



திருவள்ளூர் பல்கலைக்கழகம்
THIRUVALLUVAR UNIVERSITY
SERKKADU, VELLORE-632115

B.Sc. Zoology

SYLLABUS

FROM THE ACADEMIC YEAR
2023 – 2024

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TANSCHÉ REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc., Zoology
Programme Code:	
Duration:	UG - 3 Years
Programme Outcomes:	<p>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</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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</p> <p>PO7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team</p> <p>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.</p> <p>PO9: Reflective thinking: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.</p> <p>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.</p>

<p>PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.</p> <p>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.</p> <p>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 behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.</p> <p>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.</p> <p>PO 15: Lifelong learning: Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.</p>
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<p>Programme Specific Outcomes:</p>	<p>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.</p> <p>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</p> <p>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.</p> <p>PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society: To contribute to the development of the society by collaborating with stakeholders for mutual benefit</p>
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Credit Distribution for UG Programmes

Sem I	Cre dit	H	Sem II	Cre dit	H	Sem III	Cre dit	H	Sem IV	Cre dit	H	Sem V	Cre dit	H	Sem VI	Cre dit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5.3. Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5.4. Core Course –/ Project with viva-voce CC - XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic / Discipline Specific	3	4	2.5 Elective II Generic / Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic / Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement - (Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	3		23	3		22	3		25	3		26	3		21	3

		0		0		0		0		0		0		0
Total – 140 Credits														

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

First Year – Semester-I

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

Semester-II

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

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	30

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	30

**Third Year
Semester-V**

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	26
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		26	30

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	30

Consolidated Semester wise and Component wise Credit distribution

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

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

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
METHODS OF ASSESSMENT		
Remembering (K1)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Understanding of facts and ideas by comprehending or organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combine data together 	
Application (K3)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Analyzing the question is one that asks the student to break down something into its component parts. • Analyzing requires students to identify reasons, causes or motives and reach a conclusion or generalization. 	
Evaluate (K5)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem-solving skills 	

Highlights of the Revamped Curriculum:

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

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	Foundation Course To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world.	<ul style="list-style-type: none"> • Instil confidence among students • Create interest for the subject
I, II, III, IV	Skill Enhancement papers (Discipline centric / Generic / Entrepreneurial)	<ul style="list-style-type: none"> • Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable • Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects • Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc. • Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment • Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	<ul style="list-style-type: none"> • Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background • Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in the respective

		sectors
IV	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	<ul style="list-style-type: none"> • Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	<ul style="list-style-type: none"> • 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		<ul style="list-style-type: none"> • To cater to the needs of peer learners / research aspirants

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

First Year Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Course 1 : Invertebrata I 2. Invertebrata II 3. Lab course 1 3. Allied – 1.Chemistry-I - 2.Botany-I (Any one out of two)	4 3 3 3	4 3 3 4
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	30

SEMESTER - I

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	INVERTEBRATA I	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	To understand the basic concepts of lower animals and observe the structure and functions.										
CO2	To illustrate and examine the systemic and functional morphology of various group of invertebrates.										
CO3	To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity.										
CO4	To compare and distinguish the general and specific characteristics of reproduction in lower animals.										
CO5	To infer and integrate the parasitic and economic importance of invertebrate animals										
UNIT	Details							No. of Hours	Course Objectives		
I	Protozoa: Introduction to Classification, taxonomy and nomenclature. General characters and classification of Phylum Protozoa up to classes. Type study - <i>Paramecium</i> and <i>Plasmodium</i> - Parasitic protozoans (<i>Entamoeba</i> , <i>Trypanasoma</i> & <i>Leishmania</i>) - Economic importance Nutrition in protozoa - Host-parasitic interactions in <i>Entamoeba</i> and <i>Plasmodium</i> -Locomotion in protozoa							12	CO1		
II	Porifera: General characters and classification up to Classes. Type study - Ascon&Sycon - Canal system in sponges - Skeleton in sponges, Economic importance, Canal system in sponges - Reproduction in sponges.							12	CO2		
III	Coelenterata : General characters and classification up to classes – Type study - <i>Obelia</i> and <i>Aurelia</i> - Corals and coral reefs - Polymorphism - Economic importance -							12	CO3		

	Mesenteries in Anthozoa - Economic importance of corals and coral reefs - Polymorphism in Hydrozoa.		
IV	Platyhelminthes: General characters and classification of up to classes. Type study – <i>Fasciola hepatica</i> . Nemathelminthes: <i>Taeniasolium</i> – Parasitic adaptations. Host- parasitic interactions of Helminth parasites. Nematode Parasites and diseases - <i>Wuchereriabancrofti</i> , <i>Enterobiusvermicularis</i> , <i>Ancylostomeduodenale</i> . Aschelminthes : General characters and classification of up to classes - Type study - <i>Ascarislumbricoides</i>	12	CO4
V	Annelida: General characters and classification up to Classes. Type study – <i>Nereis</i> and <i>Hirudinariagranulosa</i> .MetamerismNephridium and coelomoducts - Modes of life in Annelids.REproduction in polychaetes.	12	CO5
Total		60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Understand the basic concepts of invertebrate animals and recall its structure and functions.	PO1	
CO2	Illustrate and examine the systemic and functional morphology of various groups of invertebrata.	PO1, PO2	
CO3	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	PO4, PO6	
CO4	To compare and distinguish the various physiological processes and organ systems in lower animals.	PO4, PO5, PO6	
CO5	Infer and integrate the parasitic and economic importance of invertebrate animals.	PO3, PO8	
Text Books (Latest Editions)			
1.	EkambaranathaIyer, 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 – McGraw 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

Mapping with Programme Outcomes:

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

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

SEMESTER- I

Course Code CC2	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	INVERTEBRATA II	Core	Y	-	-	-	4	3	25	75	100
Learning Objectives											
CO1	To understand the structures and distinct features of invertebrate phyla.										
CO2	To understand and able to distinguish the characteristic features of each phylum										
CO3	To understand the economic importance of invertebrates										
CO4	To understand the interaction of invertebrates with the environment.										
CO5	To understand the evolutionary position of different groups of invertebrates										
UNIT	Details							No. of Hours	Course Objectives		
I	Arthropoda: General characters and classification of Phylum Arthropoda up to Classes. Detailed study: <i>Penaesusindicus</i> . Affinities of <i>Peripatus</i> – Larval forms in Crustacea – Organization of Centipede and Millipede.							12	CO1, CO2		
II	Mollusca: General characters and classification of Phylum Mollusca up to Classes. Detailed study: <i>Pilaglobosa</i> . Foot and torsion in Mollusca, Economic importance of Molluscs – Cephalopoda as the most advanced invertebrate.							12	CO1, CO2, CO4, CO5		
III	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.							12	CO1, CO2, CO3, CO5		
IV	Detailed study: <i>Periplanetaamericana</i> . Insect pollinators- predators – parasites. Insects associated with human diseases: Mosquitoes, housefly, bed bug, human head louse. Insects associated with household materials: Ants, Termites, Silver fish.							12	CO4, CO5		
V	Insect pests: Insect pests, life cycle and types of damage							12	CO4, CO5		

	to plants. Pest of rice: Rice stem borer (<i>Scirpophagaincertulas</i>) – Pest of Sugarcane: The shoot borer (<i>Chiloinfuscatellus</i>) – Pest of coconut: The rhinoceros beetle (<i>Oryctes rhinoceros</i>) Pest of cotton: The spotted bollworm (<i>Eariasinsulana</i>) – Pests of vegetables: Brinjal-The shoot and fruit borer (<i>Leucinodesorbonalis</i>) – Cauliflower: The diamond black moth(<i>Plutellaxylostella</i>)Pests of fruits: Citrus butterfly(<i>Papiliodemoleus</i>) – Pest of stored products: The rice weevil(<i>Sitophilusoryzae</i>). Principles of Integrated Pest Management.		
Total		60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Classify, Identify and recall the name and distinct features of invertebrate groups..	PO1	
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of invertebrates.	PO1, PO2	
CO3	Analyze, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5	
CO4	Correlate the interaction of invertebrates with humans and critique its economic importance.	PO4, PO5, PO6	
CO5	Summarize the physiology, ecological adaptations to stimulate and integrate the significance of invertebrates to the environment, humans, and agriculture.	PO1, PO2, PO3, PO8	
Text Books (Latest Editions)			
1.	EkambaranathaAyyar, and T. N. Ananthkrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – ViswanathanPvt. Ltd, 842pp		
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12 th edn. S. Chand& Co.		
3.	Kotpal R.L. 2019. Modern Text Book of Zoology, Invertebrtes 9 th Ed., Rastogi Publications, Gangotri, Shivaji Road, Meerut, 1004 pp.		
4.	Vasantharaj David, B. 2001. Elements of Economic Entomology, Popular Book		

	Depot, Chennai. 400pp.	
5.	Ruppert and Barnes, R.D. 2006. Invertebrate Zoology, VIII Edition. Holt Saunders International Edition, Belmont, CA : Thomson-Brooks/Cole, 928pp.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Barrington, E.J.W., 2012, Invertebrate structure and function. Boston – Houghton. Mifflin and ELBS, London.	
2.	Bhamrah, H.S. and Kavitha Juneja, 2002. A text book of Invertebrates. Alinol Publications Private Limited, 4374/4B. Ansari Road, Dayaganj, New Delhi.	
3.	Hyman L.H, 1955. The invertebrates – Vol. I to Vol. VII – McGraw Hill Book Co.	
4.	Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication.	
5.	Parker, J. and Haswell, 1978. A text book of Zoology Vol. I - Williams and Williams.	
6.	Srivastava, M.D.L and Srivastava, 1969. A text book of Invertebrate Zoology, U.S- Central Book Depot, Allahabad.	
7.	Verma, A. Invertebrates: Protozoa to Echinodermata. Narosa Publishing House Private Limited. 35-36 Greams Road, Thousand Lights, Chennai.	
Web Resources		
1.	https://www.nationalgeographic.com/animals/invertebrates/	
2.	https://bit.ly/3kABzKa	
3.	https://www.nio.org/	
4.	https://bit.ly/3IJdUX0	
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	Suggest idea/concept with examples, Suggest formulae, Solve problems,	

(K3)	Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

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

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

SEMESTER I FOUNDATION COURSE

Learning objectives

- To understand the different life forms belonging to various groups of animals.
- To understand the structure and functions of animal cell.
- To make the students to understand the embryology and aware the different developmental stages.
- To provide adequate information on the environmental and evolutionary biology.
- To create awareness on the environmental pollution and to make the student aware on the recent developments in the field of biotechnology.

Unit I

Introduction to animal science- Scope of zoology- Diversity of animal life forms- Invertebrates and chordates- Nomenclature-Economic importance of invertebrates and chordates.

Unit II

Introduction to cell and molecular biology- Prokaryotic and eukaryotic cells- Structural organization of animal cell-Microscopy- Introduction to genetics- Mendelian inheritance- Genes.

Unit III

Introduction to embryology- Gametogenesis- cell division – embryonic developmental stages- organ formation- Nutrition and health- balanced diet- nutritional deficiencies.

Unit IV

Introduction to environmental biology- concepts of ecosystem- Producers-consumers-decomposers. Environmental pollution-Impact on human health- bioremediation. Biodiversity conservation and its importance. Origin of life.

Unit V

Introduction to biotechnology- transgenic animals- application of biotechnology in human health care. Introduction to microbiology- Mycology- bacteriology and virology. Immune organs.

Learning outcomes

- Be able to understand the distinct features of invertebrate and chordate life forms.
- Will understand the role of cell and their organells.
- Students will understand the basis of genetics
- Be aware on the different fields of microbiology

- Understand the fundamental structure of ecosystem

Reference books

1. EkambaranathaIyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd
2. Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.
3. EkambaranathaAyyar, and T. N. Ananthakrishnan, 2000. A Manual of Zoology. Vol 1 (Invertebrata). Part II – Viswanathan Pvt. Ltd, 842pp
4. EkambaranathaIyarandT.N.Ananthakrishnan,-AManualofZoology:ChordataViswanathanPublishers.
5. Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.
6. Gupta G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.
7. Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India
8. Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company
9. Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.
10. Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.
11. Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
12. Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.

SEMESTER - I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	INVERTEBRATA LAB COURSE	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	To identify the different groups of invertebrate animals by observing their external characteristics.										
CO2	To understand the organs, organ system and their functions in lower animals.										
CO3	To get knowledge about the different modes of life and their adaptation based on the environment.										
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.										
UNIT	Details							No. of Hours	Course Objectives		
I	Major Dissection : Cockroach: Circulatory system, Nervous system, Reproductive system. Leech : Nervous System, Reproductive system. Earthworm: Nervous System, Reproductive system. <i>Pilaglobosa</i> : Nervous system. Prawn: Nervous system (including Appendages).							12	CO1		
II	Minor Dissection: Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts. <i>Pilaglobosa</i> : Digestive system (Including radula). Freshwater Mussel: Digestive system.							12	CO2		
III	Mounting: Earthworm: Body setae; Pineal setae. <i>Pilaglobosa</i> : Radula. Freshwater muscle: Pedal ganglia.							12	CO3		
IV	Mounting : Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.							12	CO4		
V	Spotters :(i). Protozoa: Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoebahistoltytica, Plasmodium vivax(ii). Porifera: Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule(iii). Coelenterata: Obelia –							12	CO5		

	Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula(iv). Platyhelminthes: Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcusgranulosus, Taeniasolium, Schistosomahaematobium(v). Nemathelminthes: Ascaris(Male & Female), Drancunculus, Ancylostoma, Wuchereria(vi). Annelida: Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva (vii). Arthropoda: Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. (viii). Mollusca: Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva (ix). Echinodermata: Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva		
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify and label the external features of different groups of invertebrate animals.	PO1	
CO2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.	PO1, PO2	
CO3	Differentiate and compare the structure, function and mode of life of various groups of animals.	PO4, PO6	
CO4	To compare and distinguish the dissected internal organs of lower animals.	PO4, PO5, PO6	
CO5	Prepare and develop the mounting procedure of economically important invertebrates.	PO3, PO8	
Text Books (Latest Editions)			
1.	EkambaranathaIyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai		
2.	Ganguly, Sinha and A dhikari , 2 0 1 1 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.		
3.	Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 0 7 0 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/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Mapping with Programme Outcomes:

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

S-Strong(3)

M-Medium (2)

L-Low (1)

ELECTIVE PAPERS

DISCIPLINE SPECIFIC ELECTIVE COURSES

1. ANIMAL BEHAVIOUR
2. WILDLIFE CONSERVATION AND MANAGEMENT
3. NANOBIOLOGY
4. HUMAN REPRODUCTIVE BIOLOGY

GENERIC ELECTIVE COURSES

1. FOOD, NUTRITION AND HEALTH
2. RADIATION BIOLOGY
3. AGRICULTURAL ENTOMOLOGY

SKILL ENHANCEMENT COURSES

1. ORNAMENTAL FISH FARMING AND MANAGEMENT
2. BIOCOMPOSTING FOR ENTREPRENEURSHIP
3. AQUARIUM KEEPING
4. MEDICAL LABORATORY TECHNIQUES

ANIMAL BEHAVIOUR

Learning Objectives

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

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

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, Mac Millan Company, London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

Web Resources

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

Course Outcomes (COs)

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

WILDLIFE CONSERVATION AND MANAGEMENT

Learning Objectives

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

Unit I :Biodiversity Extinction and Conservation Approaches :

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

Suggested Readings

1. Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
2. Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
3. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and Subhendu Mazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India.

6. Gopal, Rajesh,1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
7. Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
8. Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
9. Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi.
10. Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press.

Web resources

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

Course outcomes (COs)

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

NANOBIOLOGY

Learning Objectives:

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

Course outcomes(Cos)

Students will be able to:

- Understand basics of Nano-science and Nano-biology.

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

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

HUMAN REPRODUCTIVE BIOLOGY

Learning Objectives:

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

Unit I

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – 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, *in vitro* fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; ethical issues; Consanguinity; Fetal Loss and Birth Defects; Adoption

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

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.

FOOD, NUTRITION AND HEALTH

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: Macro nutrients 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.

RADIATION BIOLOGY

Learning Objectives :

The course covers basic knowledge on different types of radiation, biological effects of radiation and risks on cellular level to humans, a deeper knowledge on radiation protection for ionizing and non-ionizing radiation, both in legislation and practical radiation protection technology.

UNIT-I

Scope of Radiation Biology – Sources of Natural Radiation: Terrestrial and cosmic sources - Man made radiations - Medical (occupational and diagnostic). Types of radiation – Ionizing and non-ionizing radiation.

UNIT-II

Properties of Radiation – Radiation Units (Becquerel, RAD, Gray & Curie, Sievert). Measurement of Radiation in the Environment - Alpha and Beta counters and Scintillometer.

UNIT-III

Biological effects of Radiation - Cellular level – Organ and system level – Genetic effects (chromosomal aberrations), radiation induced mutations – Radiation sickness – Syndromes – Cancer induction – Dosimetry.

UNIT-IV

Radiation safety measures - Safety standards disposal of radioactive waste management, administrative & legislative aspect of radiation protection. Nuclear reactors – Nuclear energy programme in India. Regulatory authorities– AERB, BARC, DAE, IAEA & ICRP.

UNIT-V

Applications of Radioisotopes in biology- Auto radiography, Radioimmunoassay; Agriculture -insect, pest and disease management- Sterile Insect Technology (SIT); Medicine - (Therapy & diagnosis); Food preservation.

REFERENCES

1. Rao, B.M. (2002), Radioactive Materials, Himalayas publishing House.
2. Sood, D.D. Reddy, A.V.R. and Ramamoorthy, N. (2000) Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, Radiochemistry Division, Mumbai.
3. Sharma, B.K., (1990) Environmental Chemistry, Goel Publishing House, Meerut.
4. Kiefer, J. (1990) Biological Radiation Effects, Springer-verlag.
5. Radiation Biology: A Handbook for Teachers and Students International Atomic Agency (IAEA), 2010 - Training Course Series 42.

COURSE OUTCOMES:

- To describe the various types of ionizing radiation.
- To define the radiation units used in measurement/calculations of “dose”.
- To describe the biological impact of radiation on living cells and tissues
- To highlight the applications of radiation in different fields
- To create awareness about safety precautions when using radioactive isotopes

AGRICULTURAL ENTOMOLOGY

Learning Objectives

1. Explain the basic concepts of entomology and observe the pest status of agriculture.
2. Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests.
3. Differentiate and classify the various groups of insect animals and estimate biodiversity.
4. To compare and distinguish the general and specific characteristics integrated pest management.
5. Infer and integrate the economic importance of insect species.

Unit I: Outline classification of insects - Causes for insect assuming pest status - Methods of collection, mounting and preservation of insect pests.

Unit II: Insect vectors of plant diseases, Insect pests of stored grains their preventive and curative methods, Most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton. Locust and its control. Insect pollinators and scavenger.

Unit III: Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees. Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silk worm. Lac Culture.

Unit IV: IPM, physical, mechanical, chemical and biological control methods, Pesticide application equipment.

Unit V: Introduction and steps towards IPM, Pheromones, antifeedents, repellents and biopesticide.

Text Books

1. David, Band Ananthkrishnan, T.N. 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
2. Vasanthraj David, B. and Ramamurthy, VV. 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
3. Pruthi, H.S. 1969. Textbook on Agricultural Entomology, I.C.A.R. Publication, New Delhi.
4. Awasthi, V.B. 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers.

Suggested Readings

1. Abishek Shukla, D. 2009. A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
2. Ministry of Agriculture, Government of India, 1995. Manual on Integrated Pest Management in Rice and Cotton.
3. John William S. 1995. Management of Natural Wealth, Loyola College Publications, Chennai.

Web resources

1. <http://www.fao.org>
2. <http://flybase.bio.indiana.edu/>
3. <http://www.ipm.ucdavis.edu>
4. <http://www.ent.iastate.edu/list/>
5. www.entsoc.org

Course Outcomes (COs)

1. Examine and identify the systemic and functional morphology of various group of agricultural insect pests.
2. Differentiate and classify the various groups of insects and estimate the biodiversity.
3. Explain the pest status in agriculture and control measures.
4. To compare the methods and outcomes of integrated pest management.
5. List the economic importance of agricultural insect species.

Ornamental Fish Farming & Management

Learning Objectives:

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

Unit I:

Introduction to ornamental fish keeping.

Scope and importance of ornamental fish culture.

Domestic and global scenario of ornamental fish trade and export potential.

Commercially important ornamental fishes - Indigenous and exotic varieties.

Unit II:

Biology of egg layers and live bearers.

Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture.

Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg. Guppy).

Unit III:

Aquarium design and construction; Accessories - aerators, filters and lighting.

Aquarium plants and their propagation.

Maintenance of aquarium and water quality management.

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.

BIOCOMPOSTING FOR ENTREPRENEURSHIP

Learning Objectives:

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

Course outcomes:

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

Unit – I

Biocomposting – Definition, types and ecological importance.

Unit – II

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

Unit – III

Preparation of Biocompost pit and bed using different amendments.

Unit – IV

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

Unit – V

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

Practical

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

References

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

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

AQUARIUM KEEPING

Learning Objectives

- 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. To create knowledge on self employment opportunity.

UNIT II

External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.

UNIT III

Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry

UNIT IV

Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control.

UNIT V

Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.

REFERENCE BOOKS:

1. Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.
2. Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong.
3. O'Connell, R. F., The freshwater aquarium (1977), Arco Publishing Company, INC New York.
4. Jingran V.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi
5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi

Course Outcome:

- Students to learn about different ornamental fishes and identify the diseases of them
- To develop entrepreneur potential in the field of aquarium and get self employment.

MEDICAL LABORATORY TECHNIQUES

Learning Objectives

1. To understand the different protocols and procedures to collect clinical samples.
2. To explain the characteristics of clinical samples.
3. To demonstrate skill in handling clinical equipment.
4. To evaluate the safety precautions while handling clinical samples.
5. To summarise the control measures to avoid contamination of clinical samples.

Unit I: Laboratory Safety and Human Health and Hygiene : Laboratory safety –toxic chemicals and biohazards waste- biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.

Unit II: Haematology : Composition of blood and their function- collection of blood & lab procedure-haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.

Unit III: Medical Microbiology and Instrumentation Techniques : Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) – Magnetic Resonance imaging – flowcytometry – treadmill test – PET.

Unit IV: Medical Physiology : Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG).

Unit V: Diagnostic Pathology : Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtome- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Text Books

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10th edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

Suggested Readings

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia. Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

Web Resources

1. <https://bit.ly/3tUs8In>
2. <https://bit.ly/2XKu7mT>
3. <https://bit.ly/3hNS1EP>
4. <https://bit.ly/2ZgrLga>
5. <https://bit.ly/3hTBO1b>