

B.Sc., ZOOLOGY

SYLLABUS

**FROM THE ACADEMIC YEAR
2023-2024**

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

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

	PO9: Reflective thinking: Critical sensitivity 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. PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. PO 15: Lifelong Learning: Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of workplace 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, 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 students 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-voice component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state-of-art technologies in conducting an Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and interdisciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome/Benefits
I	Foundation Course To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I,II,III,IV	Skill Enhancement papers (Discipline centric/Generic/Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing/Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, fieldwork 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 know-how 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 stakeholder 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 the respective sectors
IV	DBMS and Programming skill, Biostatistics,	Exposure to industry moulds students into solution
	Statistical Quality Control, Official Statistics, Operations Research	Providers - Generates Industry ready graduates - Employment opportunities enhanced
II year Vacation activity	Internship /Industrial Training	Practical training at the Industry/ Banking Sector /Private/Public sector organizations/Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva-voce	- Self-learning is enhanced - Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	- Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group/aspiring researchers; 'Training for Competitive Examinations' – caters to the needs of the aspirants towards most sought-after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: For Advanced Learners/ Honors degree		To cater to the needs of peer learners/research aspirant
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill

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	II 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
		--		AI Allied IB Practical	P	2	2	25	75	100
	IV	23BZO2S1	SEC –II	Aquarium Keeping	T	2	2	25	75	100
		23BZO2S2	DSC-I	Animal Behaviour	T	2	2	25	75	100
				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
		--		AI Allied IB Practical	P	2	2	25	75	100
	IV	23BZO3S1	SEC-III	B Biocomposting for Entrepreneurship	T	2	2	25	75	100
	IV	233AT/ 23BZO3S2	DSC-II	Adipadai Tamil/ Nanobiology	T	2	2	25	75	100
				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
		--		AI 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	W Adipadai Tamil/Wildlife Conservation and Management	T	2	2	25	75	100
		23BES4		E. E.V.S	T	2	2	25	75	100
				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		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		5	7	25	75	100
		23BZO6P1		Animal Biotechnology, Microbiology and Immunology Practical	P	2	3	25	75	100
		23BEA6		Extension Activity	P	1	-	25	75	100
		23BZO6S1	PCS	Essential Reasoning and Quantitative Aptitude	T	2	2	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>Panama 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 invertebrata.		PO1, PO2
CO3	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.		PO4, PO6
CO4	To compare and distinguish the various physiological processes and organ systems in lower animals.		PO4, PO5, PO6
CO5	Infer and integrate the parasitic and economic importance of invertebrate animals.		PO3, PO8
Text Books(Latest Editions)			
1.	Ekambaranatha Iyer, 2000. A Manual of Zoology, 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), Drancunculus, 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 economically important invertebrates.	PO3, PO8
Text Books (Latest Editions)		
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai	
2.	Ganguly, Sinha 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 Santuries.										
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 compoundmicroscopie,confocal microscope and electron microscope-Characteristics features-Mendels Principles-DNA-RNA modern concept of gene-central dogma of molecular biology.										
Unit IV	Embroyology and Development of Biology: Gametes (Sex cells)-Egg-Sperm-Fertilization-Cleavage-Developmental stages-Zygote-Clevage-Morula-Blastula and Gastrula.Origin of life,Spontaneous generation theoryof 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, Lacculture, Vermiculture, Poultry Keeping, Dairy farming-Zoological survey of India, Central Marine Fishries Research Institute.										

SEMESTER II

CourseCode	CourseName	Category	L	T	P	S		Inst.Hours	Marks		
									CIA	External	Total
23BZO2C1	CHORDATA	Core	Y	-	-	-	5	5	25	75	100
Learning Objectives											
CO1	To understand the structures and distinct features of Phylum Chordata.										
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.										
CO3	To understand the economic importance of vertebrates										
CO4	To know about the adaptations of vertebrates										
CO5	To understand the evolutionary position of different groups of vertebrates										
	Details							No. of Hours	Course Objectives		
UNIT I	General Characters and Classification of Phylum Chordata: Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (<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>Scoliodon sorrah</i>) General characters and classification, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance.							12	CO1, CO2, CO4, CO5		
UNIT III	Amphibia: General characters and classification - Origin of Amphibia - Type study - <i>Rana hexadactyla</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>Calotes versicolor</i> (endoskeleton of <i>Varanus</i>)) - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification							12	CO1, CO2, CO4, CO5		
UNIT V	Aves and Mammalia: Aves: General characters and classification - Type study - <i>Columba livia</i> - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification - Type study - Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.							12	CO1, CO2, CO4, CO5		
	Total							60			

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.	PO1
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.	PO1, PO2
CO3	Analyze, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5
CO4	Correlate the different modes of life and parental care among different vertebrates.	PO3, PO5, PO6
CO5	Summarise the morphology and ecological adaptation in vertebrates and list out the economic importance.	PO2, PO3, PO5, PO8
Text Books (Latest Editions)		
1.	Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891 p.	
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.	
3.	Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar-144008, 942.	
4.	Ganguly, Sinha, Bharati Goswami and Adhikari, 2004. Biology of animals Vol. II - New central book Agency (p) Ltd.	
5.	Kotpal, R.L.A, Modern text book of Zoology Vertebrates - Rastogi publications. 2009	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.	
2.	Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.	
3.	Hickman, C.P. Jr., F.M. Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.	
4.	Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra-282003, 477 pp.	
5.	Parker and Haswell, 1964. Text Book of Zoology, Vol III (Chordata), A.Z.T, B.S. Publishers and Distributors, New Delhi-110051, 952 pp.	
6.	Pough H. Vertebrate life, VIII Edition, Pearson International.	
7.	Waterman, Allyn J. et al., 1971. Chordate Structure and Function, MacMillan & Co., New York, 587 pp	
8.	Young, J.Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.	
Web Resources		
1.	http://tolweb.org/Chordata/2499	
2.	https://www.nhm.ac.uk/	
3.	https://bit.ly/3Av1Ejg	
4.	https://bit.ly/3kqTfYz	
5.	https://biologyeducare.com/aves/	
6.	https://www.vedantu.com/biology/mammalia	

MethodsofEvaluation		
Internal Evaluation	ContinuousInternalAssessmentTest	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75Marks
	Total	100Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
Understand/ Comprehend(K 2)	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	Cts	Inst. Hours	Marks		
									CIA	External	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 reproductive 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, Pectoral girdle, Pelvic girdle, Forelimb, Hindlimb. Chelonian - 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, Ammocoetes 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, Rana, Bufo, 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	Oncompletionofthiscourse,studentswill;	
CO1	Identifyandrecallthenameanddistinctexternalandinternalfeaturesofanimalsbelongingtophylum Chordata.	PO1
CO2	Explainthestructuralorganizationofvariousorgansandsystemsindifferentclassesofvertebrates.	PO1,PO2
CO3	Analyse,compareanddistinguishthemorphologicalfeaturesanddevelopmentalstagesofchordates	PO4,PO6
CO4	Dissectandexplainvariousorgansandinternalsystemsindifferentvertebratesandcorrelateitsfunction.	PO4,PO5,PO6
CO5	Summarisethe morphologyandecologicaladaptationsinvertebratesandlistouttheeconomicimportance.	PO3,PO8
TextBooks (LatestEditions)		
1.	LalSS,2009.PracticalZoologyVertebrate,RajpalandSonsPublishing,484pp.	
2.	VermaP.S,2000.AManualofPracticalZoology:Chordates,S.ChandLimited,627pp.	
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)		
1.	RobertWilliamHegner,2015.PracticalZoology,BiblioLife,522pp.	
2.	Young,J,Z.,1972.Thelifeofvertebrates.OxfordUni.London.	
WebResources		
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	
MethodsofEvaluation		
Internal Evaluation	ContinuousInternalAssessmentTest	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
Externa lEvaluation	EndSemesterExamination	75Marks
	Total	100Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
SCHEME OFEVALUATION		
I.Dissect and display the digestive system of given bony fish		20Marks
II.Mounting -placoid/Ctenoid scales(Sketch and lable the parts)		5Marks
III.Comment on the given Osteology Specimen		5Marks
IV.IdentifyCommentontheSpotters A,B,C,D &E		15Marks
V.Choose any commercdial 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
ObservationNote/Record		20Marks
Total		75Marks

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 atypical 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, Mollys, Swordtails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.										
Reference Books: - Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi. - Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerk's hire, printed in Hon Kong. - O'Connell, R.F., The freshwater aquarium (1977), Arco Publishing Company, INC New York. - Jingran V.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi - Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi.											
Course Outcome: - Students to learn about different ornamental fishes and identify the diseases of them - To develop entrepreneurial potential in the field of aquarium and get self employment.											

DSC-I

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.
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SEMESTER III

Course Code	CourseName	Category	L	T	P	S	Inst.Hours	Marks			
								CIA	External	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 comrehent 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,theoriesonCarcinogen esis,Ageingof Cells – Apoptosis and Stemcellstudies.							12	CO1,CO2,C O3,CO4,CO5		
UNIT IV	Mendelian Genetics and Inheritance: Mendeliangenetics:Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, backand testcross; Interaction of genes: Incompletdominance,codominance,complementar ygenes,supplementarygenes,inhibitinggenes,lethalgenesa							12	CO1,CO2,CO 4,CO5		

	ndativism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups sex linked inheritance- eye colour in Drosophila, colour blindness and hemophilia in man.		
UNIT V	Linkage and Crossing Over: Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, Human and Population Genetics: Human genetics: sex determination – Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis; Eugenics, Euphenics, and Euthenics. gene pool, gene frequency and genotype frequency.	12	CO1, CO2, CO4, CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	To understand and recall the basic structure, origin 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.		
Reference 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 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, 734 pp.
7.	Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.
8.	Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609 pp.
9.	Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd., p. 923
10.	Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p. 832.
11.	Loewy, A.G. and P. Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., New Deihi-110020, 516 pp.
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. Essential of Cytology, Himalaya Publishing House, Bombay-400004, 368 pp.
14.	Swansen, C.P. and P.L. Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New Delhi-110001, 373 pp.
15.	Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education. p. 1080.

Web Resources

1.	http://www.microscopemaster.com/organelles.html
2.	https://bit.ly/3tXwDSB
3.	https://bit.ly/3tWNpRX
4.	https://bit.ly/3AuYR9M
5.	https://rsscience.com/cell-organelles-and-their-functions/

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-III

Course Code	Course Name	Category	L	T	P	S		Inst.Hours	Marks		
									CIA	External	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 theories 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 gland observation of polytene chromosome in salivary gland 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							12	CO4		

	colormutant-Bareye, Whiteeye, Sepiaeye. Mounting of Sex Comb of Drosophilamelanogaster.		
UNIT V	Study offlower colour in Antirrhinum/ Mirabilis. Coatcolour in Mice. Comb pattern in Poultry. Blood Typing.Biometrical Computation of: Mean, Median and Mode, Variance, StandardDeviation.Problemson:Student's't'testandChisquaretest. GeneticproblemsonMultiplealleles, GeneInteractions(Complemetary/Supplementary/DominantEpistasisgeneinteractions). GeneticProblemsonLinkageandCrossingover:03 Prs.a)Drosophila.b)Maize.c)Human(SexLinkage).	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 Techniquetodistinguishgeneticmaterialindifferentorganisms to surveybiodiversity.	PO4,PO6	
CO4	Toassessthechangesingeneticmaterialandtopredict andconsidertheconsequencesofthosechanges.	PO4,PO5,PO6	
CO5	Toreportandjustifytheresultsofmolecularandgeneticexperimentsinanaccurateandmeaningful 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.	AndreasHofmann,SamuelClokie,2018.Wilsonand Walker'sPrinciplesand TechniquesofBiochemistryandMolecularBiology,CambridgeUniversityPress ,UK.		
2.	Bancroft,J.D.andGamble,M(2007)TheoryandPracticeofHistological Techniques,6thEdition,ChurchillLivingstone.		

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
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 mendels law using beads.	20 Marks
II. Mounting of squamous epithelial cells/Blood cells sketch and lable the parts	10Marks
III.Finding out the trait type of the mendelian traits inMan 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 Cellbiology and two from Genetics	15Marks
Observation note book	20 Marks
Total	75 Marks

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)

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
Learning Objectives: ➤ To highlight the importance of Biocomposting for entrepreneurship in waste management. ➤ To enable students for setting up Biocompost units and bins for waste reduction.											
UNIT I	Biocomposting–Definition, types and ecological importance.										
UNIT II	Types of Biocomposting technology–Field pits/ground heaps/tank/large-scale/batch and continuous methods.										
UNIT III	Preparation of Biocompost pit and bed using different amendments.										
UNIT IV	Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.										
UNIT V	Economics of establishment of a small biocompost unit– project report proposal for Self Help Group (Income and employment generation). Practical ➤ Preparation procedures for Biocompost pit. ➤ Selection of Biocompost material, separation of Compostable and Non-compostable materials. ➤ Packing and marketing of Biocompost. ➤ Field visit to Biocomposting unit.										
References Bikas R. Pati & Santi M. Mandal (2016). Recent trends in composting technology. Vander Wurff, A. W. G., Fuchs, J. G., Raviv, M., Termorshuizen, A. J. (Editors) 2016. Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COST Action FA1105, www.biogreenhouse.org.											
Course outcomes: ➤ The students will gain knowledge about the process of Biocomposting. ➤ Students will be able to demonstrate Biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc. ➤ To gain knowledge about the economic cost of establishing small Biocompost units as a cottage industry.											

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		
								CIA	External	Total
23BZO4C1	Developmental Biology	Core	Y	-	-	-	4 4	25	75	100
LearningObjectives										
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 post embryonic 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 of frog & 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, Meta nephric 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 of culture of 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			

MappingwithProgrammeOutcomes:		
Course Outcomes		
CO1	Todescribeandillustratethesignificanceofcellularprocessesinembryonic development.	PO1
CO2	Torelatethefactorsthatcontributetothedevolutionalprocess,constructfa temapsandillustratethestepsinmorphogenesisandorganogenesis.	PO1,PO2
CO3	To correlate the involvement of specific cell types in theformation of specific organs and explain the importanceofmorphogens.	PO4,PO6
CO4	Todistinguishbetweenthe differenttypesofdevelopmentalmechanismsinv ariousorganismsandappraisethespecies- baseddifferencesindevelopment.	PO4,PO5,PO6
CO5	Tojustifyandvalidatetheroleofenvironmentand geneticsininfluencingembryonicdevelopment	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		
Internal Evaluation	ContinuousInternalAssessmentTest	25Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75Marks
	Total	100Marks

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 off-beat situations, Discussion, Debating or Presentations

SEMESTER IV

Course Code	CourseName	Category	L	T	P	S		Inst. Hours	Marks		
									CI A	Extrenal	Total
23BZO4P1	DEVELOPMENTAL BIOLOGY PRACTICAL	Core	-	-	P	-	3	3	25	75	100
LearningObjectives											
CO1	Toencouragestudentstointerprettheorganizationofgenomicmaterialandtoresearchtheoriesofgenetic inheritance.										
CO2	Toimparttheskillsrequiredtopreparesamplesofgeneticmoleculesandtodeterminetheirpurity,structur eandcharacteristicsandtoanalyzegenomic preparations.										
CO3	Tostudythechangesingeneticmaterialandtopredictandconsiderthe consequencesofthosechanges.										
CO4	Toencouragestudentstoreportandjustifytheresultsofmolecularandgenetic experimentsinanaccurateandmeaningfulmanner.										
	Details							No.of Hours	Course Objectives		
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 techniquestodistinguishgeneticmaterialindifferentorganismstosurveyb iodiversity.							PO4,PO6			
CO4	Toassessthechangesingeneticmaterialandtopredict andconsidertheconsequencesofthosechanges.							PO4,PO5,PO6			
CO5	Toreportandjustifytheresultsofmolecularandgeneticexperimentsinanac curateandmeaningful 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.	AndreasHofmann,SamuelClokier,2018.Wilsonand Walker'sPrinciplesand TechniquesofBiochemistryandMolecularBiology,CambridgeUniversityPress,UK.
2.	Bancroft,J.D.andGamble,M(2007)TheoryandPracticeofHistological Techniques,6thEdition,ChurchillLivingstone.
3.	IanFreshneyR.,2010.CultureofAnimalCells:AManualofBasicTechnique And SpecializedApplications,JohnWiley&Sons,USA.
4.	JohnKiernan(2008)HistologicalandHistochemicalMethods:Theoryand Practice,4thedition,ColdSpringHarborLaboratoryPress.
5.	Kerr,J.(2013)FunctionalHistology,Elsevier6.Kiernan,J.A.(2008)Histological&Histochemicalmethods:The ory&Practice(4thEd).ColdSpring HarborLaboratoryPress.
6.	LeonardDavis,MarkDibner,JamesBattey,2012.BasicMethodsInMolecular Biology,ElsevierSciencePubilshingCo.,NY,USA.
	LuizCarlos(2005)BasicHistology:TextandAtlas(11thEd).McGrawHill Medical.
7.	RobertF.Schleif,PieterC.Wensink,2012.PracticalMethodsInMolecular Biology,Springer-Verlag,NY,USA.
	Ross,M.H.,Kaye,G.I.&Pawlina,W.(2002)Histology:Atextandatlas(4th ed).LippincottWilliams&Wilkins.
	SarahStauffer,AaronGardner,WilkoDuprez,DewiAyuKencanaUngu,PhilipWisner,2018.LabsterVirtualLab Experiments:BasicGenetics,Springer Publishers,NY,USA.
WebResources	
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
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

Mapping with Programme Outcomes:

	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 prosta glandins, 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 histoarchitecture of male reproductive system; Testis: Cellular functions; Spermatogenesis and its hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract; Andropause
UNIT III	Outline and histoarchitecture of female reproductive system; Ovary: oogenesis and its hormonal regulation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles and their regulation, changes in the female tract; Menopause
UNIT IV	Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy 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 functions 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. JusticeKuldipSingh1998.HandbookofEnvironment,ForestandWildlifeProtectionLawsinIndia,NatrajPublishers,Dehradun.
5. Hosetti,B.B.1997ConceptsinWildlifeManagement,DayaPublishingHouse,Delhi.
6. Sutherland, W. J2000.Theconservationhandbook:Research,ManagementandPolicy.BlackwellScience.
7. Caughley, G. and Sinclair, A. R. E1994Wildlifeecologyandmanagement.BlackwellScience.
8. WoodroffeR, 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 RH Jr. (ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D. C., Nataraj Publishers, Dehra Dun, p547.
2. Rodgers WA, 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 Perspective, 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 Approaches of wildlife.
2. To integrate and assess the National, international approaches for biodiversity conservation.
3. To analyse and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.
4. To explain the role 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	Exter nal	Total
23BZO5C1	EVOLUTIONARY BIOLOGY	Core	Y	-	-	-	4	5	25	75	100
LearningObjectives											
CO1	Evolutionarybiologyisabranchofthebiologicalsciencesconcernedwiththeoriginoflifeandthedi versificationandadaptationoflifeformsovertime.										
CO2	Thiscoursehelpstounderstandtheimportantprocesses,principles,and conceptsofevolution.										
CO3	ToprovideadequateinformationontheLamarckism-NeoLamarckism– Darwinism,NeutralTheoryofMolecularEvolution,andHumanGenomeProject.										
CO4	Toexplaintheimportanceofthefossilrecordsinevolutionarystudies,andthe roleofphylogeneticstudiesinthewidercontextofbiodiversityandconservation.										
CO5	In this course,we will apply the knowledge of human evolutionary history tosimulate how genetic variation within and among human populations affects risk,diagnosis,andtreatmentofmodern diseases.										
UNIT	Details							No.ofHours	Course Objectives		
UNIT I	Inorganic and organic evolution-History of evolutionarythought,Primordialearthandprimevalatmosphere,Ch emical origin of life: Synthesis of organic molecules,Urey- Miller experiment, Origin of prokaryotes and eukaryotes.							12	CO1		
UNIT II	Lamarckism-NeoLamarckism-Darwinism- NeoDarwinismandmodernsynthetictheory- DeVrie’sMutationtheory–modernconceptsofmutation- Mutationandtheirroleinevolution-Animal Colouration andMimicry.							12	CO2		
UNIT III	Isolating mechanisms-Modes of speciation- Hybridizationisanevolutionarycatalyst-Law of Adaptive Radiation- Adaptive radiation in reptiles and mammals- Convergence and parallelism-Evolutionary constancy.							12	CO3		
UNIT IV	Morphological,physiologicalandbiochemical,embryological,Tax onomicalandgeographicalevidences-Palaeontologicalevidences– evolutionary genomics.Types of rocks-Geological timescale– Natureoffossils-Datingoffossils-Fossilrecordsof man andfossilrecordsofhorse.							12	CO4		
UNIT V	Naturalselectioninactioninman-levelofselection- Eugenics, Euphenics and Euthenics-Adaptation- HumanGenomeProject– 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 in reptiles and mammals,	PO4, PO5, PO6
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 text book of Organic Evolution, Nirali Prakashan,	
6.	Rastogi VB. 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.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Burns GW. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co. Inc.	
2.	Gardner EF. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.	
3.	Harth and Jones EW. 1998. Genetics – Principles and Analysis. Jones and Bar Hett Publ. Boston.	
4.	Levine L. 1969. Biology of the Gene. Toppan.	
5.	Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.	
6.	Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.	
7.	White MJD. 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	

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/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)

SEMESTER-V

Course Code	CourseName	Category	L	T	P	S		Inst. Hours	Marks		
									CIA	External	Total
23BZO5C2	ANIMAL PHYSIOLOGY	Core	Y	-	-	-	4	5	25	75	100
Learning Objectives											
CO1	TofamiliarisestudentstheprinciplesandbasicfactsofAnimalPhysiology										
CO2	Togivestudentaninsightaboutthemolecularandcellularbasisofphysiologicalfunctions in animals.										
CO3	Togiveanideaabouttheregulationoforgansystemfunctionsinawholeanimalusingaconceptualmodeloffeedbacktoexplainhomeostasis.										
CO4	Tomakethestudentsawareabouthowthestructure-functionrelationshipsandits synchronisationwiththemolecularsignals.										
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- Bohreffect-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–Heartbeatanditsregulation -pace maker – Cardiac cycle – ECG - Pulse and bloodpressure.Nephronstructure&mechanismofurinefor mation, Regulation of acid base balance,Excretoryproducts,Osmoregulationinfishes.							12	CO2		
UNIT III	Muscle&NervePhysiology Typesofmuscles–Ultra structure of striated muscle,Muscle contraction&properties,Neurons– structure&types-Impulse propagation,synaptic transmission, neurotransmitters-Reflexaction, Nervedisorders–epilepsy, Alzheimer’sdisease, Parkinson’sdisease.							12	CO3		
UNIT IV	SenseOrgans Structureof eye,physiology ofvision,visual elements and pigments, photochemistry of vision-Eyedefects–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 processes.		PO1, PO2
CO3	be able to develop the idea of multi-level controlling and feedback mechanisms in relation to various physiological functions.		PO4, PO6
CO4	be able to understand the basic physiological processes 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. Saunders 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, 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.RandKumar,N.2017.Animalphysiologyandbiochemistry,Vishal publishingcompany,Jalandhar,864pp.	
6.	Sreekumar,S.2010.Basicphysiology,PHIlearningprivateltd.,NewDelhi.210Pp	
7.	TortoraG.J.&DerricksonB.,2016.PrinciplesofAnatomyandPhysiology,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		
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/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:

	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	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, bio transformation, 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	BiodiversityConservation: Biodiversity crisis – habitat degradation, poaching of wildlife.-Socio economic and political causes of loss of biodiversity.- Insituandexsituconservationofbiodiversity- HotspotsofBiodiversity.Greenpeacemovement-Chipko Movement-Roleofgovernmentagencies:CentralandState 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	
CourseOutcomes			
Course Outcomes	Oncompletionofthiscourse,studentswill;		
CO1	Understandthefundamentalstructureandfunctionsof the ecosystem.		PO1
CO2	Assesstheinter-relationshipbetweenorganismsand Between bioticandabioticfactorsinanecosystem.		PO1,PO2
CO3	Analyzethefactorsthatcausepollution,climatechange, lossofbiodiversityanddepletionofresources.		PO4,PO6
CO4	Evaluatetheimpactofhumanpopulationgrowthand socio-economicdevelopmentonthestructureandfunctionof theecosystem.		PO4,PO5,PO6
CO5	Designplans to scientifically solve environmental problemsusingbiologicaltools,technologiesandgovernmentpolicies.		PO3,PO8
TextBooks (LatestEditions)			
1.	MatthewR. Fisher, 2018. EnvironmentalBiology.OpenOregonEducational Resources.JamesMadisonUniversity.		
2.	Asthana,D.K.andMeera,A.2009.Atextbookofenvironmental studies,S. Chand,NewDelhi.		
3.	Sanyal,K.Kundu,M.andRana,s.2009.Ecologyandenvironment,Booksand allied,Kolkata.		
4.	Grant,W.E.andSwannack,T.M.,2008,EcologicalModelling,Blackwell.		
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)			
1.	OdumE.P.1983.BasicEcology,Saunders,NewYork		
2.	Wilkinson,D.M.,2007,FundamentalProcessesinEcology:AnEarthsystem Approach,OxfordUniversityPress,UK.		
3.	Saha,T.K.2010.EcologyandEnvironmentalbiology,BooksandAllied, Kolkata.		
WebResources			
1.	https://bit.ly/2VYWOM5		
2.	https://bit.ly/2VZQFiT		
3.	https://bit.ly/3kqdXYA		
4.	https://bit.ly/39rvvgt		

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/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:

	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). Fundamentals 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	credits	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-dioxide, 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 ecology lab and develop skill about quantitative determination of biomolecules and quantitative analysis of blood.		PO1
CO2	Demonstrate the instruments, discuss the clinical importance and its applications, and explain the Principle of bioinstruments.		PO1,PO2
CO3	Understand and identify the chemical composition of major and minor nutrients and analyse Physio- Chemical parameters that regulate metabolism.		PO4,PO6
CO4	Evaluate and Examine the various parameters of haematology and biochemistry and Identify the Nitrogenous waste products of animals.		PO4,PO5,PO6
CO5	Summarise the effect of various physical and chemical factors on enzyme activity/. Compile the changes in various physiological parameters in man and other animals using various tools and techniques.		PO3,PO8
Text Books (Latest Editions)			
1.	Widmaier, E.P., Raff, H. and Strang, K. T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP.		
2.	Bishop, 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 wastewater, 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.PrinciplesofAnimalPhysiology,EdwardArnoldLtd,London.,342PP.
4.	Guyton,A.C.andHall,J.B.,2011.TextBookofMedicalPhysiology,9th Edition,W.B.SandersCompany,PrismBooks(Pvt.)Ltd.,Bangalore.,1064PP.
5.	Wilson,J.A.1984,PrinciplesofAnimalPhysiology,MacmillanPublishing.,426PP.
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/3lO29yP

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

SCHEME OFEVALUATION

I. Estimation of Oxygen Cosumption 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 biolgy Three from Physiology)	15Marks
V.Observation note book and Field visit Report	20 Marks
Total	75 Marks

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)

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
Learning Objectives											
CO1	To explain the main mechanisms of environmental toxicants in causing a toxic response in living organisms.										
CO2	To describe the optimal use of nature, in the form of plants, animals, bacteria, fungi and algae, to produce renewable energy, food and nutrients in a synergistic integrated cycle of profit-making processes										
CO3	To provide practical knowledge and hands-on tools and techniques for dose-response assessment of hazardous substances.										
CO4	The use of biological systems for remediation of contaminated environments (land, air, water), and for environment-friendly processes.										
CO5	To develop data that can ensure appropriate protection of public health from the adverse effects of exposure to environmental agents.										
UNIT	Details							No. of Hours	Course Objectives		
UNIT I	Evolution: Fossils: Trilobite, Nautilus, Living fossil limulus and Peripatus. Animal evolution: Importance of Archaeopteryx, 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. Estimation of chlorine water. Environmental Determinants: Estimation of BOD/Estimation of COD. Physicochemical properties of water. Toxicity Testing: Methodology of toxicity testing—acute and chronic tests (demonstration), Use of LC50 values—sublethal effects of critical pollutants on fish.							12	CO2		
UNIT III	Preparation of nutrient agar medium. Settling rate of bacteria from air. Bacterial Gram staining. Identification of bacteria from air up to colony characteristics. Enumeration of bacteria from air. Study of collection, concentration and preservation techniques of algae. Identification techniques of algae (Study of morphological characteristics of algae). Identification and significance of major algae with regard to pollution. Calculation of Nygaard's Indices. Calculation of species diversity-Margalef diversity index, Calculation of Kothe's species deficit index. Estimation of Standard Plate Count (SPC) from water. Estimation of MPN of coliforms from water.							12	CO3		

UNIT IV	Determination of phosphate levels in clean and pollutedwaters. Determination of pH of soil. Determination oforganicmatterinsoil.Determinationofpercentcompositio nofsolubleandinsolublecomponentsofcommunitysolidwas te.Determinationofpercentcomposition of various components of community solidwaste.Studyoftreatmentefficiencyofwater-hyacinth inremovalofTDSandchangesinpH.	12	CO4
UNIT V	MiniProject and Spotters:Bio gas production - Foodtoxicitytests- Fieldvisit,Refluxcondenser,BODincubator,Spectrophoto meter,Colorimeter,Atomicabsorptionspectroscopy,Ultrace ntrifuge,Incubator,HPLC. Visit to wastewater and drinking water treatmentplants.Studyofavermicompostplant.Biogasprodu ction-Foodtoxicitytests- Fieldvisit,Refluxcondenser,BODincubator,Spectrophoto meter,Colorimeter,Atomicabsorptionspectroscopy,Ultrace ntrifuge,Incubator,HPLC. Visittowastewateranddrinkingw atertreatmentplants.Studyofa vermicompostplant.	12	CO5
	Total	60	
CourseOutcomes			
Course Outcomes	Oncompletionofthiscourse,studentswill;		
CO1	Understandthepropertiesoftoxicants,effects,originandoccurrenceintheen vironmentandexplaintheprincipleandprocedureforqualityevaluation,mon itoring and remediation of contaminated environments.	PO1	
CO2	Estimate the toxic chemicals in the environment. Applytoolsandtechniquesforexperimentingwithenvironmentalproblems.I dentifyandimplement 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,illhealthanddeathwithreferencetoex posuretochemicals.Selectthesuitableexperimentaldesignetoassessthetoxic effects of pesticides and pollutants.	PO4,PO5,PO6	
CO5	Discuss the applicability of chemical analysis and toxicitydata,bothindividuallyandtogether,inrisk assessmentandenvironmentalmonitoring.	PO3,PO8	
TextBooks (LatestEditions)			
1.	AbhijitDutta,2009.Experimentalbiology:ALaboratoryScience,Narosa,NewDelhi.		
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).

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

1.	Allan S. Cragg, 2010. Environmental Biotechnology, Oxford University Press. UK.
2.	APHA, 1992. Standard Methods for the examination of water and wastewater, American Public Health association, Washington D.C.
3.	APHA, 2005. Standard Methods for the examination of water and wastewater, 21 st Ed., American Public Health association, Washington D.C.
4.	Boyd C.E., 1992. Water Quality and Pond Soil Analysis for Aquaculture, C.E. Boyd, C.S. Tucker, Auburn University.
5.	Csuros, M., 1994. Environmental Sampling and Analysis for Technicians, M. Lewis Publishers, Boca Raton. Florida.
6.	Eugenia et al, 2008. Environmental Biotechnology and cleaner Bio Process, Taylor & Francis London, UK.
7.	Francis, B.M., 1994. Toxic Substances in the Environment, John Wiley and Sons.
8.	Hauser, B.A., 2001. Drinking Water Chemistry: A Laboratory Manual, Lewis Publishers, Boca Raton, Florida
9.	Maier, R.M., Pepper I.L. and C.P. Gerba, 2009. Environmental Microbiology. 2 nd Ed. Academic Press. USA
10.	Rastogi, S.C., 2005. Experimental physiology, New Age International Pvt. Ltd. New Delhi.
11.	Rump, H.H., 1999. Laboratory Manual for the Examination of Water, Wastewater and Soil, 3 rd Ed., Wiley-VCH, New York.

Web Resources

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

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 off beats situations, Discussion, Debating or Presentations	
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		10 Marks
III. Identify Sketch and Comment on the given apparatus /Living fossils		10 Marks
IV. Identify sketch and comment on the given spotters from Evolution		15 Marks
V. Observation note book and Field visit Report		20 Marks
Total		75 Marks

Mapping with Programme Outcomes:

	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	Category	L	T	P	S		Inst. Hours	Marks		
									CIA	External	Total
23BZO6C1	ANIMAL BIOTECHNOLOGY	Core	Y	-	-	-	4	6	25	75	100
Learning Objectives											
CO1	To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.										
CO2	To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.										
CO3	To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.										
CO4	To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods										
	Details							No. of Hours	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 tools to obtain the desired Products from the cells.	PO1	
CO2	To develop and explain the protocols for genetically manipulating cells and produce transgenic animals	PO1, PO2	
CO3	To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.	PO4, PO6	
CO4	To choose the correct methods of transgenesis and to consider their use in improving animal husbandry Nationally and globally	PO4, PO5, PO6	
CO5	To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.	PO3, PO8	
Text Books (Latest Editions)			
1.	Singh B.D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.		
2.	Sasidhara, R., 2015. Animal biotechnology, MJP publishers.		
3.	Dubey R.C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.		
4.	Dubey S.K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.		
5.	Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication.		
6.	Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi.		
7.	Sambamurthy K., Ashutosh Kar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd.		
8.	Ramdoss P., 2009. 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–Aguidetogeneticengineering,WMCbrownpublisher,UK.
5.	Ramawat,K.GandShaileyGoyal,2009.Comprehensivebiotechnology, S.Chandcompany,NewDelhi,India.
6.	PrimroseS.B.,R.M.TwymanandR.W.Old,2001.Principlesofgenemanipulation,Wiley- Blackwell,UK.
7.	PrimroseS.B.,2001.MolecularBiotechnology,PanimaPublishingCorporation,NewDelhi,India.
8.	HamesB.D.andHigginsS.J.1995.GeneProbes:APracticalApproach,OxfordUniversityPress,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

Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions
Understand/Compr ehend(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:

	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
Learning Objectives											
CO1	To become familiar with the foundation concepts of history of Microbiology										
CO2	To understand the structure and functions of a typical prokaryotic cell										
CO3	To gain the knowledge of microscopy and staining concepts										
CO4	To understand and implement disposal and safety measures										
	Details								No. of Hours	Course Objectives	
UNIT I	Introduction to microbiology History, scope, branches of microbiology. Contribution of Leeuwenhoek, Jenner, Pasteur, Koch, Systematic position: 5 kingdom classification of Whittaker and 3 kingdom classification of Carl Woese. Comparison of Bacteria, Archaea, Eukarya (tabular and diagrammatic). Controlling microbes.								12	CO1	
UNIT II	Introductory Mycology, Bacteriology and Virology General characteristics and outline classification of fungi, Morphology of some common fungi Rhizopus, Aspergillus, Penicillium- Yeasts: General characteristics and outline classification of yeasts 3. General characteristics of Lichens and Mycorrhiza. Classification of bacteria. General characteristics of Cyanobacteria : General characteristics, Magnetosomes, Enrichment and isolation of Magnetotactic bacteria. Types of staining Virus General characteristics, Structure and Classification. DNA viruses: Herpesviruses and Poxviruses. RNA viruses Paramyxoviruses, Rhabdoviruses.								12	CO2	
UNIT III	Immune Cells and Organs: Overview of Immune System - General concepts and Haematopoiesis. Cells of the immune system - Immune Cells. Organs of the Immune system: Primary lymphoid organs - Secondary Lymphoid organs - Innate and Adaptive Immunity: Innate and Adaptive Immunity; (Cell mediated and humoral). Major Histocompatibility Complex (MHC): HLA antigens.								12	CO3	
UNIT IV	Antibodies: Structure, function and properties of the Immunoglobulins, Different classes of Immunoglobulins; antigenic determinants on antibodies (isotype, allotype and idiotype). Hybridoma technology - production of monoclonal antibodies and catalytic antibodies (abzymes). Hypersensitivity: classification and brief description of various types of hypersensitivities. Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases.								12	CO4	

UNIT V	Transplantationimmunology:Typesofgrafts,immunologicbasisofgraf trejection, immunosuppressivetherapyandclinicaltransplantation. ClinicalImm unology: Immunityandtumors-tumorantigens (TSTA and TAA), immune response to tumors.Tumor evasion of theimmune system, Immunotherapyfortumors.Immunityagainst- viral,bacterialandparasiticinfections.Vaccines:Types and uses- Immunization schedule for children.		12	CO5
	Total			
CourseOutcomes				
CourseOut comes	Oncompletionofthiscourse,studentswill;			
CO1	Tounderstandhistory,relevanceofmicrobiologyand classificationofbacteria		PO1	
CO2	Tounderstandtheworkingofvariousmicroscopesand theirapplication		PO1,PO2	
CO3	Togainknowledgeofvarious(physicalandchemical)metho ds of controlofmicroorganismsandsafety measurestobefollowedwhilehandlingmicrobes		PO4,PO6	
CO4	Tounderstand the structure of bacterial cells, its organelles,physiologyandbehaviour.		PO4,PO5,PO6	
CO5	Tolearndifferentmethodsofstainingbacteriaanddemonstr ate proficiency in handling aseptic bacteriologicalspecimen.		PO3,PO8	
TextBooks(LatestEditions)				
1.	AnejaK.R.,ExperimentsinMicrobiology,plantpathology,Tissuecultureand MushroomCultivation,NewAgeInternational,NewDelhi.			
2.	AtlasR.M.,Microbiology–fundamentalsandapplications,Macmillan PublishingCompany,NewYork.			
3.	RavindraNath,Fundamentals ofBiologyCoursesforBiotechnology,-Vol.1, SpecialBangaloreUniversityedition,KalayaniPublishers.			
4.	GreenwoodD,RichardCD,JohnSandPeutherF(1992).MedicalMicrobiology, 16thedition.ELBS,Churchilllivingstone.			
ReferencesBooks (Latesteditions,andthestyleasgivenbelowmustbestrictlyadheredto)				
1.	Alexopoulos C.J.and Mims C.W., Introductory Mycology, New Age 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,McGrawHillBookCompany,NewYork.			
6.	BensonHaroldJ,MicrobiologicalApplications,WCBMcGraw–Hill,NewYork.			

7.	Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited.
8.	Collins CH, Patricia M, and Lyne JM (1995). Collins and Lyne's Microbiological Methods 7th edition. Grange, Butterworth, Oxford.
9.	Cappuccino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cummings Inc. California.
10.	Pelczar MJ, Chan ECS 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.

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 off-beat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	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	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	Toencouragestudentstointerprettheorganizationofgenomicmaterialandtoresearchtheoriesofgenetic inheritance.										
CO2	Toimparttheskillsrequiredtopreparesamplesofgeneticmoleculesandtodeterminetheirpurity,structure and characteristics andtoanalyzegenomic preparations.										
CO3	Tostudythechangesingeneticmaterialandtopredictandconsiderthe consequencesofthosechanges.										
CO4	Toencouragestudentstoreportandjustifytheresultsofmolecularandgenetic experimentsinanaccurateandmeaningfulmanner.										
UNIT	Details								No.of Hours	Course Objectives	
UNIT I	Isolationofgeneticmolecules:IsolationofDNAfromspleen.TotalRNAisolati onfromplant/animalcells								12	CO1	
UNIT II	Qualitativeandquantitativeanalysis of geneticmolecules: Determination of thepurityofisolatedDNAandRNAsamplesbyUVspectrophotometry.Quantit ative estimation of DNA by Spectrophotometry								12	CO2	
UNIT III	Molecularanalysis:AgarosegelelectrophoresisofDNA.Restrictionfragment lengthpolymorphismstudy.Eliza,WesternBlot.								12	CO3	
UNIT IV	BloodGrouping.Total WBCandRBC.Estimation ofHaemoglobin. Aggutation test to show Antigen -Antibody reaction. Preparation of Serumcomponents.RadialImmunodiffusionetest.DoubleImmunodiffusionetes t.RestrictionDigestionofplasmidDNA.Ligationofrestrictedfragments.Hangi ng drop experiment for observation of live bacteria from given sample.								12	CO4	
UNIT V	Basicanimalcellculturetechniqueandtransgenesis:Trypsinizationoflivercells .DeterminationoftheviabilityoftrypsinizedcellsbyTrypanBluemethod.Creati onoftransgenicfliesthroughvirtuallabactivity(https://media.hhmi.org/bioint eractive/vlabs/transgenic_fly/index.html)								12	CO5	
	Total							60			
MappingwithProgrammeOutcomes: CourseOutcomes											
Course Outcomes	Oncompletionofthiscourse,studentswill;										
CO1	Todescribe,examineandinterprettheorganizationof genomicmaterialandtoresearchtheoriesofgeneticinheritance.							PO1			
CO2	Toprepare samples of genetic molecules and to determinetheirpurity,structureandcharacteristics.							PO1,PO2			
CO3	Toexperimentwithgenomicpreparationsanddevisetechniquet o distinguishgeneticmaterialindifferent 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 L., 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.	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 Dibner, 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		
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		Studnets 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					