Undergraduate Programmes
2023 May
Tentative Template

Terminologies

Abbreviation	Full-form	Remarks	Related to Major and Minor Courses	
Major (Core)	Main Discipline			
Major (Elective)	Elective Options		related to the Major Discipline	
Minor Stream	Other Disciplines (Inter/ Multidisciplinary) not related to the Major	either from the same Faculty or any other faculty		
OEC	Open Elective Courses/ Generic		**Not** Related to the Major and Minor	
VSEC	Vocational and Skill Enhancement Courses			
VSC	Vocational Skill Courses		~~Not~~ Related to the Major and Minor	Advanced laboratory practical of Major
SEC	Skill Enhancement Courses		**Not** Related to the Major and Minor	
AEC	Ability Enhancement Courses	Communication skills, critical reading, academic writing, etc.	**Not** Related to the Major and Minor	
VEC	Value Education Courses	Understanding India, Environmental science/education, Digital and technological solutions, Health & Wellness, Yoga education, sports, and fitness	**Not** Related to the Major and Minor	

IKS	Indian Knowledge System	I. Generic IKS Course: basic knowledge of the IKS II. Subject Specific IKS Courses: advanced information pertaining to the subject: part of the major credit.	Subject Specific IKS related to Major	
OJT	On-Job Training (Internship/Apprenticeship)	corresponding to the Major Subject	Related to the Major	
FP	Field projects	corresponding to the Major Subject	Related to the Major	
CC	Co-curricular Courses	Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts	Not Related to the Major and Minor	
CE	Community Engagement and service		Not Related to the Major and Minor	
RP	Research Project	corresponding to the Major Subject	Related to the Major	

Programme Template:

Programme Degree e.g. B.A./B.Com./B.Sc./ B.M.S., etc.		B.Sc.
Parenthesis if any (Specialization) e.g. History, Human Development, English, etc.		Zoology
Preamble (Brief Introduction to the programme)		The NEP scheme of Zoology syllabus is to be implemented from the A.Y. 2024-2025. The syllabus will cover the basics to the higher advances of the subject over the four years of the program. While following UGC guidelines and approval from appropriate Ethical Committee, the use of animals could be included and / or substituted the same with audiovisual, ICT and simulation aids such that the syllabus is made more interesting with new, innovative topics. Providing the pedagogy as indicated by module-wise outcomes of all courses would be helpful for the teachers in order to gauge the depth of the knowledge to be imparted keeping to the higher orders of learning as per Bloom's revised taxonomy. Use of innovative pedagogies such as inquiry-based, flipped classroom, blended learning, project-based, skill-based, participative learning and such others. Experiential learning through field studies would enhance understanding through 'out of class' learning. Assessment methods would be outcome-based which would help in mapping the curricula for the attainment of the course outcomes.
Programme Specific Outcomes (PSOs) *Action Verbs demonstrating (Major) discipline-related knowledge acquisition, mastery over cognitive and professional, vocational skills are to be used e.g. demonstrate sound understanding of.., analyse, compare, create, design, etc… (minimum 5)*		After completing this programme, Learner will
	1.	Apply the field-based and the in-class knowledge of animal biology to identify and classify the animals in their natural habitat up to class level
	2.	Identify the various types of animal behaviour, and animal interactions with the ecosystem
	3.	Relate the applications of specialized fields such as developmental biology, toxicology, hematology, economic and applied zoology
	4.	Design the research activity that involves application of critical thinking and experimental skills
	5.	Practice the scientific writing and documentation of research while conducting the research projects
	6.	Get career opportunities in a variety of fields such as conservation, research, education, and animal management – skills acquired
	7.	Acquire in-depth knowledge of biodiversity and adopt an eco-friendly approach towards life ensuring sustainable use of resources

	8.	Develop that attributes that promote lifelong learning & extension, communication, and Leadership skills
Eligibility Criteria for Programme		10+2 certificate preferably with biology as one of the major subjects
Intake (For SNDT WU Departments and Conducted Colleges)		

- *External Examination does not always mean Theory paper. It may practical examination, Product submission, projects, etc. checked by external examiners.*
- *Internal evaluation should not be Written Theory papers like Unit tests. Internal marks will be acquired through practical, small group or individual Projects, activities, presentations, seminars, workshops, products, assignments, application-based work, reports, etc.*
- Practical may be part of the main courses alongwith theory modules instead of having separate courses of practical work.

Structure with Course Titles

(Options related to our area of study to be provided with "OR" for baskets of different types)

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester I					
1.1	**Study of Non-chordates**	Major (Core)	2	100	50	50
	Practical Course	Major (Core)	2			
1.2	**Comparative Physiology -I**	Major (Core)	2	50	0	50
1.3	**Nutrition & Health**	OEC	4	100	50	50
1.4	**Basic Instrumentation Techniques**	VSC	2	50	50	0
1.5	**Laboratory Safety Measures**	SEC	2	50	50	0
1.6	**Basic Communication Skills - I**	AEC	2	50	0	50
1.7	**Generic IKS**	IKS	2	50	0	50
1.8	**Sustainable Development**	VEC	2	50	50	0
1.9	**Health and Wellness, Yoga education /**	CC	2	50	50	0

	sports, and fitness/ Cultural Activities/ NSS/NCC and Fine/ Applied/ Visual/ Performing Arts					
			22	**550**	**300**	**250**
	Semester II					
2.1	**Study of Chordates**	Major (Core)	2	100	50	50
	Practical Course	Major (Core)	2			
2.2	**Comparative Physiology- II**	Major (Core)	2	50	0	50
2.3	**Useful & Harmful Insects**	Minor Stream	2	50	0	50
2.4	**Amazing Animal World**	OEC	4	100	50	50
2.5	**Conchology**	VSC	2	50	0	50
2.6	**Fish Aquarium Setting**	SEC	2	50	50	0
2.7	**Basic Communication Skills - II**	AEC	2	50	50	0
2.8	**Ecosystem Conservation**	VEC	2	50	0	50
2.9	**Health and Wellness, Yoga education / sports, and fitness/ Cultural Activities/ NSS/NCC and Fine/ Applied/ Visual/ Performing Arts**	CC	2	50	50	0
			22	**550**	**250**	**300**

Exit with UG Certificate with 10 extra credits (44 + 10 credits)

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester III					
3.1	**Fundamental of Genetics**	Major (Core)	4	100	50	50
3.2	**Evolution**	Major (Core)	4	100	50	50
3.3	**General Organization of Non-Chordata**	Minor Stream	4	100	50	50
3.4	**Animal Behaviour**	OEC	2	50	0	50
3.5	**Vermicomposting**	VSC	2	50	50	0
3.6	**Professional Communication Skills -I**	AEC	2	50	0	50
3.7	**Ecology related project work – Recording, documenting fauna from different habitats**	FP	2	50	50	0
3.8	**Health and Wellness, Yoga education / sports, and fitness/ Cultural Activities/ NSS/NCC and Fine/ Applied/ Visual/ Performing Arts**	CC	2	50	50	0
			22	**550**	**300**	**250**
	Semester IV					
4.1	**Human Genetics**	Major (Core)	4	100	50	50
4.2	**Ethology**	Major (Core)	4	100	50	50
4.3	**General Organization of Chordata**	Minor Stream	4	100	50	50
4.4	**Sociobiology**	OEC	2	50	0	50
4.5	**Pet Care**	SEC	2	50	0	50
4.6	**Professional Communication Skills - II**	AEC	2	50	0	50
4.7	**Creating Butterfly garden**	CEP	2	50	50	0
4.8	**Health and Wellness, Yoga education / sports, and fitness/ Cultural Activities/ NSS/NCC and Fine/ Applied/ Visual/ Performing Arts**	CC	2	50	50	0

			22	**550**	**250**	**300**

Exit with UG Diploma with 10 extra credits (44 + 10 credits)

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester V					
5.1	**Biomolecules**	Major (Core)	4	100	50	50
5.2	**Developmental Biology**	Major (Core)	4	100	50	50
5.3	**Enzymology**	Major (Core)	2	50	0	50
5.4	**Zoogeography**	Major (Elective)	4	100	50	50
5.5	**Comparative Physiology - I**	Minor Stream	4	100	50	50
5.6	**Economic Zoology - Dairy, Poultry**	VSC	2	50	50	0
5.7	**Awareness about: Biodiversity Conservation/e-waste drive / biocomposting /vermicomposting**	FP/CEP	2	50	50	0
			22	**550**	**300**	**250**
	Semester VI					
6.1	**Molecular Biology**	Major (Core)	4	100	50	50
6.2	**Hematology**	Major (Core)	4	100	50	50
6.3	**Parasitology**	Major (Core)	2	50	0	50
6.4	**Applied Zoology - Aquaculture**	Major (Elective)	4	100	50	50
6.5	**Comparative Physiology - II**	Minor Stream	4	100	50	50
6.6	**Internship in : Research Laboratory / Industry / Environment related NGO / Pathology Lab**	OJT	4	100	50	50
			22	**550**	**250**	**300**

Exit with Degree (3-year)

4-Year Degree with Honors

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester VII					
7H.1	**Toxicology**	Major (Core)	4	100	50	50
7H.2	**Immunology**	Major (Core)	4	100	50	50
7H.3	**Type animal - Sepia**	Major (Core)	4	100	50	50
7H.4	**Histology**	Major (Core)	2	50	50	0
7H.5	**Pathology**	Major (Elective)	4	100	50	50
7H.6	**Research Methodology**	Minor Stream (RM)	4	100	50	50
			22	**550**	**300**	**250**
	Semester VIII					
8H.1	**Endocrinology**	Major (Core)	4	100	50	50
8H.2	**Sports Physiology**	Major (Core)	4	100	50	50
8H.3	**Type animal - Rat**	Major (Core)	4	100	50	50
8H.4	**Osteology**	Major (Core)	2	50	0	50
8H.5	**Aquatic Ecosystem**	Major (Elective)	4	100	50	50
8H.6	**Internship in : Research Laboratory / Industry involved in animal testing, clinical trials**	OJT	4	100	50	50
			22	**550**	**250**	**300**

4-Year Degree with Research

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester VII					
7R.1	**Toxicology**	Major (Core)	4	100	50	50
7R.2	**Immunology**	Major (Core)	4	100	50	50
7R.3	**Type animal - Sepia**	Major (Core)	2	50	0	50
7R.4	**Pathology**	Major (Elective)	4	100	50	50
7R.5	**Research Methodology**	Minor Stream (RM)	4	100	50	50
7R.6	**Research Project**	Research Project	4	100	100	0
			22	**550**	**300**	**250**
	Semester VIII					
8R.1	**Endocrinology**	Major (Core)	4	100	50	50
8R.2	**Sports Physiology**	Major (Core)	4	100	50	50
8R.3	**Type animal - Rat**	Major (Core)	2	50	0	50
8R.4	**Aquatic Ecosystem**	Major (Elective)	4	100	50	50
8R.5	**Research Project**	Research Project	8	100	100	100
			22	**550**	**250**	**300**

ZOOLOGY SYLLABUS TO BE IMPLEMENTED FOR A. Y. 2024-2025

Course Syllabus

Semester I

1.1 Major (Core)

Course Title	**Study of Non-chordates**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to :
	1. Relate the characteristic features of invertebrate phyla with their levels of organizations
	2. Interpret phylogenic relationships between the invertebrate phyla
Module 1 (Credit 1) : General organization of Phylum Protozoa to Nematoda	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Differentiate between the various levels of body wall and coelom organization
	2. Compare the development of organ systems across phylum Protozoa to Nematoda
Content Outline	General organization of: ● Unicellular organization Kingdom Protista - Phylum Protozoa ● Multicellular organization: o Colonization level - Phylum Porifera o Division of labour – Phylum Cnidaria ● Triploblastic acoelomate and pseudocoelomate organization o Acoelomate organization – Phylum Platyhelminthes o Pseudocoelomate organization – Phylum Nematoda
Module 2 (Credit 1) : General organization of Phylum Annelida to Phylum Echinodermata	
Learning Outcomes	After learning the module, learners will be able to

(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)	1. Compare the development of organ systems across phylum Annelida to Echinodermata
	2. Interpret the phylogenic relationship between the invertebrate coelomates
Content Outline	• Triploblastic Coelomate organization ○ Animals with metameric segmentation: Phylum Annelida ○ Animals with jointed appendages: Phylum Arthropoda ○ Animals with mantle: Phylum Mollusca ○ Animals with enterocoel: Phylum Echinodermata ○ General organization of Phylum Hemichordata

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Group activity on the topics related taxonomy and biodiversity in and around the local vicinity and presentation of the same.
2. Documentation using photography (e.g., biodiversity observation) or videography (self-made videos uploaded on social media)
3. Padlet activity - Designing Infographics on topics related to the syllabus such as animals belonging to various classes and uploading them on Padlet for collaborative learning

Major Practical Course (2 CreditS)	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to:
	1. Identify the invertebrate animals from their external characters
	2. Perform temporary mounting for observations and hands on experiments
	3. Sketch and label specific body structures of animals
	4. Prepare report based on field study
Content Outline	• Classification of Phylum ○ Protozoa: *Amoeba, Euglena, Paramoecium, Plasmodium* ○ Porifera: *Leucosolenia, Euplectella*, *Euspongia*

	○ Phylum Cnidaria: *Hydra*, *Obelia* colony, *Aurelia, Adamsia, Fungia, Madrepora* ○ Phylum Platyhelminthes: *Planaria*, Liver fluke, Tapeworm ○ Phylum Nematoda: *Ascaris* - male and female ○ Phylum Annelida: *Nereis*, Earthworm, Leech ○ Phylum Arthropoda: Crab, Lobster, *Lepisma*, Beetle, Dragonfly, Butterfly, Spider, Tick, Scorpion, Centipede, Millipede ○ Phylum Mollusca:Chaetoderma, Neopilina, *Chiton, Dentalium, Pila, Unio, Sepia, Nautilus* ○ Phylum Echinodermata: Starfish, Brittle star, Feather star, Sea urchin, Sea cucumber ○ Phylum Hemichordata : *Balanoglossus* ● Mounting of foraminiferan shells ● Observation of food vacuole and contractile vacuole in paramecium from live culture ● Mounting of Setae from Earthworm ● Study of mouthparts in insects-Biting and chewing, siphoning, sponging, piercing and sucking, lapping and chewing ● Types of metamorphosis in insects - Ametabolous (Lepisma), Hemimetabolous (Cockroach), Holometabolous (Butterfly) ● Effect of varying pH on enzyme amylase activity ● Study of nutritional apparatus - gastrovascular cavity of hydra, digestive system of liver fluke, earthworm and cockroach and bird, ruminant stomach ● Study of respiratory apparatus – spiracle and trachea of cockroach, gills of shark and bony fish, lungs of frog and mammals ● Study of circulatory apparatus – heart of cockroach, fish, frog and mammal ● Detection of normal and abnormal constituents of urine ● Study trip to local zoo / national park / aquarium / coastline / biodiversity park and submission of report.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Submission of field report based on actual study trip or virtual.
2. Submission of the regular report maintained in the journal of the laboratory activities.
3. Viva voce based on all the practical

Note: Rubrics to be developed for subjective type of assessment

References :

1. Invertebrate Zoology - E. L. Jordan and P. S. Verma. Reprint Edition, 2015. S. Chand and Co.
2. A Textbook of Invertebrate Zoology: Vol. I. - T. C. Majupuria. 1st edition, 1962- , S. Nagin and Co.
3. Invertebrate Zoology - P. S. Dhami and J. K. Dhami, 1st Edition, 1979. R. Chand and Co.
4. Zoology - S. A. Miller and J. B. Harley, 8th Edition, 2009. Tata McGraw Hill
5. Modern Textbook of Zoology - R. L. Kotpal. Reprint Edition, 2012. Rastogi Publications
6. A Textbook of Zoology, Invertebrates. Vol. I - T. J. Parker and W. A. Haswell. 1st Indian Edition, 1992.-CBS Publishers and Distributors Pvt. Ltd.
7. An Introduction to the Invertebrates - Janet Moore. 2nd Edition, 2006. Cambridge University Press

1.2 Major (Core)

Course Title	**Comparative Physiology - I**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Compare the various physiological systems between the various taxa and their respective ecosystems
	2. Draw out interrelation between the various physiological processes
Module 1 (Credit 1) : Study of Nutrition and Respiration	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Relate to the nutritional aspects in animals & humans
	2. Differentiate between respiratory structures of animals
Content Outline	● Nutrition: ○ Study of structure and function of nutritional apparatus of : Amoeba, Hydra, Earthworm, Cockroach, Amphioxus, Pigeon and Ruminants. ○ Physiology of digestion in humans ● Respiration: ○ Study of structure and function of respiratory organs in Earthworm, Spider, Bony fish, Frog and Pigeon. ○ Structure of lungs and physiology of respiration in humans
Module 2 (Credit 1) : Study of Circulation and Excretion, Osmoregulation	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Analyze the comparative aspects of circulation in different animals.
	2. Evaluate the structural & functional ability of human heart
	3. Relate to the excretion & osmoregulatory mechanisms in animals with respect to their habitats
Content Outline	● Circulation:

	○ Types of circulation: (a) Open and Closed, (b) Single and Double ○ Study of hearts (structure and function): Earthworm, Cockroach, Shark, Frog, Calotes and Pigeon ○ Structure and mechanism of working of heart in human ● Excretion and Osmoregulation: ○ Study of excretory and osmoregulatory structures and functions: Contractile vacuoles, Flame cells, Nephridia, Malpighian tubules ○ Categorization of animals based on principle nitrogenous excretory products ○ Structure of kidney, uriniferous tubule and physiology of urine formation in human

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Group presentations based on topics assigned that are related to physiology
2. Preparation of working models illustrating the functional aspects of physiological processes

Note: Rubrics to be developed for subjective type of assessment

References :

1. Invertebrate Zoology - E. L. Jordan and P. S. Verma. Reprint Edition, 2015. S. Chand and Co. Ltd.
2. A Textbook of Invertebrate Zoology: Vol. I. - T. C. Majupuria. 1st edition, 1962, S. Nagin and Co.
3. Invertebrate Zoology - P. S. Dhami and J. K. Dhami, 1st Edition, 1979. R. Chand and Co.
4. Zoology - S. A. Miller and J. B. Harley, 8th Edition, 2009. Tata McGraw Hill
5. Modern Textbook of Zoology - R. L. Kotpal. Reprint Edition, 2012. Rastogi Publications
6. A Textbook of Zoology, Invertebrates. Vol. I - T. J. Parker and W. A. Haswell. 1st Indian Edition, 1992. - CBS Publishers and Distributors Pvt. Ltd.
7. Chordate Zoology And Elements of Animal Physiology - E. L. Jordan, P. S. Verma. 1st Edition, 1980. S. Chand and Co. Ltd.
8. Chordate Zoology - P. S. Dhami and J. K. Dhami, Reprint Edition, 1991. R. Chand and Co.

1.3 Open Elective Courses/ Generic (OEC)

Course Title	**Nutrition & Health**
Course Credits	4
Course Outcomes	After going through the course, learners will be able to
	1. Categorize food into different component groups
	2. Design diet as per nutritional requirements
	3. Relate the symptoms to identify nutrition related problems
	4. Assess the requirements of the community related to nutrition to bring awareness about balance diet
Module 1 (Credit 1) Concept of Nutrition and Balanced Diet	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Relate the concepts of nutrition and balanced diet with good health
	2. Assess the food based on its nutritive value
	3. Plan and recommend diet for different age groups
Content Outline	• Concept of Nutrition, Relation of nutrition to health, Adequate nutrition, optimum nutrition and malnutrition • Concept of balanced diet, The Food Guide, Pyramid & MyPlate in the Indian context, Importance of Dietary fibres • Concept of BMR and its calculation using Harris-Benedict equation • Dietary recommendations for an infant, child, normal adult, pregnant women and aged • BMI calculation and its significance
Module 2 (Credit 1) Dietary Components	
Learning Outcomes *(Specific related to the module..*	After learning the module, learners will be able to
	1. Classify food into different component groups

e.g. Define, Differentiate, Carry out, Design, etc. …)	2. Interpret the importance and role of different food components
Content Outline	• Carbohydrates - Types and their biological importance • Dietary fibres and significance • Lipids - Types and their biological importance • Role of essential fatty acids, PUFAs, MUFAs • Amino acids and proteins - Functions • Vitamins (A, B, C, D, E) - Occurrence and biological significance • Water - Its physiological role
Module 3 (Credit 1) : Nutrition related health issues	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Identify the health problems related to nutritional deficiencies based on symptoms
	2. Plan the control / remedial measures for nutritional disorders

Content Outline	• Malnutrition disorders: causes, symptoms, prevention and remedy of: PEM, Anemia (Iron deficiency), Marasmus, Kwashiorkor, Goiter
	• Obesity- Causes, symptoms and effects
	• Vitamin deficiency related disorders : causes, symptoms, prevention and remedy :
	  ○ Vit A : *Xerophthalmia*, night blindness
	  ○ Vit B12 : Pernicious anaemia
	  ○ Vit. C : Scurvy
	  ○ Vit D : Rickets, Osteomalacia
	• Acidity
	• Peptic ulcers

Module 4 (Credit 1) Nutrition and Public health	
Learning Outcomes *(Specific related to the module.. e.g. Define,*	After learning the module, learners will be able to
	1. Discuss the importance of nutrition and health status of the community

Differentiate, Carry out, Design, etc. …)	2. Develop a report on improvement of nutritional status of the community
Content Outline	• Nutrition and Public Health • Public /Community Nutrition- Concept and Scope • National Nutrition Survey- India • UNICEF Nutrition Strategy • Anthropometric Standards • Indices of Health and Nutrition situation of a community. (IMR, MMR, TFR, Birth rate, Death rate, Life expectancy • National Nutrition week

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Group presentations based on assigned nutritional disorders
2. Group activity - Report submission based on survey related to nutrition / dietary habits and lifestyle
3. Community engagement - Documentation using photography on community health programs to create awareness
4. Videography based on healthy recipes
5. Preparation and submission of scrap-book based on newspaper, magazine articles based on aspects of nutrition

Note: Rubrics to be developed for subjective type of assessment

References:

1. Nutrition in Health and Disease - Anderson L., Dibble M., Turkki P., Mitchell H. and Rynbergen H. 17th Edition, 1982. J.B. Lippincott Company. Philadelphia, Toronto.
2. Modern Nutrition in Health and Disease - Goodhart R.S. and ShilsM.e. (Ed), 1994. Lea and Febiger, Phila.
3. Nutritive Value of Indian Foods - Gopalan C., Rama Sastri B.V. and Balasubramanian S.C. 2nd Edition, 1989. ICMR Offset Press, New Delhi.
4. Principles of Biochemistry. Lehninger A.L. 1984 Worth Publishers New York.
5. Textbook of Biochemistry with Clinical Correlations - Churchill Livingstone, Edinburg. Devlin T.M. 2nd Edition, 1986. John Wiley.

6. Human Nutrition and Dietetics - Garrow, J.S., James, W.P.T. and Ralph, A. 10th Edition, 2000. Churchill Livingstone.
7. Foods, Nutrition and Diet Therapy - Krause M.V. and Mahan K. 7th Edition, 1984. W.B. Saunders Company U.S
8. Nutrient Requirements and Recommended Dietary Allowances for Indians National Institute of Nutrition, (ICMR) Hyderabad, Telangana. https://www.nin.res.in/
9. Indian Food composition Tables - T. Longvah, R. Ananthan, K. Bhaskaracharya, K. Venkaiah. National Institute of Nutrition, (ICMR) Hyderabad, Telangana- https://www.nin.res.in/
10. https://www.unicef.org/media/131516/file/2023-HAC-India.pdf

1.4 Vocational Skill Courses (VSC)

Course Title	**Basic Instrumentation Technique (Laboratory Course)**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Apply the instrumentation techniques for various estimations
	2. Design experiments as an extension of the techniques learnt
Module 1 (Credit 1) Microscopy and pH metry	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Prepare temporary mountings for observation under different magnifications of microscope
	2. Perform experiments using pH meter
Content Outline	• Principle, structure, working, precautions while handling Microscope. • To focus slide under 10x, 40x and 100x objective • Principle, structure, working, precautions while handling pH meter. • To calculate pH by Henderson Hasselbalch's equation & confirmation by pH meter, pH paper & Universal indicator • Prepare pH indicator paper using red cabbage juice and determine pH of various solutions
Module 2 (Credit 1) Colorimetry and Chromatography	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Apply the principle of colorimetry for quantitative estimation experiments
	2. Design experiments for separation of various mixtures using suitable chromatographic technique
Content Outline	• Principle, structure, working, precautions while handling Colorimeter • Dilution of given sample and estimation of OD by using colorimeter • Calculation of concentration form given sample OD using regression analysis / USB formula • Principle, types of chromatography, uses

	• Separation of amino acids from the mixture by ascending paper chromatography • Separation of amino acids from the mixture by circular paper chromatography. • Calculate Rf value of separated amino acids and identify them from standard Rf value chart • Separation of dyes using adsorption chromatography by chalk. • Separation of lipids / fatty acids by thin layer chromatography

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

Teacher is expected

1. One page report based on the lab activity done to be submitted as and when it is completed after the lab session and subsequently a detailed report through journal writing
2. Viva voce based on all the practical

Note: Rubrics to be developed for subjective type of assessment

References :

1. Introduction to Practical Biochemistry - David T. Plummer. 3rd edition, 2017. Tata McGraw Hill Publishing Co. Ltd.
2. Introductory Practical Biochemistry - S.K. Sawhney and Randhir Singh. Reprint Edition, 2014. Narosa Publishing House.
3. Microscopy and Cell Biology - V. K. Sharma. 1991. Tata McGraw Hill Publishing Co. Ltd.
4. Bioinstrumentation - L. Veerakumari. 2006. M.J.P. Publishers.
5. Principles and Techniques of Practical Biochemistry - Keith Wilson and John Walker. 2002. Cambridge University Press.

1.5 Skill Enhancement Courses (SEC)

Course Title	**Laboratory Safety Measures**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Apply the good laboratory practices in practical courses of the curriculum
	2. Analyze the results of the experiments through appropriate statistical tools
Module 1 (Credit 1) Lab safety	
Learning Outcomes *(Specific related to the module..* *e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Integrate good laboratory practices in regular practicals
	2. Demonstrate the skills acquired through carrying out SOPs correctly
Content Outline	• Introduction and scope of Good Laboratory Practices • Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gas, Aspiratory hazards and Biohazardous infectious agents. • SOPs for maintenance of laboratory equipments - Microscope, pH meter, Colorimeter, Centrifuge • Handling and usage of glassware • Methods of sterilization - Autoclave, Hot air oven, Laminar flow, millipore filter assembly
Module 2 (Credit 1) Lab skills	
Learning Outcomes *(Specific related to the module..* *e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Design experiments with correct resources and accurate measurements
	2. Analyze the results of the experiments through appropriate statistical tools

Content Outline	• Graphical representation of the statistical data through - Bar diagram, Histogram and Pie diagram. • Prepare molar and normal solutions of different concentrations • Perform serial dilutions and find the concentration of unknown diluted samples using standard graphs. • Titration of strong acid - strong base • Titration of weak acid - weak base

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Solving problems based on central tendencies and / or appropriate graphical representation of the given data
2. Ill-defined practical preparation to be improvised by students
3. Laboratory mini-research project based on the skill / SOPs learnt in this course
4. Viva voce based on all the practicals

Note: Rubrics to be developed for subjective type of assessment

References :

1. Biological instruments and methodology – Dr. P. K. Bajpai, December 2010 Edition. S. Chand company Ltd.
2. Calculations in Molecular biology and Biotechnology - Frank H. Stephenson,3rd Edition 2016 Academic Press.
3. A Manual of Medical Laboratory Technology -A. H. Patel, 2016 Edition, Navneet Prakashan Ltd.
4. Introduction to Practical Biochemistry – David T. Plummer, 3rd Edition 2017, Tata McGraw Hill Publishing Co. Ltd.
5. Introductory Practical Biochemistry – S.K. Sawhney and Randhir Singh, Reprint 2014 Edition, Narosa Publishing House
6. Microscopy and Cell Biology - V. K. Sharma, First Edition 1991, Tata McGraw Hill Publishing Co. Ltd.
7. Bioinstrumentation – L. Veerakumari, January 2011 Edition, M.J.P. Publishers
8. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker, 5th Edition 2000, Cambridge University Press.

1.8 Value Education Courses (VEC)

Course Title	**Sustainable Development**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Highlight the significance, targets and indicators of SDGs
	2. Reflect on case studies related to SDGs 7, 12, 13, 14 and 15
Module 1 (Credit 1) : Theme of UN Sustainable Development Goals (SDGs)	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Relate the SDGs with the current scenario in the context of climate change
	2. Identify the various issues that need to be addressed through the goals of sustainable development
Content Outline	• Introduction to the Sustainable Development – Definition and significance, the need for sustainable development • UN SDGs – History, United Nations Conference on Sustainable Development, Rio+20 and its objectives • Overview of all the 17 SDGs – Targets and Indicators
Module 2 (Credit 1) : Case studies on sustainable practices	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Relate the SDGs with the current scenario in the context of climate change
	2. Recommend measures to mitigate the effects of climate change through the SDG guidelines
Content Outline	• Concept of Clean and Green Energy to combat climate change • Sustainable practices for production and consumption • Sustainable use of natural resources

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Report submission based on survey related to SDGs such as electricity consumption audit, green audit, water consumption audit on campus / at personal level

2. Poster exhibition to create awareness about SDGs - Design the poster on each goal with their information, create a new logo, include pictures from real world related to the goal
3. Group presentations based on the case studies related to SDGs 7, 12, 13, 14 and 15

Note: Rubrics to be developed for subjective type of assessment

References :

1. THE 17 GOALS - Sustainable Development - the United Nations. https://sdgs.un.org/
2. The Global Sustainable Development Report 2023. https://unstats.un.org/sdgs/report/2023/
3. Global Ocean Science Report - The Current Status of Ocean Science around the World. 2017. UNESCO Publishing
4. NITI AAYOG Annual Report 2022-2023. https://www.niti.gov.in/reports-sdg
5. ABC of Sustainable Development. - G Venkatesh. ISBN 978-87-403-1005-4. 1st edition. 2015. Bookboon.com
6. Textbooks for Sustainable Development - A Guide to Embedding. 1st edition. 2017. United Nations Educational, Scientific and Cultural Organization Mahatma Gandhi Institute of Education for Peace and Sustainable Development (UNESCO MGIEP)

ZOOLOGY SYLLABUS TO BE IMPLEMENTED FOR A. Y. 2024-2025

Course Syllabus

Semester II

2.1 Major (Core)

Course Title	**Study of Chordates**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Compare the characteristics between the chordate classes
	2. Interpret phylogenic relationships between the chordate classes
Module 1 (Credit 1) : General organization of lower chordates	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Differentiate between the organization of invertebrate phyla studied earlier and the lower chordates
	2. Interpret the evolutionary advancement among lower chordates
Content Outline	• General characteristics of chordates • General organization of Sub-phylum Urorchordata and Cephalochordata • General organization of Cyclostomata
Module 2 (Credit 1) General organization of Vertebrates	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Distinguish between the various systems of the all the classes
	2. Relate the characteristic features of various classes with reference to the adaptations for the mode of living
Content Outline	• General organization of Class: ○ Pisces

	○ Amphibia ○ Reptilia ○ Aves ○ Mammalia

Major Practical Course (2 Credits)	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Identify the animals based on their observations of the external characteristics
	2. Perform experiments based on temporary mountings
	3. Prepare field report based on observations done during field excursions
Content Outline	● Identification of Urochordata: (*Herdmania*), Cephalochordata (*Amphioxus*), Cyclostomata (*Petromyzon, Myxine*) ● Identification of Pisces: Chondrichthyes (Shark, Sting ray, Electric ray) & Osteichthyes (Mackerel, Flying fish, Puffer fish and Sea horse) ● Identification of Amphibia (Frog, Toad, Salamander, Caecilian) ● Identification of Reptilia (Chameleon, *Calotes*, *Phrynosoma*, Russel's Viper, Cobra, Rat snake, Python, Turtle, Tortoise, Crocodile) ● Identification of Aves (Kite, Duck, Parakeet) ● Identification of Mammalia : Duck-billed Platypus, Kangaroo, Shrew, Hedgehog, Guinea pig, Bat and Aquatic Mammals - Dolphin, Seal, Dugong, Blue Whale ● Mounting of scales in fish – Cycloid, Ctenoid and Placoid ● Types of fins in fishes – Cartilaginous and Bony ● Types of Feathers, Beaks and Feet in birds ● Study of control and coordination – nervous system of earthworm, cockroach, sepia, T.S of nerve cord in earthworm and spinal cord in vertebrates, outer view and V.S of mammalian brain

	• Study of reproduction – Binary fission and Conjugation in Paramoecium, Hydra budding, T.S of mammalian testis and ovary, Hen's egg • Study of mitosis using onion root tip • Study of meiosis using Tradescantia bud • Study trip to local zoo / national park / aquarium / coastline / biodiversity park and submission of report.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Digitization of the museum (if available)- Barcoding of the specimens and slides (The information on classification and distinguishing characteristics to be included to assist learning of taxonomy)
2. Submission of field report based on actual study trip or virtual.
3. Viva voce based on all the practicals

Note: Rubrics to be developed for subjective type of assessment

References :

1. Chordate Zoology - E. L. Jordan and P.S. Verma. 14th Revised Edition, 2013. S. Chand and Co. Ltd.
2. Chordate Zoology - P. S. Dhami and J. K. Dhami, Reprint Edition, 1991. R. Chand and Co.
3. Zoology- S. A. Miller and J. B. Harley, 8th Edition, 2009. Tata McGraw Hill
4. Modern Textbook of Zoology : Vertebrates - R. L. Kotpal. 2010. Global Media Publications
5. A Textbook of Zoology, Vol. II- T. J. Parker and W. A. Haswell-Low Price Indian Edition. 1991. CBS Publications and Distributors Pvt. Ltd.
6. Chordate Zoology And Elements of Animal Physiology - E. L. Jordan, P. S. Verma. 1st Edition, 1980. S. Chand and Co. Ltd.

2.2 Major (Core)

Course Title	**Comparative Physiology - II**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Evaluate how the various physiological processes help the organisms to adapt to their environment
	2. Compare the various physiological systems between the various taxa and their respective ecosystems
Module 1 (Credit 1) : Locomotion, Control and Coordination	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Compare the locomotory organs among the invertebrates and vertebrates
	2. Relate the control and coordination process with the habits and habitats of the organisms
Content Outline	• Locomotion : ○ Locomotory organs - structure and functions of: Pseudopodia in Amoeba, Ciliary movement in Paramecium, Setae and peristaltic movement in annelids, Jointed legs in arthropods, Tube feet in starfish ○ Structure of striated muscle fibre in human and sliding filament theory • Control and Coordination ○ Irritability in Paramecium, nerve net in Hydra, nerve ring and nerve cord in earthworm. ○ Types of neurons based on the structure and function. ○ Conduction of nerve impulse: Resting potential, Action potential and Refractory period, Synaptic transmission
Module 2 (Credit 1) : Reproduction	
Learning Outcomes *(Specific related to the module..*	After learning the module, learners will be able to
	1. Compare the modes of reproduction among the invertebrates and vertebrates

e.g. Define, Differentiate, Carry out, Design, etc. …)	2. Interpret the advancements in the reproductive system among the organisms
Content Outline	• Reproduction • Types of reproduction – asexual and sexual Asexual – Types of fission, Types budding, Parthenogenesis; Sexual reproduction – Syngamy, Conjugation in Paramoecium • Gametogenesis, Types of gametes, External and internal fertilization • Oviparity, ovoviviparity and Viviparity • Reproductive system of earthworm • Reproductive system of rat

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Group presentation on assigned topics related to physiology
2. Preparation of working models illustrating the functional aspects of physiological processes

Note: Rubrics to be developed for subjective type of assessment

References:

1. Invertebrate Zoology. E. L. Jordan and P. S. Verma. Reprint Edition, 2015. S. Chand and Co.

2. Chordate Zoology And Elements of Animal Physiology - E. L. Jordan, P. S. Verma. 1st Edition, 1980. S. Chand and Co. Ltd.

3. A Textbook of Invertebrate Zoology: Vol. I. T. C. Majupuria. 1st edition, 1962- , S. Nagin and Co.

3. Invertebrate Zoology- P. S. Dhami and J. K. Dhami, 1st Edition, 1979. R. Chand and Co.

4. Chordate Zoology - P. S. Dhami and J. K. Dhami, Reprint Edition, 1991. R. Chand and Co. Ltd.

5. Zoology- S. A. Miller and J. B. Harley, 8th Edition, 2009. Tata McGraw Hill

6. Modern Textbook of Zoology. R. L. Kotpal. Reprint Edition, 2012. Rastogi Publications

7. A Textbook of Zoology, Invertebrates. Vol. I , 1st Indian Edition, 1992. - T. J. Parker and W. A. Haswell-CBS Publishers and Distributors Pvt. Ltd.

8. A Textbook of Zoology, Vol. II- 1st Indian Edition, 1992. - T. J. Parker and W. A. Haswell-CBS Publishers and Distributors Pvt. Ltd.

2.3 Minor Stream

Course Title	**Useful and harmful insects**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Identify the useful and harmful insects
	2. Evaluate the economic importance of the insects
Module 1 (Credit 1) Useful Insects	
Learning Outcomes *(Specific related to the module..* *e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1.Describe the useful insects
	2. Interpret the forensic investigations based on insect study
Content Outline	1.1 Honey bee- Structure of bee hive, Life cycle and uses 1.2 Silk moth- Life cycle and uses 1.3 Lac insect-Life cycle and uses 1.4 Insects useful as biocontrol agents- Entomophagous insects- Ladybird beetle, Parasitoid wasps 1.5 Insects of forensic importance 1.6 Post Mortem Index using insects
Module 2 (Credit 1) Harmful Insects	
Learning Outcomes *(Specific related to the module..* *e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Identify the insect pests
	2. Design/Propose the control measures with reference to the insect pests
Content Outline	• Life cycle and damage /disease caused by insect pests and control measures: 2.1 Common Household insect pests- cockroach, termites 2.2 Pests of stored grains- Rice weevil, Red Flour Beetle 2.3 Insects as vectors- Mosquito, Housefly, Rat flea 2.4 Insects of veterinary importance- Horse fly, Screw worm fly

	2.5 Pests of agriculture- Red cotton bug, Rhinoceros beetle Lemon butterfly 2.6 Desert locust 2.7 Aphids

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Group presentations based on the economic importance of insects
2. Documentation using photography (Collection of photos and making the report)
3. Padlet Activity: Preparation Infographics based on the life cycles of insects and upload on Padlet

Note: Rubrics to be developed for subjective type of assessment

References :

1. Modern entomology- D. B. Tembhare. Second Edition, 2023. Himalaya Publishing House
2. Textbook of applied Entomology Volume I and Volume II- K. P. Srivastava- 2010 Kalyani Publishers
3. An Introduction to Sericulture- G. Ganga, J. Sulochana Chetty- Second edition, 2020. Oxford & IBH Publishing Co Pvt Ltd
4. Lac culture in India- N. Ghorai. 2020. Published by Satish Serial Publishing House
5. Applied Entomology- - P. G. Fenemore and Alka Prakash. Revised Second Edition, 2006. New Age International (P) Ltd.
6. Textbook of Applied Zoology - Pradip Jabde. 2016. Discovery Publishing Pvt Ltd.
7. A Handbook of Economic Entomology - Abhishek Shukla. 2009. Daya Publishing House
8. Destructive and Useful Insect, Their Habits and Control - C. L. Metcalf, R. I. Metcalf and W. P. Flint. 2018 McGrow Hill Co. New York

2.4 Open Elective Courses/ Generic (OEC)

Course Title	**Amazing Animal World**
Course Credits	4
Course Outcomes	After going through the course, learners will be able to
	1. Interpret the uniqueness of the animals enlisted
	2. Relate the distinguishing characteristics with the adaptations
	3. Create awareness of the wonders of animal kingdom through activities such as volunteering for field studies
	4. Prepare models of the animals to illustrate their unique characters
Module 1 (Credit 1) Fauna of National / State	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Enlist the distinguished characteristics
	2. Evaluate the unique characteristics as per the adaptations
Content Outline	General Morphology, Habits and habitat and Significance: ● Butterflies - the flying jewels - Blue Mormon, Kaiser-i-Hind ● Herpetofauna of India- *Rhacophorus malabaricus*, Monitor lizard, Chameleon ● Feathered Bipeds: Yellow footed green Pigeon, Peacock ● Mammals of India: Giant Indian Squirrel, Gangetic Dolphin, Royal Bengal Tiger, Elephant, Swamp Deer, Rhinoceros
Module 2 (Credit 1) Amazing animals	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Enlist unique characteristics of the animals
	2. Interpret the significance of the unique characteristics

Content Outline	General Morphology, Habits and habitat and Unique features: ● Jelly fish - *A. victoria* ● Pistol Shrimp ● Suicidal Ant ● Praying mantis ● Pearl oysters ● Electric eel ● Puffer fish ● Axolotl larva ● Pebble toad ● Flying Snake ● Indian Cuckoo ● Red Panda
Module 3 (Credit 1) : Incredible Fauna	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Enlist the recently discovered fauna
	2. Justify the uniqueness of the fauna listed
Content Outline	● **Recently discovered fauna:** ○ Tapir Frog ○ Stealthy Gecko ○ Rose-rainbow fish ○ Southern maned sloth ○ Sea anemone from Japan - *Stylobatus* ● **Unique fauna:** ○ Kangaroo ○ Duck-billed Platypus ○ Penguins ○ Whale ○ Sphenodon
Module 4 (Credit 1) Marvels of animals	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Relate the marvels with their application in the practical world
	2. Evaluate the significance of the marvels for the survival of the animals
Content Outline	● Coral reef ● Bioluminescent animal - Fireflies, Angler fish ● Parental care in fishes

	• Parental care in amphibians • Migration in birds • Social organization - Honey bee, Hanuman Langur • Hibernation/aestivation in frog • Echolocation - Bats, Dolphin

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Designing field-based activities to relate the amazing animals to their counterparts in the local habitats
2. Preparation of models of the animals to illustrate their unique characters

Note: Rubrics to be developed for subjective type of assessment

References :

1. Chordate Zoology Volume I- E. L. Jordan and P. S. Verma, 2013 , S. Chand and Co. Ltd.
2. Invertebrate Zoology - E. L. Jordan and P. S. Verma, 2022, S. Chand and Co. Ltd.
3. A Textbook of Invertebrate Zoology: Vol. I. - T. C. Majupuria. 1st edition, 1962- , S. Nagin and Co.
4. Chordate Zoology- P. S. Dhami and J. K. Dharmi,2006 , R. Chand and Co.
5. Invertebrate Zoology- P. S. Dhami and J. K. Dhami,2021, R. Chand and Co.
6. Introduction to Vertebrates- J. Moore 2006, Cambridge University press
7. Zoology- S. A. Miller and J. B. Harley, 1999, Tata McGraw Hill
8. Modern Textbook of Zoology, Invertebrates - R. L. Kotpal. 12th edition, 2013, Rastogi Publications
9. A Textbook of Zoology, Invertebrates. Vol. I , 1st Indian Edition, 1992. - T. J. Parker and W. A. Haswell. CBS Publishers and Distributors Pvt. Ltd.l
10. A Textbook of Zoology, Invertebrates. Vol. I , 1st Indian Edition, 1992. - T. J. Parker and W. A. Haswell. CBS Publishers and Distributors Pvt. Ltd.

2.5 Vocational Skill Courses (VSC)

Course Title	**Conchology**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Identify various molluscan and crustacean shells based taxonomic keys
	2. Create museum of shell collections / models
Module 1 (Credit 1) Study of shells	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. identify various shells based taxonomic keys
	2. Identify various crustacean shells using taxonomic keys
Content Outline	• Identify and classify Gastropod shells using a taxonomic key or guidebook. • Identify and classify Bivalve shells using a taxonomic key or guidebook • Identify and classify Cephalopods shells using a taxonomic key or guidebook • Identify and classify Crustacean shells using a taxonomic key or guidebook.
Module 2 (Credit 1) Applied conchology	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Create the museum of shell collections, models
Content Outline	• Study the process of shell collection, cleaning, and preservation using different techniques (e.g. boiling, soaking, freezing, etc.). • Study biodiversity indices using shells collected from beaches. • Design and create a shell-based artwork or jewelry piece, and present it to the class (ASSIGNMENT BASED)

	• Conduct a field trip to collect shells, and identify the different types of shells found at any nearby beach/ Field trip to pearl culture farm.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Preparation of models of shells
2. Preparation of decorative shell artifacts
3. Viva voce based on the practicals

Note: Rubrics to be developed for subjective type of assessment

References :

1. Invertebrate Zoology Volume I- Jordan and Verma, 2009, S. Chand and Co. Ltd.
2. Invertebrate Zoology- T. C. Majupuria, 2022. S. Nagin and Co.
3. Invertebrate Zoology- P. S. Dhami and J. K. Dhami. 2021, R. Chand and Co.
4. Zoology- S. A. Miller and J. B. Harley, 1999,Tata McGraw Hill
5. Modern Textbook of Zoology, Invertebrates. - R. L. Kotpal. 2014. Rastogi Publications
6. A Textbook of Zoology, Invertebrates. Vol. I , 1st Indian Edition, 1992. - T. J. Parker and W. A. Haswell-CBS Publishers and Distributors Pvt. Ltd.
7. Seashells of India -Deepak Apte, 2015, Oxford University Press

2.6 Skill Enhancement Courses (SEC)

Course Title	**Fish Aquarium setting**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Create aquarium keeping as one of the departmental activities
	2. Perform experiments related to aquarium maintenance
Module 1 (Credit 1) : Ornamental fishes, Aquarium plants & Fish feed	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Identify various ornamental fishes and their feed
	2. Identify various aquarium plants
Content Outline	• Identification and breeding and maintenance of: Ornamental fishes: Angel, Danio, Discus, Flower horn, Gourami, Siamese fighter, Goldfish • Aquarium plants : Hydrilla, Amazon sword, Aqua rose, Pistia, Cork screw, Cobamba. Ludwigia • Fish Feed : Live feed - Artemia, Daphnia, Moina, Infusoria, Chaetoceros, Blood worms • Formulated feed - Composition and nutritional value
Module 2 (Credit 1) Aquarium equipment	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Perform experiments of water testing parameters
	2. Demonstrate use of various accessories by setting up aquarium
Content Outline	• Aquarium set up: o Monitoring water quality parameters - pH, Temperature, Conductivity, Dissolved Oxygen, Free Carbon dioxide, Ammonia, Nitrate, Phosphates o Monitoring the air siphons, cleaning techniques, aerators, filters o Types of gravel o Types of feeding cups

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Aquarium setting up and maintenance based on this course
2. Submission of daily reports of the hands-on training of aquarium setting
3. Viva voce based on the course content

Note: Rubrics to be developed for subjective type of assessment

References :

1) Aquarium Systems - 1981, Hawlins,. (Ed). Academic Press.
2) Living Aquarium - Hunnam,1981, P. Ward Lock,
3) Aquarium Fishes and Plants - Ratjak, K. and Zukal, R
4) Seawater Aquariums - Spotte,1979, John Wiley & Son.
5) Salt water Aquarium in the Home - Straughan,1976 WHSmith Pub,
6) Illustrated Guide to Aquarium Fishes - Dick Mills, 1987. Published by Galley and Price, an imprint of W.H. Smith and Sons Limited, England.
7) Aquarium and its management-Dr.Nandita Singh, Dr.Surekha Gupta, Dr.Geeta Joshi-2023. AkiNik Publications
8) Ornamental aquarium fishes of India- 1999- K. L. Tekrival and A.A. Rao. TFH United Kingdom.
9) Marine Ornamental species (collection, culture and conservation), J. C. Cato and C. L. Brown. –2008, Blackwell Science
10) Aquarium: Fish Keeping C B L Srivastava, 2002, Published by Kitab Mahal
11) Home Aquarium – C. S. Thara Devi and K. V. Jayashree,2015. Saras Publication.

2.8 Value Education Courses (VEC)

Course Title	**Ecosystem Conservation**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. Evaluate the interdependence and interactions between abiotic and biotic factors in the environment
	2. Examine the scenario of wild life conservation in India in the light of guidelines from different relevant governing agencies
Module 1 (Credit 1): Concepts of Ecosystem	
Learning Outcomes *(Specific related to the module..* *e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Interpret the concept of ecosystem and its types
	2.Evaluate the interdependence and interactions between abiotic and biotic factors in the environment
Content Outline	● Concept of ecology and components of an ecosystem and their interactions ● Types of ecosystems : terrestrial and aquatic and their sub-types ● Food chain and food web in ecosystem, Ecological pyramids - energy, biomass and number.
Module 2 (Credit 1) : Biodiversity Conservation	
Learning Outcomes *(Specific related to the module..* *e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
	1. Examine the scenario of wild life conservation in India in the light of guidelines from different relevant governing agencies
	2. Create awareness about the environment conservation in the society through environment related activities
Content Outline	● Conservation strategies: *in situ*, ex-situ, National parks, Sanctuaries and Biosphere reserves. ● Introduction to legislations and authority bodies for biodiversity conservation (IUCN, NBB, Wildlife Protection Act of India) ● Conservation projects in India – Project Tiger, Project Elephant, Project Rhino, Olive Ridley Turtle Conservation Project

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Group presentations based on success stories of Conservation
2. Infographics based on information of national parks and sanctuaries in India

3. Report submission based on Conservation projects

Note: Rubrics to be developed for subjective type of assessment

References :

1. Fundamentals of Ecology- E.P. Odum, 3rd Edition 1971, Saunders Publication
2. Fundamentals of Ecology- M.C. Dash, 2nd edition 1993, Tata McGraw Hill
3. Essentials of Ecology and Environmental Science - S.V.S Rana, 5th Edition 2013, PHI Publications
4. Biodiversity- S.V.S Rana, 4th Edition January 2009, Prentice Hall Publications
5. Ecology and Environment- P.D. Sharma, 13th Edition January 2011, Rastogi Publications
6. Introduction to Ecology- R. Dajoz, 2nd Edition January 1977, Hodder Arnold Publications
7. Wildlife Laws and its Impact on Tribes- Mona Purohit , 2007 Edition, Deep and Deep Publications
8. Biodiversity- K.C. Agarwal, 1999 Edition, Agro Botanica Publications