mutation theory–modern concepts of mutation-Mutation and their role in evolution-Animal Colouration and Mimicry.							12	CO2			
UNIT III	Isolating mechanisms-Modes of speciation-Hybridization is an evolutionary catalyst-Law of Adaptive Radiation-Adaptive radiation in reptiles and mammals-Convergence and parallelism-Evolutionary constancy.							12	CO3			
UNIT IV	Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences-Palaeontological evidences–evolutionary genomics. Types of rocks-Geological timescale– Nature of fossils-Dating of fossils-Fossil records of man and fossil records of horse.							12	CO4			
UNIT V	Natural selection in action in man-level of selection-Eugenics, Euphenics and Euthenics-Adaptation-Human Genome Project– Evolution and ethics.							12	CO5			
	Total							60				
Course Outcomes												
Course Outcomes	On completion of this course, students will;											
CO1	To understand the Primordial earth and theories on origin of life							PO1				
CO2	To integrate and assess Lamarckism-Neo Lamarckism–Darwinism							PO1, PO2				
CO3	To analyse various fossil records of man and fossil records of horse, various types of rocks-Geological timescale.							PO4, PO6				
CO4	To explain the Nature of fossils-Dating of fossils, evidences of evolution, Adaptive radiation							PO4, PO5, PO6				

	in reptiles and mammals,	
CO5	To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases.	PO3, PO8
Text Books (Latest Editions)		
1.	Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.	
2.	Lull, R. S. 2010. Organic evolution, The Macmillan, New York.	
3.	Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company	
4.	Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.	
5.	Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A textbook of Organic Evolution, Nirali Prakashan,	
6.	Rastogi V B. 1991. Organic Evolution. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.	
7.	Stricberger, M. W., 1996. Evolution. Jones & Bartlett, USA	
8.	Colbert, E. H. Morales, M. and Minkoff, E. C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.	
Reference Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Burns G W. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co. Inc.	
2.	Gardner E F. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.	
3.	Harth and Jones E W. 1998. Genetics—Principles and Analysis. Jones and	

Mapping with Programme Outcomes:

	Bar Hett Publ. Boston.	
4.	Levine L. 1969. Biology of the Gene. Toppan.	
5.	Pedder I J. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.	
6.	Rastogi V B. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.	
7.	White M J D. 1973. Animal Cytology and Evolution. Cambridge Univ. Press.	
Web Resources		
1.	https://bit.ly/3nPD09m	
2.	https://bit.ly/3CHOdGL	
3.	https://bit.ly/2XvcCXl	
4.	https://bit.ly/2XAL1Vh	
5.	https://bit.ly/3zoU9Jl	
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

S-Strong(3) M-Medium(2) L-Low(1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

SEMESTER-V

CourseCode	CourseName	Category	L	T	P	S		Inst. Hours	Marks		
									CIA	Exter- nal	Total
23BZO5C2	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		
UNIT I	Nutrition & Respiration Nutrition: Digestion and absorption of carbohydrates, proteins and lipids. Minerals & Vitamins – their deficiency. Hormonal control of digestion. Types of Respiration, Respiratory pigments-structure of Haemoglobin, Transportation of gases- Bohr effect- Regulation of respiration- bronchitis, asthma- Physiological effects of smoking.							12	CO1		
UNIT II	Circulation & Excretion Blood-composition and functions, Mechanism of clotting. Types of Hearts – Heartbeat and its regulation -pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, Regulation of acid base balance, Excretory products, Osmoregulation in fishes.							12	CO2		
UNIT III	Muscle & Nerve Physiology Types of muscles – Ultra structure of striated muscle, Muscle contraction & properties, Neurons – structure & types- Impulse propagation, synaptic transmission, neurotransmitters- Reflex action, Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.							12	CO3		
UNIT IV	Sense Organs Structure of eye, physiology of vision, visual elements and pigments, photochemistry of vision- Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract- Structure of ear and mechanism of hearing- Hearing impairments – deafness, labyrinthine disease - Olfactory, gustatory and tactile sense organs.							12	CO4		
UNIT V	Reproductive Physiology Endocrine glands in man- Hormones, action and disorders - Feed-back mechanism, Outlines of mechanism of hormonal activity. Puberty, adolescence, pregnancy, parturition, lactation and birth control.							12	CO5		
	Total							60			
Course Outcomes											

Course Outcomes	On completion of this course, students will;	
CO1	be able to explain how the various organ systems are coordinated and controlled.	PO1
CO2	be able to list the functions of various organs in relation to physiological process.	PO1, PO2
CO3	be able to develop the idea of multi level controlling and feedback mechanism in relation to various physiological functions.	PO4, PO6
CO4	be able to understand the basic physiological process related to adaptation, metabolism and major requirements.	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., 377pp.	
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, 320pp.	
4.	Parameswaran, Anantakrishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329pp.	
5.	Verma P.S., Tyagi B.S. & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417pp.	
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., 1064pp.	
	Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340pp.	
	Hill, W.R., Wyse, G.A. and Anderson, M. 2016. Animal Physiology (4th edn). Sinauer Associates is an imprint of Oxford University Press; USA, 828pp.	
2.	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India,	

Mapping with Programme Outcomes:

	New Delhi, 928pp.
3.	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra-282003, 966pp.
4.	Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi.
5.	Singh, H. and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864pp.
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. 1232pp.

	Wood,D.W.,1968.PrinciplesofAnimalPhysiology,EdwardArnoldLtd, London.,342pp.	
WebResources		
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	
MethodsofEvaluation		
InternalEva luation	ContinuousInternalAssessmentTest	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75Marks
	Total	100Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
Understand/ Comprehend (K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview	
Application(K 3)	Suggestidea/conceptwithexamples,Suggestformulae,Solveproblems, Observe,Explain	
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate betweenvariousideas,Mapknowledge	
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion, Debatingor Presentations	

S-Strong(3) M-Medium(2) L-Low(1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

SEMESTER-V

CourseCode	CourseName	Category	L	T	P	S	Credits	Inst.Hours	Marks		
									CIA	External	Total
23BZO5C3	ENVIRONMENTAL BIOLOGY	Core	Y	-	-	-	4	5	25	75	100
Learning Objectives											
CO1	To understand the structure and function 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.										
	Details							No. of Hours	Course Objectives		
UNIT I	Ecosystem: Concept of an ecosystem- Structure and function of an ecosystem- Producers, consumers and decomposers- Energy flow in the ecosystem- Ecological succession- Food chains, food webs and ecological pyramids- Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem- Grassland ecosystem- Desert ecosystem- Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).							12	CO1		
UNIT II	Population And Biological Cycles: Structure and distribution – Growth curves- Groups, natality, Mortality- Density indices, Life study tables- factors affecting population growth- Carrying capacity. Population regulation and human population control. Complete and incomplete biogeochemical cycles- Sedimentary cycle.							12	CO2		
UNIT III	Environmental Stresses And Management: Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemicals in agriculture, industry and hygiene and their disposal. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.							12	CO3		
UNIT IV	Environmental Pollution: Definition- cause, effects and control measures of: - Air pollution- Water pollution- Soil pollution- Marine pollution- Noise pollution- Thermal pollution- Nuclear hazards.							12	CO4		

UNIT V	Biodiversity Conservation: Biodiversity crisis –habitat degradation, poaching of wildlife.-Socio economic and political causes of loss of biodiversity.-Insituand exsitu conservation of biodiversity- Hotspotsof Biodiversity.Greenpeace movement-Chipko Movement-Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests-National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management, Legislations for environmental Protection, Biovillages–sustainable utilization and development, Environmental ethics.	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/3kqXYA		
4.	https://bit.ly/39rvvgt		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test		25 Marks
	Assignments		
	Seminars		
	Attendance and Class Participation		

External Evaluation	EndSemesterExamination	75Marks
	Total	100Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
Understand/Comprehend (K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview	
Application(K3)	Suggestidea/conceptwithexamples,Suggestformulae,Solveproblems,Observe,Explain	
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiatebetweenvariousideas,Mapknowledge	
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion, DebatingorPresentations	

MappingwithProgrammeOutcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

S-Strong(3) M-Medium(2) L-Low(1)

CourseCode	CourseName	Category	L	T	P	S	Credits	Inst.Hours	Marks		
									CIA	External	Total
23BZO5E1	FOOD, NUTRITION AND HEALTH	DSE-I	Y	-	-	-	4	5	25	75	100
Learning Objectives The course covers the basic concepts of balanced diet for people of different ages besides focusing on the consequences of malnutrition and the deficiency diseases and the diseases caused due to poor hygiene.											
Unit I	Nutrition and dietary nutrients: Basic concepts of Food: Components and nutrients. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.										
Unit II	Macronutrients and micronutrients: Macronutrients. Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role. Micronutrients. Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.										
Unit III	Malnutrition and nutrient deficiency diseases: Definition and concept of health: Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives.										
Unit IV	Life style dependent diseases- hypertension, diabetes mellitus, and obesity their causes and prevention. Social health problems- smoking, alcoholism, narcotics. Acquired Immuno Deficiency Syndrome (AIDS): causes, treatment and prevention.										
Unit V	Diseases caused by microorganisms: Food hygiene: Potable water- sources and methods of purification at domestic level. Food and Water-borne infections: Bacterial diseases: cholera, typhoid fever - viral diseases: Hepatitis, Poliomyelitis - Protozoan diseases: amoebiasis, giardiasis - Parasitic diseases: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention. Causes of food spoilage and its prevention.										
References 1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamental of Foods, Nutrition and Diet Therapy; Fifth Ed; New Age International Publishers. 2. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd. 3. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO. 4. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd. 5. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence. 6. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.											
Course outcomes: Students will be able to: ➤ Understand the role of food and nutrients in health and disease. ➤ Gain knowledge about hygiene, food safety, disease transmission. ➤ Perform food system management and leadership functions that consider sustainability in business, healthcare, community and institutional areas.											

SEMESTER-V

CourseCode	CourseName	Category	L	T	P	S		Inst.Hours	Marks		
									CIA	External	Total
23BZO5P1	ECO-PHYSIOLOGY PRACTICAL	Core		-	P	-	2	4	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 that 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.										
UNIT	Details							No. of Hours	Course Objectives		
UNIT I	Estimation of Abiotic Factors: Estimation of dissolved Oxygen, Dissolved carbon-di-oxide, Determination of alkalinity in water samples, Determination of salinity of water samples, Determination of bicarbonate and carbonates.							12	CO1		
UNIT II	Digestive Enzymes: Survey of digestive enzymes in Cockroach, counting of cockroach haemocytes using haemocytometer. Ptyalin activity in relation to temperature and pH in human saliva. Ecological Methods: Estimation of oxygen consumption in an aquatic and a terrestrial animal.							12	CO2		
UNIT III	Biochemical Tests: Use of pH meter for estimation of pH in water and soil samples, Study of microarthropods of water and soil samples (Tullgren's funnel method and Ladell's Floating Method). Collection, isolation, identification and mounting of marine and freshwater plankton. Study of sandy shore fauna - Study of rocky shore fauna - Study of animal Association.							12	CO3		
UNIT IV	Qualitative Detection of Biomolecules: Qualitative tests for identification of carbohydrates, proteins and lipids. Amino acid in haemolymph of any insect by chromatographic technique. Estimation of Haemoglobin by Cyanmethemoglobin method, Blood grouping - total and differential counts. Determination of plasma hemoglobin, Total erythrocyte count by hemocytometer.							12	CO4		

UNIT V	FieldWork: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to local polluted site- Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems- pond, river, hillslopes, etc.	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	List and recall the basic equipment used in physiology 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, M.L., Fody, E.P., Schoeff, L.E. 2010. Clinical Chemistry: Principles, Procedure, correlations. Wolters Kluwer, India, 298 PP.		
3.	Burtis, C.A. and Ashwood, E.R. 2008. Tietz textbook of Fundamental 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-282003, 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,PrinciplesofAnimalPhysiology,MacmillanPublishing.,426 PP.
6.	Eugenia,2008.EnvironmentalBiotechnologyandcleaversBioprocesses, London.
7.	Ramesh,R&M,Anbu1996.Chemicalmethodsforenvironmental Analysisofwaterandsediment.MacmillanIndiaLimited,Chennai.
WebResources	
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/3IO29yP
MethodsofAssessment	
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions
Understand/Comprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview
Application(K3)	Suggestidea/conceptwithexamples,Suggestformulae,Solveproblems, Observe,Explain

MappingwithProgrammeOutcomes:

Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate betweenvariousideas,Mapknowledge							
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons							
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion, Debatingor Presentations							
SCHEME OFEVALUATION								
I. Estimation of Oxygen Consumption by a Fish Estimation of Salt loss /Salt gain /Salivary amylase of Man in relation to the Temperature Variation								20 Marks
II.Mount any One of the Plankton from the given sample sketch and label the parts/Qualitative analysis of Carbohydrate,Protein and Lipid								10Marks
III.Identify Sketch and Comment on the given apparatus								10 Marks
IV.Identify sketch and comment on the given spotters(Two from Environmental biology Three from Physiology)								15Marks
V.Observation note book and Field visit Report								20 Marks
Total								75 Marks
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

S-Strong(3) M-Medium(2) L-Low(1)

SEMESTER-V

CourseCode	CourseName	Category	L	T	P	S		Inst.Hours	Marks		
									CIA	External	Total
23BZO5P2	EVOLUTION AND ENVIRONMENTAL TOXICOLOGY PRACTICAL	Core	-	-	P	-	2	4	25	75	100
LearningObjectives											
CO1	Toexplainthemainmechanismsofenvironmentaltoxicantsincausingatoxicresponse inliving organisms.										
CO2	Todescribetheoptimaluseofnature,intheformofplants,animals,bacteria,fungiandalgae,toproducerenewableenergy,foodandnutrientsinasynergistic integratedcycleofprofit-makingprocesses										
CO3	Toprovidepracticalknowledgeandhandsontoolsandtechniquesfordose-responseassessmentofhazardoussubstances.										
CO4	Theuseofbiologicalsystemsforremediationofcontaminatedenvironments (land,air,water),andforenvironment-friendlyprocesses.										
CO5	Todevelopdatasthatcanensureappropriateprotectionofpublichealthfromtheadverseeffectsofexposurestoenvironmental agents.										
UNIT	Details							No.of Hours	CourseObjectives		
UNIT I	Evolution: Fossiles:Trilobite,Nautilus, Living fossile limulus and Peripatus Animals of Evolutionary importances-Archaeopterux,Darwin’s Finches Mimicry-Leaf insects,Stick insects Monarch and viceroy butterfly Adaptive Colouration Chameleon and Lycodon							12	CO1		
UNIT II	Estimation Methods: Estimation of Ammonia, Nitrites,Iron, soil alkalinity, Determination of hardness of water.Estimationofchlorinewater.EnvironmentalDeterminants:EstimationofBOD/EstimationofCOD. Physicochemicalpropertiesofwater. ToxicityTesting: Methodologyoftoxicitytesting–acuteandchronictests(demonstration),UseofLC50 values–sublethaleffectsofcriticalpollutantsonfish.							12	CO2		
UNIT III	Preparation of nutrient agarmedium. Settling rate ofbacteria from air. Bacterial Gram staining. Identificationofbacteriafromairuptocolonycharacteristics.E numerationof bacteriafromair.Studyofcollection,concentrationandpreservationtechniquesofalgae.Identificationtechniquesofalgae(Studyofmorphologicalcharacteristicsofalgae).Identificationand significanceofmajaoralgaewithregardtopollution. CalculationofNygaard’sIndices.Calculationofspecies diversity-Margalefdiversity index,CalculationofKothe’sspeciesdeficitindex.							12	CO3		
	EstimationofStandardPlateCount(SPC)fromwater. EstimationofMPNofcoliformsfromwater.										

UNIT IV	Determination of phosphate levels in clean and pollutedwaters. Determination of pH of soil. Determination oforganicmatterinsoil.Determinationofpercentcomposition ofsolubleandinsolublecomponentsofcommunitysolidwaste. Determinationofpercentcomposition of various components of community solidwaste.Studyoftreatmentefficiencyofwater-hyacinth inremovalofTDSandchangesinpH.	12	CO4
UNIT V	MiniProject and Spotters:Bio gas production - Foodtoxicitytests- Fieldvisit,Refluxcondenser,BODincubator,Spectrophotometer,Colorimeter,Atomicabsorptionspectroscopy,Ultracentrifuge,Incubator,HPLC. Visit to wastewater and drinking water treatmentplants.Studyofavermicompostplant.Biogasproduction-Foodtoxicitytests- Fieldvisit,Refluxcondenser,BODincubator,Spectrophotometer,Colorimeter,Atomicabsorptionspectroscopy,Ultracentrifuge,Incubator,HPLC. Visittowastewateranddrinkingwater treatmentplants.Studyofa vermicompostplant.	12	CO5
	Total	60	
CourseOutcomes			
CourseOutcomes	Oncompletionofthiscourse,studentswill;		
CO1	Understandthepropertiesoftoxicants,effects,originandoccurrenceintheenvironmentandexplaintheprincipleandprocedureforqualityevaluation,monitoring and remediation of contaminated environments.	PO1	
CO2	Estimate the toxic chemicals in the environment. Applytoolsandtechniquesforexperimentingwithenvironmentalproblems.Identifyandimplement solutions to the problems.	PO1,PO2	
CO3	Analysetheconsistentandinconsistentrangeofelements.Interpret the role of the elements in Environmental pollution and the effects on organisms.	PO4,PO6	
CO4	Relatethemetabolicactivity,diseases,illhealthanddeathwithreference toexposuretochemicals.Selectthesuitableexperimental design toassessthe toxic effects of pesticides and pollutants.	PO4,PO5,PO6	
CO5	Discuss the applicability of chemical analysis and	PO3,PO8	
	toxicitydata,bothindividuallyandtogether,inrisk assessmentandenvironmentalmonitoring.		
TextBooks (LatestEditions)			
1.	AbhijitDutta,2009.Experimentalbiology:ALaboratoryScience,Narosa,New Delhi.		
2.	DASH.K.,2005.TextBookofBiotechnology.WileyDreamtechPvtLtd, NewDelhi.		
3.	Rastogi,S.C., 2005. Experimental physiology, New age International publishers,NewDelhi.		
4.	Ramesh,RandM,Anbu1996.ChemicalmethodsforenvironmentalAnalysisof waterandsediment.MacmillanIndiaLimited,Chennai.		
5.	Micheal,P,1984.EcologicalMethodsforfieldvisitandlaboratoryinvestigation. TataMcGrawHill,NewDelhi.		

6.	Agarwal,A.StateofIndia’sEnvironment:ACitizensReport,CentreforScience andEnvironment,NewDelhi.
7.	Goel,P.K. WaterPollution:Causes,EffectsandControl.NewAgeInternational, Publishers,NewDelhi(2006).
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)	
1.	AllanS.Cragg,2010.EnvironmentalBiotechnology,OxfordUniversityPress. UK.
2.	APHA,1992.StandardMethodsfortheexaminationofwaterandwastewater, AmericanPublicHealthassociation,WashingtonD.C.
3.	APHA,2005.StandardMethodsfortheexaminationofwaterandwastewater, 21 st Ed.,AmericanPublicHealthassociation,WashingtonD.C.
4.	BoydC.E.,1992.WaterQualityandPondSoilAnalysisforAquaculture,C.E. Boyd,C.S.Tucker,AuburnUniversity.
5.	Csuros, M., 1994. Environmental Samplingand Analysis for Technicians,M.LewisPublishers,BocaRaton.Florida.
6.	Eugeniaetal,2008.EnvironmentalBiotechnologyandcleanerBioProcess, Taylor&FrancisLondon,UK.
7.	Francis,B.M.,1994.ToxicSubstancesintheEnvironment,JohnWileyandSons.
8.	Hauser,B.A.,2001.DrinkingWaterChemistry:ALaboratory Manual,LewisPublishers,BocaRaton,Florida
9.	Maier,R.M.,PepperI.L.andC.P.Gerba,2009.EnvironmentalMicrobiology.2 nd ed.AcademicPress.USA
10.	Rastogi,S.C.,2005.Experimentalphysiology,NewageInternationalPvt.Ltd. NewDelhi.
11.	Rump,H.H.,1999.Laboratory ManualfortheExaminationofWater, WastewaterandSoil,3 rd Ed.,Wiley-VCH,NewYork.
WebResources	
1.	http://www.envexp.com/technical/method-downloads/cod-method-410
2.	https://bit.ly/3u6o0Fb
3.	https://bit.ly/3hX8Ux0
4.	https://bit.ly/3EN2nz0
5.	https://www.ncbi.nlm.nih.gov/pubmed/2170158
MethodsofAssessment	
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions
Understand/Comprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryoroverview
Application(K3)	Suggestidea/conceptwithexamples,Suggestformulae,Solveproblems, Observe,Explain
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate betweenvariousideas,Mapknowledge
Evaluate(K5)	Longeressay/Evaluationessay,Critiqueorjustifywithprosandcons
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion, Debatingor Presentations

MappingwithProgrammeOutcomes:

SCHEME OF EVALUATION	
I.Estimation of Ammonia/Soil Alkalinity /Estimation of BOD	20 Marks
II.Determine the PH of Soil/Organic Matter in Soil/Determination of Phosphate level in clean and Polluted water	10Marks
III.Identify Sketch and Comment on the given apparatus /Living fossils	10 Marks
IV.Identify sketch and comment on the given spotters from Evolution	15Marks
V.Observation note book and Field visit Report	20 Marks
Total	75 Marks

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

S-Strong(3) M-Medium(2) L-Low(1)

SEMESTER-VI

Course Code	CourseName	Cate gory	L	T	P	S		Inst .Ho urs	Marks			
									CIA	Exte rnal	Total	
23BZO6C1	ANIMAL BIOTECHNOLOGY	Core	Y	-	-	-		4	6	25	75	100
LearningObjectives												
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											
	Details							No.ofH ours		Course Objectives		
UNIT I	Fundamentals of Biotechnology : Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications; r-DNA technology: Enzymes; Vectors–pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Host cells; Gene cloning: steps in cloning, selection of clones–chromogenic substrate, antibiotics.							12		CO1		
UNIT II	Techniques in Animal Biotechnology: Isolation and purification: DNA and mRNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, DNA chips, microarray; PCR: principle, types and application; Gene library: screening with probes; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.							12		CO2		
UNIT III	Transgenic Animal Technology : Transgenesis: Concept, transgenes, transgenic animal models- knockout mice, sheep; Applications of transgenesis : Molecular farming, Transgenic fishes, transgenic live stocks, and animals as bio reactors.							12		CO3		
UNIT IV	Animal Biotech and Health Care: Medical biotechnology: Monoclonal antibodies, recombinant vaccines–hepatitis B, hormones–insulin. DNA diagnostic systems: tuberculosis, AIDS, genetic diseases; Gene therapy: Ex vivo and in vivo, role in cancer treatment; CRISPR gene editing. Molecular markers: RFLP, RAPD, DNA fingerprinting and application.							12		CO4		
UNIT V	Applications and Ethics: Human genome project: Mapping of human genome, applications, ethics; Industrial biotechnology: Bioreactors-Basic concepts of fermentation, bioreactor design, production of ethanol and streptomycin; Ethics: Socio ethical problem, recent Trends in animal biotechnology, ethical implications.							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 tool 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 solution 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. Animal Biotechnology-Recent concepts and developments, MJP publishers.	
9.	Sathyanarayan U., 2008. Biotechnology, Books and Allied, Kolkata.	
10.	Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGrawhill, 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. 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.	HamesB.D.andHigginsS.J.1995.GeneProbes:APracticalApproach,Oxford UniversityPress,UK.	
WebResources		
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	
MethodsofEvaluation		
Internal Evaluation	ContinuousInternalAssessmentTest	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75Marks
	Total	100Marks
MethodsofAssessment		

Mapping with Programme Outcomes:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

S-Strong(3) M-Medium(2) L-Low(1)

SEMESTER-VI

CourseCode	CourseName	Category	L	T	P	S		Inst. Hours	Marks		
									CIA	External	Total
23BZO6C2	MICROBIOLOGY AND IMMUNOLOGY	Core	Y	-	-	-	4	6	25	75	100
LearningObjectives											
CO1	TobecomefamiliarwiththefoundationconceptsofhistoryofMicrobiology										
CO2	Tounderstandthestructureandfunctionsof atypical prokaryotic cell										
CO3	Togaintheknowledgeofmicroscopyandstainingconcepts										
CO4	Tounderstandandimplementdisposalandsafety measures										
	Details							No.of Hours	Course Objectives		
UNIT I	Introductiontomicrobiology History,scope, branches ofmicrobiology.ContributionofLeeuwanhoek,Jenner, Pasteur,Koch,Systematicposition: 5 kingdom classification of Whittaker and 3kingdom classification of CarlWoese.ComparisonofBacteria,Archaea,Eukarya (tabular and diagrammatic).Controlling microbes.							12	CO1		
UNIT II	IntroductoryMycology,Bacteriology and Virology Generalcharacteristicsandoutlineclassificationoffungi,Morphologyofsomecommonfungi Rhizopus,Aspergillus, Penicillium- Yeasts:General characteristics andoutlineclassificationofyeasts3.Generalcharacteristicsof Lichens andMycorrhiza. Classificationofbacteria.General characteristics of Cyanobacteria :General characteristics, Magnetosomes, Enrichmentandisolationof Magnetotacticbacteria.Types of staining Virus General characteristics, Structure and Classification.DNAviruses: Herpesviruses and Poxviruses.RNAviruses Paramyxoviruses,Rhabdoviruses.							12	CO2		
UNIT III	ImmuneCellsandOrgans:OverviewofImmuneSystem - General concepts and Haematopoeisis. Cells ofthe immune system - Immune Cells. Organs ofthe Immune system: Primary lymphoid organs - SecondaryLymphoidorgans- Innate and Adaptive Immunity: Innate and AdaptiveImmunity;(Cellmediatedandhumoral).MajorHisto compatibilityComplex(MHC):HLAantigens.							12	CO3		
UNIT IV	Antibodies:Structure,functionandpropertiesoftheImmunoglobulins,DifferentclassesofImmunoglobulins;antigenic determinantsonantibodies(isotype,allotypeandidiotype).Hybridomatechnology- productionofmonoclonalantibodiesandcatalyticantibodies (abzymes).Hypersensitivity: classification and brief description of various types of hypersensitivities. Autoimmunity: cause of auto immune diseases- classification of auto immune diseases.							12	CO4		
UNIT V	Transplantationimmunology:Typesofgrafts,immunologicbasisofgraftrejection, immunosuppressivetherapyandclinicaltransplantation.ClinicalImmunology:Immunityandtumors-tumorantigens (TSTA and TAA), immune response to tumors.Tumor evasion of theimmune system, Immunotherapyfortumors.Immunityagainst-							12	CO5		

	viral,bacterialandparasiticinfections.Vaccines:Types and uses- Immunization schedule for children.		
	Total		
CourseOutcomes			
CourseOut comes	Oncompletionofthiscourse,studentswill;		
CO1	Tounderstandhistory,relevanceofmicrobiologyand classificationofbacteria	PO1	
CO2	Tounderstandtheworkingofvariousmicroscopesand theirapplication	PO1,PO2	
CO3	Togainknowledgeofvarious(physicalandchemical)method sofcontrolofmicroorganismsandsafety measurestobefollowedwhilehandlingmicrobes	PO4,PO6	
CO4	Tounderstand the structure of bacterial cells, its organelles,physiologyandbehaviour.	PO4,PO5,PO6	
CO5	Tolearnndifferentmethodsofstainingbacteriaanddemonstrat e proficiency in handling aseptic bacteriologicalspecimen.	PO3,PO8	
TextBooks(Lates tEditions)			
1.	AnejaK.R.,ExperimentsinMicrobiology,plantpathology,Tissuecultureand MushroomCultivation,NewAgeInternational,NewDelhi.		
2.	AtlasR.M.,Microbiology–fundamentalsandapplications,Macmillan PublishingCompany,NewYork.		
3.	RavindraNath,FundamentalsofBiologyCoursesforBiotechnology,-Vol.1, SpecialBangaloreUniversityedition,KalayaniPublishers.		
4.	GreenwoodD,RichardCD,JohnSandPeutherF(1992).MedicalMicrobiology, 16thedition.ELBS,Churchilllivingstone.		
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)			
1.	Alexopoulos C.J. Mims C.W., Introductory Mycology, Age and New International,NewDelhi.		
2.	ThomasM. Bell, 1965. An Introduction to General Virology, William HeinemannMedicalbooks,London.		
3.	StanierR. Y.,IngrahamJ.L.,GeneralMicrobiology,PrenticeHallofIndiaPrivate Limited,NewDelhi.		
4.	SalleA.J., Fundamental Principlesof Bacteriology, Tata McGraw – Hill PublishingCompanyLimited,NewDelhi.		
5.	Pelczar.J.ChanE.C.S.andKriegN.R.,Microbiology,McGrawHillBook Company,NewYork.		
6.	BensonHaroldJ,MicrobiologicalApplications,WCBMcGraw–Hill,New York.		
7.	BrockT.D.andMadiganM. T.,BiologyofMicroorganisms,PrenticeHallof IndiaPrivateLimited.		
8.	CollinsCH,PatriciaM,andLyneJM(1995).CollinsandLynesMicrobiological Methods7thedition.Grange,ButterWorth,Oxford.		

9.	Cappucino J and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cummings Inc. California.
10.	Pelczar MJ, Chan EC and Krieg NR (1993). Microbiology 5th edition, Tata McGraw Hill.
11.	Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.

Mapping with Programme Outcomes:

Web Resources		
1.	https://vlab.amrita.edu/?sub=3&brch=73	
2.	https://learn.chm.msu.edu/vibl/	
3.	https://mvi-au.vlabs.ac.in/	
4.	https://virtuallab.tlc.ontariotechu.ca/intro.php	
5.	https://www.merlot.org/merlot/viewMaterial.htm?id=79694	
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	

S-Strong(3) M-Medium(2) L-Low(1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S							
CO2	M	S						
CO3				S		S		
CO4				S	S	M		
CO5			S					S

CourseCode	CourseName	Category	L	T	P	S	Inst .Ho urs	Marks			
								CIA	Exte rnal	Total	
23BZO6E1	AGRICULTURAL ENTOMOLOGY	DSE-II	Y	-	-	-	4	6	25	75	100
LearningObjectives 1. Explainthebasicconceptsofentomologyandobservethepeststatusofagriculture. 2. Illustrateandexaminethesystemicandfunctional morphologyofvariousgroupofagricultur alinsectpests. 3. Differentiateandclassifythevariousgroupsofinsectanimalsandestimatebiodiversity. 4. Tocompareand distinguishthegeneralandspecificcharacteristics integratedpestmanagement. 5. Inferandintegratetheeconomicimportanceofinsectspecies.											
UNIT I	Outline classification of insects - Causes for insect assuming pest status - Methods ofcollection,mountingandpreservationof insectpests.										
UNIT II	Insect vectors of plant diseases, Insect pests of stored grains their preventive andcurativemethods,Mostcommoninsectpestsofthefollowingplantsandtheircontrol measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton. Locust and its control.Insectpollinatorsandscavenger.										
UNIT III	Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees forapiary,Newton’s beehive,enemies and diseases ofhoney bees.Sericulture: Introduction,typesofsilkworms,silkwormraces,lifehistoryofmulberrysilkworm,featu resofsericultureindustry,pestsanddiseasesofsilkworm.LacCulture.										
UNIT IV	IPM, physical, mechanical, chemical and biological control methods,Pesticideapplicationequipment.										
UNIT V	Introduction and steps towards IPM, Pheromones, antifeedents, repellents and biopesticide.										
TextBooks 1. David,BandAnanthakrishnan,T.N.2006.Generaland AppliedEntomology, Secondedition,TataMcGrawhillpublishing companyLtd.,NewDelhi,India. 2. VasanthrajDavid,B.andRamamurthy,VV.2012.ElementsofEconomicEntomology,S eventhdition,Namruthapublications,Chennai. 3. Pruthi,H.S.1969.TextbookonAgriculturalEntomology,I.C.A.R.Publication,N ewDelhi. 4. Awasthi,V.B.2012.IntroductiontoGeneralandAppliedEntomology,thirdedition,Scie ntificpublishers.											
SuggestedReadings 1. AbishekShukla,D.2009.AHandBookofEconomicEntomology,VedamseBooks,NewDelhi. 2. MinistryofAgriculture,GovernmentofIndia,1995.ManualonIntegratedPestManagementinRicean dCotton. 3. JohnWilliamS.1995.ManagementofNaturalWealth,LoyolaCollegePublications,Chen nai.											
Webresources 1. http://www.fao.org 2. http://flybase.bio.indiana.edu/ 3. http://www.ipm.ucdavis.edu 4. http://www.ent.iastate.edu/list/ 5. www.entsoc.org											
Course Outcomes(COs) 1. Examineand identify thesystemic and functional morphology of various groupofagriculturalinsectpests. 2. Differentiateandclassifythevariousgroupsofinsectsandestimatebiodiversity. 3. Explainthepeststatusinagricultureandcontrolmeasures. 4. Tocomparethemethodsandoutcomesofintegratedpestmanagement. 5. Listtheeconomicimportanceofagriculturalinsectspecies.											

SEMESTER-VI

Course Code	CourseName	Category	L	T	P	S		Inst.Hours	Marks		
									CIA	External	Total
23BZO6P1	ANIMAL BIOTECHNOLGY, MICROBIOLOGY AND IMMUNOLOGY PRACTICAL	Core		-	P	-	2	3	25	75	100
LearningObjectives											
CO1	Toencouragestudentstointerprettheorganizationofgenomicmaterialandtoresearchtheories ofgeneticinheritance.										
CO2	Toimpartheskillsrequiredtopreparesamplesofgeneticmoleculesandtodeterminetheirpurity ,structure and characteristics andtoanalyzegenomic preparations.										
CO3	Tostudythechangesingeneticmaterialandtopredictandconsiderthe consequencesofthosechanges.										
CO4	Toencouragestudentstoreportandjustifytheresultsofmolecularandgenetic experimentsinanaccurateandmeaningfulmanner.										
UNIT	Details							No.of Hours	CourseOb jectives		
UNIT I	Isolationofgeneticmolecules:IsolationofDNAfrom spleen.TotalRNAisolationfromplant/animalcells							12	CO1		
UNIT II	Qualitativeandquantitativeanalysis of geneticmolecules: Determination of the purity of isolated DNAandRNAsamplesbyUVspectrophotometry.Quantitative estimation of DNA by Spectrophotometry							12	CO2		
UNIT III	Molecularanalysis: AgarosegelelectrophoresisofDNA.Restrictionfragmentle ngthpolymorphismstudy.Eliza,WesternBlot.							12	CO3		
UNIT IV	BloodGrouping.Total WBCandRBC.Estimation ofHaemoglobin. Aggutination test to show Antigen -Antibody reaction. Preparation of Serum components. RadialImmunodiffusionest.DoubleImmunodiffusionest.Restri ctionDigestionofplasmidDNA.Ligationof restrictedfragments.Hanging drop experiment for observation of live bacteria from given sample.							12	CO4		
UNIT V	Basicanimalcellculturetechniqueandtransgenesis:Trypsinization oflivercells.DeterminationoftheviabilityoftrypsinizedcellsbyTry panBluemethod.Creation of transgenic flies through virtual lab activity(https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html)							12	CO5		
	Total							60			
MappingwithProgrammeOutcomes: CourseOutcomes											
Course Outcome s	Oncompletionofthiscourse,studentswill;										
CO1	Todescribe,examineandinterprettheorganizationof genomicmaterialandtoresearchtheoriesofgeneticinheritance.							PO1			
CO2	Toprepare samples of genetic molecules and to determinetheirpurity,structureandcharacteristics.							PO1,PO2			
CO3	Toexperimentwithgenomicpreparationsanddevisetechniques todis tinguishgeneticmaterialindifferent Organisms to survey							PO4,PO6			

	biodiversity.	
CO4	To assess the changes in genetic material and to predict and consider the consequences of those changes.	PO4, PO5, PO6
CO5	To report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.	PO3, PO8
Text Books (Latest Editions)		
1.	Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.	
2.	Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.	
3.	Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.	
4.	Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.	
5.	Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Andreas Hofmann, Samuel Clokier, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.	
2.	Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA.	
3.	Leonard Davis, Mark Dabner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.	
4.	Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.	
5.	Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.	
Web Resources		

S-Strong(3) M-Medium(2) L-Low(1)

SCHEME OF EVALUATION	
I. Isolation of DNA from Spleen/Isolation of total RNA from plant/Animal cells/ Quantitative estimation of DNA by Spectrophotometry Finding out the blood group based on Antigen-antibody reaction	20 Marks
II. Qualitative analysis of donated milk by methylene blue test/	10 Marks
III. Motility of bacteria-Hanging drop technique/Isolation of microorganism from soil and water	10 Marks
IV. Identify sketch and comment on Blotting technique/DNA chip/Sterilization apparatus	5 Marks
V. Identify sketch and comment on the given spotters	15 Marks
Observation note book	15 Marks
Total	75 Marks

Title of the Course		ESSENTIAL REASONING AND QUANTITATIVE APTITUDE					
Paper Number		Professional Competency Skill					
Category	PCS	Year	II	Credits	2	Course Code 23BZO6S1	
		Semester	IV				
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total
	1		1		-		2
Objectives of the Course		• Develop Problem solving skills for competitive examinations • Understand the concepts of averages , simple interest , compound interest					
UNIT-I:		Quantitative Aptitude: Simplifications=averages-Concepts –problem-Problems on numbers-Short cuts- concepts –Problems					
UNIT-II:		Profit and Loss –short cuts-Concepts –Problems –Time and work - Short –uts -Concepts -Problems.					
UNIT-III:		Simple interest –compound interest- Concepts- Problems					
UNIT-IV:		Verbal Reasoning : Analogy- coding and decoding –Directions and distance –Blood Relation					
UNIT-V:		Analytical Reasoning :Data sufficiency Non-Verbal Reasoning : Analogy ,Classification and series					
Skills acquired from this course		Students relating the concepts of compound interest and simple interest					
Recommended Text		1.”Quantitative Aptitude” by R.S aggarwal ,S.Chand & Company Ltd 2007					
Website and e-Learning Source		https://nptel.ac.in					