B. Sc. Zoology
(Wild Life Biology)

Syllabus

AFFILIATED COLLEGES

Program Code: 22G

2021 – 2022 onwards

BHARATHIAR UNIVERSITY

**(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000,Shanghai -901-1000, URAP - 982)**

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **B. Sc. Zoology (Wildlife Biology)** program describe accomplishments that graduates are expected to attain within five to seven years after graduation.	
PEO1	Conservation and Biodiversity as passion
PEO2	Self-involvement in Ecological issues
PEO3	As biologist in conservation units
PEO4	As biologist in Environment Impact Assessment
PEO5	As base level conservation staff in governmental and non-governmental agencies
PEO6	As conservation managers or leaders
PEO7	Conservation oriented education
PEO8	Opportunities as civil servants
PEO9	Opportunities in higher education
PE10	Opportunities in Wildlife Research

Program Specific Outcomes (PSOs)	
After the successful completion of B.Sc., Zoology (Wildlife Biology program, the students are expected to	
PSO1	Apply knowledge of Biodiversity, in view of Conservation.
PSO2	Capable of Identify, formulate, and solve complex environmental issues
PSO3	Capable of design and evaluate solutions for environment issues
PSO4	Capable of using research-based knowledge and research methods in Wildlife Conservation.
PSO5	Capable of creating, selecting, adapting and applying appropriate techniques in area of Wildlife.
PSO6	Understand and commit to professional ethics
PSO7	Capable of engaging in independent learning and understanding of nature & resources
PSO8	Capable of demonstrating knowledge and skills.
PSO9	Capability as team leader in managing projects.
PS10	Capability to communicate with society and aware society about the need of Conservation.

Program Outcomes (POs)	
On successful completion of the B. Sc. Zoology (Wildlife Biology) program	
PO1	Distribution and diversity of Non-chordates.
PO2	Distribution and diversity of Chordates.
PO3	Ecology of various habitats.
PO4	Concept of systematics, evolution & Natural history.
PO5	Identification of Butterflies, Birds, Reptiles & Mammals.
PO6	In situ and ex situ conservation.
PO7	Modern techniques in biological sciences.
PO8	Understanding research tools in wildlife.
PO9	Usage of Geo-spatial tools.
PO10	Data handling, modeling, interpretation & prediction.

BHARATHIAR UNIVERSITY: COIMBATORE 641 046
B. Sc. ZOOLOGY (Wildlife Biology) Curriculum
(For the students admitted during the academic year 2021 – 22 onwards)

Course Code	Title of the Course	Credits	Hours/wk		Maximum Marks		
			Theory	Practical	CIA	CEE	Total
FIRST SEMESTER							
	Part I-Language I	4	6	-	50	50	100
	Part II-English I	4	6	-	50	50	100
	Core course I: Animal Diversity – Non Chordata	3	6		50	50	100
	Core Practical I	-	-	4	-		-
	Allied A: **Biochemistry/Botany**	2	2	-	30	45	75
	Allied Practical	-		2	-	-	-
	Environmental Studies	2	2	-	-	-	50
	Total	**17**					**425**
SECOND SEMESTER							
	Part I-Language II	4	6	-	50	50	100
	Part II-English II	4	6	-	50	50	100
	Core course II: Animal Diversity –Chordata	4	6		50	50	100
	Core Practical I	4	-	4	50	50	100
	Allied A: **Biochemistry/ Botany**	3	2	-	30	45	75
	Allied A Practical	2	-	2	25	25	50
	Value Education – Human Rights	2	2	-	-	50	50
	Total	**23**					**575**
THIRD SEMESTER							
	Part I-Language III	4	6	-	50	50	100
	Part II-English III	4	6	-	50	50	100
	Core course I: Comparative Anatomy of Vertebrates.	3	6		50	50	100
	Core Practical II	-		4	-		-
	Allied B: **Biochemistry/Botany**	2	2	-	30	45	75
	Allied B Practical	-	-	2	-	-	-
	Skill Based I: Entomology	3	3	-	30	45	75
	Non Major Elective I * Yoga.	2	2	-	-	-	50
	Total	**20**					**500**
FOURTH SEMESTER							
	Part I-Language II	4	6	-	50	50	100
	Part II-English I	4	6	-	50	50	100
	Core course IV: Ecology, Evolution & Zoogeography	4	6		50	50	100

	Core Practical II	4	-	4	50	50	100
	Allied B: **Biochemistry/Botany**	3	2	-	30	45	75
	Allied B Practical	2	-	2	25	25	50
	Skill Based I: Ornithology	3	3	-	30	45	75
	Non Major Elective II * General Awareness.	2	2	-	-	-	50
Total		**26**					**650**
FIFTH SEMESTER							
	Core Course V: Cell Biology &Microbiology.	4	5	-	50	50	100
	Core Course VI: Conservation Biology.	4	5	-	50	50	100
	Core Course VII: Genetics & Biotechnology.	4	5	-	50	50	100
	Core Practical III	-	-	2	-	-	-
	Core Practical IV	-	-	2	-	-	-
	Elective Course I: Forestry	3	3		30	45	75
	Elective Course II:Indian Wildlife laws &Forensics	2	3	-	25	25	50
	Elective Course V: Practical	-	-	2	-	-	-
	Internship/Project work #**	1	-	-	25	-	25
	Skill Based III: Biostatistics & Computer Applications	3	3	-	30	45	75
TOTAL		**21**					**525**
SIXTH SEMESTER							
	Core Course VIII: Animal Physiology.	4	5	-	50	50	100
	Core Course IX: Developmental Biology.	4	5	-	50	50	100
	Core Course X: Animal Behaviour	4	5	-	50	50	100
	Core Practical III	4	-	2	50	50	100
	Core Practical IV	4	-	2	50	50	100
	Elective Course III: Quantitative methods in Wildlife.	3	3	-	30	45	75
	Elective Course IV: Geo-informatics	3	3	-	30	45	75
	Elective Course V: Practical	2	-	2	25	25	50
	Skill Based IV: Wildlife Management Techniques.	3	2	-	30	45	75
	Extension activities**	2	1	*	50	-	50
TOTAL		**33**					**825**

	GRAND TOTAL	140					3500
ONLINE COURSES							
1.		SWAYAM					
2.		MOOC'S					

* Non Major Elective I: Basic Tamil I / Advanced Tamil I / Yoga / Women studies and Non major Elective II: Basic Tamil II / Advanced Tamil II / GeneralAwareness.

* It is compulsory that those who opt for any languages other than Tamil, they should choose Basic Tamil (Who don't studied Tamil) or Advanced Tamil (For those who studied Tamil up toHSC).

 ** Only internal marks.

  #Internship/ Project work has to be completed in summer vacation during the time period decided by the department.

#VALUE ADDED COURSE (OPTIONAL)

S.No	PAPAERS	TOTAL MARKS
1.	Tiger Monitoring.	100
2.	Data Mining.	100
3.	Economics of Conservation.	100
4.	Intellectual Property Rights.	100

First Semester

Course code		ANIMAL DIVERSITY – NON CHORDATA	L	T	P	C
Core/Elective/ SBS		**Core Course I**	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge about life forms	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. To understand the taxonomy and relationship and evolution of animals.
2. To identify the phyla of invertebrate animals, and recognize their distinguishing features;
3. To appraise the diversity of animals in a phylogenetic context.
4. To understand how different body designs solve biological problems related to physiological and environmental challenges.
5. To develop an appreciation for the role of invertebrates in biological communities, ecological interactions, and conservation problems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The learner will be able to understand the diversity and basic taxonomy of Non chordates.	K2
2	The learner will get an idea of adaptation and importance of non-chordates.	K3
3	The learner will be able to identify the animal at basic level.	K4
4	The paper will give a strong observation skill and prompt him to think about its conservation, sustainable economic utilisation and its potentials in technological prospects	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**CLASSIFICATION AND PROTISTA**		**17 hours**

Concept of five kingdom classification of life. Introduction to Protista & Animal kingdom – Systems of classification & nomenclature - levels of organization - Types of symmetry. General characters of Protista & Classification with examples.

> **Type study:** Paramecium.
> **General topics:** Parasitic Protista, Life Cycle of Plasmodium, Locomotion & Nutrition in Protozoa.

Unit:2		**PORIFERA AND COELENTERATA**		**17 hours**

Characters & classification (up to class) of Porifera & Coelenterata with examples –Salient features of –*Ctenophora*.

> **Type study:** Leucosolenia, Obelia Colony.
> **General topics:** Canal system in sponge, Polymorphism in Coelenterata, Diversity (Types) of corals and structure of coral polyp, Coral reefs.

Unit:3		**PLATYHELMINTHES, ASCHELMINTHES AND ANNELIDS**		**18 hours**

Characters & classification (up to class) of Platyhelminthes, Aschelminthes & Annelids with examples.

> **Type study:** *Taenia, Ascaris, Megascolex*.
> **General topics:** Coelom coelomoducts & metamerism, Parasitic adaptations in Helminths and annelids, Filter feeding in Polychaetes.

Unit:4	ARTHROPODA	18 hours

	Characters & classification (up to class) of Arthropoda with examples. Brief descriptions of *Limulus* (living fossil), *Sacculina*(Parasitic castration), Copepods, Scorpion, Spider, *Peripatus*(affinities), Millipedes (role in ecosystem) & Centipedes (General Description).
	    Type study: Cockroach & Prawn,
	    General topics: Crustacean larvae, Social Insects	

Unit:5	MOLLUSCA AND ECHINODERMATA AND HEMICHORDATA.	18 hours

	Characters & classification (up to class) of Mollusca and Echinodermata with examples. Characters of Hemichordata. Brief descriptions of Fresh water Mussel, *Chiton, Sepia*, Star fish, Sea Cucumber &*Balanoglossus*
	    Type study: *Pila*, Starfish (External & Water vascular system only).
	    General topics: Larval forms of Mollusca, Torsion & de-torison in Mollusca, Economically important Mollusca, Echinoderm larva, Evolutionary affinities of Hemichordata.	

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	90 hours

Text Book(s)

1	Nair NC. (2017). *Invertebrata and Chordata,* Saras Publication Nagercoil,Tamilnadu.
2	Nair NC, Leelavathy S, SoundaraPandian N Murugan T and Arumugam N. (2010). *A Text Book of Invertebrates,* Saras Publication Nagercoil, Tamilnadu.
3	Kotpal RL, Agarwal SK and Khetarpal RP. (1990). *Modern Text book of Invertebrates,* Rastogi Publications, Meerut.
4	Jordan And Verma. (1963). *Invertebrate Zoology,* S. Chand & Co, New Delhi

Reference Books

3	Anderson TA. (2001). *Invertebrate Zoology*, Oxford University Press, New Delhi.
4	Barrington EJW. (1967). *Invertebrate Structure and Functions*. English Language Book Society.
5	Hyman LH, *The Invertebrates (6 vols).* McGraw-Hill Companies Inc. NY
8	Ebanasar J and Sheeja BD. *Outlines of five kingdoms of life,* Shine and Twinkle Publication, Nagercoil.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	M	M	M
CO3	M	M	M	S	M	M	S	S	M	S
CO3	M	S	M	M	M	S	M	M	S	M
CO4	M	M	S	M	M	M	S	M	M	S

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

Second Semester

Course code		ANIMAL DIVERSITY - CHORDATA	L	T	P	C
Core/Elective/ SBS		**Core Course II**	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge on life forms	**Syllabus Version**	**2021-2022**		

Course Objectives:

1. To understand the taxonomy and relationship and evolution of animals.
2. To identify the class of vertebrate animals, and recognize their distinguishing features.
3. To appraise the diversity of animals in a phylogenetic context.
4. To understand how different body designs solve biological problems related to physiological and environmental challenges.
5. To develop an appreciation for the role of vertebrates in biological communities, ecological interactions, and conservation problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The learner will be able to understand the diversity and basic taxonomy of chordates.	K2
2	The learner will get an idea of adaptation and importance of chordates.	K3
3	The learner will be able to identify any vertebrate animal at basic level.	K4
4	The paper will give a strong observation skill and prompt him to think about its conservation, sustainable economic utilisation and its potentials in technological prospects	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	FISHES	17hours

General characters and classification of Chordata (up to class) with examples. Brief descriptions of *Amphioxus*, *Ascidia*, Hag fish, *Scolidon*, Mullet, *Anabas*, Cat fish, Sea horse.
General topics: Affinities of Prochordates, Accessory respiratory organs in teleost, Types of Fins and function Comparison of Teleost and elasmobranches, Evolutionary significance of Dipnoi, Migration of Fishes.

Unit:2	AMPHIBIA	17hours

Classification and characters of Amphibia (up to order with examples). Habitat, classification, examples and brief descriptions of Proteus - Salmander –Newts - Ambystoma - Mud puppy – Congo eels – Sirens –Toads (Indian, African and South American) – Tree frogs – Rana.

Unit:3	REPTILIA	18hours

Classification and characters of Reptilia (up to order with examples). Habitat, classification, examples and brief descriptions- Varanus – Uromastix – Chameleon – Phrynosoma – Iguano – Heloderma – Typhlops – Him snakes –Uropeltis – Xenopeltis – Boas & Pythons – Vipers – Cobras – Coral snakes – Rattle snakes –Crocodiles – Alligator –Gharial – Tortoise & Turtles.

Unit:4	AVES	18hours

– Salient features of Aves – classification up to Family. Brief descriptions with examples of Fowls - Swifts – Humming Birds – Hornbills – Frog mouths – Night jars – Plover – Turns – Gulls – Herons –Strokes – Ibis – Spoon Bills – Doves – Hoopoe – King fishers – Bee eater –

Vultures - Rollers – Cookoos –Coucals – Fowls – Quails – Pelicans – Cormorants – Flamingo – Woodpeckers –Bee eaters – Fly catchers – Bush chat – Fan tails -Wag tails – Parrots &Parakeets Cockatoos – Owls – Trogons – Tits – Larks – Prinia – Shrike – Drongo – Finches – Swallow – Thrushes – Bulbul – Sun bird – Pitta – Warbler &Barblers.

Unit:5	MAMMALS	18hours

Classification and characters of Mammals (up to order with examples). Habitat, classification, examplesandbriefdescriptionsofEchidna- Platypus–Tasmanianwolf–Kangaroo–opossum – Shrew – Hedgehog – Bats - Rodents – Hare – Aquatic Mammals - Ant eaters – Felids - Canids– Herspestids–Mustellids-Bear-Hyena-Oldworldmonkeys–NewworldMonkeys–Artiodactyla-Elephants – Perissiodactyla.

Unit:6	CONTEMPORARY ISSUES	2 hours

Expert lectures, online seminars – webinars / Field work

	Total Lecture hours	90hours

Text Book(s)

1	Arumugam N. *Animal Diversity - Volume - 2 - Chordata*, Saras Publication, Nagercoil, Tamilnadu.
2	Thangamani A, Prasannakumar S, Narayanan LM, Arumugam N. (2014). *A Text Book ofChordates,* Saras Publication, Nagercoil, Tamilnadu.

Reference Books

1	EkambaranathaAyya and Ananthakrishnan TN. (1995). *Manual of Zoology Vol – II*, S. Viswanathan Pvt. Ltd. Chennai.
2	KotpalRL. (2019). *Mordern Text Book of Zoology Vertebrates*, 4th edition, Rastogi Publications, Meerut.
3	Young JZ. (1950). *Life of Vertebrates.* Clarendon Press, Oxford, UK.
4	Pough Harvey F, Christine M .Janis and John B. Heiser. (2002). *Vertebrate Life*, Pearson Education Inc. New Delhi.
5	Verma PS.(2013).*Chordate Zoology*, S Chand Publishers, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	M	M	M	S	M	M
CO3	M	S	M	M	M	M	S	S	M	S
CO3	M	M	M	M	S	M	S	M	S	M
CO4	M	M	M	M	M	S	S	M	S	S

Course code		**CHORDATA AND NON-CHORDATA PRACTICAL**	**L**	**T**	**P**	**C**
Core/Elective/ SBS		Core Practical I				
Pre-requisite		Knowledge on taxonomy of Animals	**Syllabus Version**		**2021-2022**	

Course Objectives:

The main objectives of this course are to:
1. To develop skill of Taxonomy
2. To improve hands on practiceskill
3. To develop fieldknowledge

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Able to explain taxonomy of animals	K3
2	Develop concept of ecosystems and interactions	K3
3	Identify Fishes, Insects & Birds	K3
4	Importance of Biodiversty	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

MAJOR PRACTICAL

1. Identification of given Insect order based on the dichotomous keyprovided.
2. Identification of family of givenFish
3. Based on the sketch of body parts identify family of snake based on theKey provided.
4. Micrometry measurement of given Protozoan /micro arthropod / anysample.
5. Digital Projection of a Forest/ Reef / Benthic / Aquatic ecosystem and identifications vertebrates &invertebrates in theprojection.

MINOR PRACTICAL

1. Cockroach/Mosquito: Mounting of Appendages &Mouthparts
2. Earth worm: Mounting of bodysetae
3. Fish: Mounting ofScales
4. Motility of Paramecium – Hanging dropmethod.

VISIT

Visit to any nearby area of biodiversity significance (Report should be included in record). The trip may be undertaken during holydays or other free hours or anytime without affecting class hours.

SUBMISSION OF REPORT

1. Submission of Field Report on Bird Watching: Report of minimum 5 day bird watching in a locality should be submitted during examination. The trip may be undertaken during holydays or other free hours or anytime without affecting class hoursindividually.
2. Submission of Photo Album of invertebrates & Vertebrates with identification and classification (Evaluation of report should be based on field effort, diversity of photos, classification and identification. Costly presentation of photos albums should compulsorily be discouraged, as the objective of this is to make students familiar with fauna. The collection may be undertaken during holydays or other free hours or anytimewithout affecting class hours, individually).

SPOTTERS
1. **Classifygivingreasons:***Paramecium,Obelia*,Liverfluke,*Ascaris,Pila*,Starfish, *Balanoglossus*, Any fish, Tree frog, Snake, King Fisher and Bat.
2. **Draw labeled sketches**: *Amphioxus*, Trochophore, AnyEchinodermlarvae.
3. **Biologicalsignificance:***Paramecium*–Conjugation,MalarialParasite,Gemmules, *Limulus*, Hippo campus, Nautilus. Axolotl larva,
4. **Relate structure and function:**Spicules of sponges, Scolex of tapeworm, *Nereis*parapodium, Carapace and plastron of Turtle, Electric organ – *Narcine*.
5. **Descriptive Notes:** *Hydra, Physalia*, Rotifer, Sea cucumber, Chiton, Placoid scales, Chameleon, Quillfeather.

QUESTION PATTERN: (50 + 50 MARKS)
External: Major: 15, Minor: 10, Record: 5, Spotter: 15 (5 spotters each carry 3 marks), Field report and bird watching: 5 mark. **Internal:** Submission of Album (identification and photo of minimum 30 species): 5 marks, Field study/tour (minimum 10 hr.): 5 marks, Model practical 30 marks, Record: 5 Marks, Attendance 5 marks.

TotalPractical Hours	60(Each Semester) x 2 = 120 Hours PerYear

Text Book(s)	
1	Verma, PS.(2000).*A Manual of Practical Zoology- Chordates*, S Chand Publications, New Delhi.
2	Verma, PS.(2010).*A Manual of Practical Zoology-Invertebrares*, S Chand Publications, New Delhi.
Course Designed By: Dr. SANIL R., Associate Professor, GAC, Ooty	

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	M	S	M	M	S
CO3	S	M	S	M	M	S	M	M	S	M
CO3	M	S	M	M	S	S	M	S	M	M
CO4	M	M	M	M	M	M	S	M	M	M

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

Third Semester

Course code		COMPARATIVE ANATOMY OF VERTEBRATES	L	T	P	C
Core/Elective/ SBS		Core Course III	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge on Animal Taxonomy	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. To understand the comparative anatomy and relationship in view ofevolution.
2. To make an in-depth knowledge about various vertebrate organs and organsystem.
3. To develop a knowledge about the structural organization of each vertebral group and to understand the structural complexity in advancedtaxa

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The learner will develop and idea of the structural organisation of chordates.	K2
2	The learner will develop an idea of functioning of each organ and formation of organ systems.	K3
3	The learner will be able to identify and understand the increasing complexity of organ systems with advancement of evolution.	K4
4	The paper will give a strong basic insight in understanding advanced courses like Physiology and Biochemistry.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**DIGESTIVE AND RESPIRATORY SYSTEM**		**15hours**

Comparative account of Digestive system of shark, frog, pigeon and rabbit – Ruminant stomach and function. Gills of fishes – Pharyngeal derivatives – Swim Bladder - Comparative account of Lungs and
air ducts in Vertebrates.

Unit:2		**NERVOUS SYSTEM**		**14hours**

Comparative account on structure of Brain, Cranial and spinal nerves of Shark, Frog and Rabbit. Sense organs of vertebrates.

Unit:3		**SKELETAL SYSTEM**		**15hours**

Regions of Vertebral column - Structure of typical vertebrae - Types of vertebrae – Ribs and sternum. Comparison of Skull, Pelvic, pectoral girdle and limbs of Shark, Frog and Rabbit. Account of skull of Reptiles. Exoskeleton of Vertebrates (Scales, Feathers, hairs etc.).

Unit:4		**CIRCULATION AND MUSCULATURE**		**15hours**

Aorta and aortic arches – Comparative account of heart, arterial system and venous system in shark, frog, Calotes, pigeon and rabbit. Brief account of appendicular musculature – Electric organs in fish.

Unit:5		**URINOGENITAL SYSTEM**		**14hours**

Comparison of Pronephros – Mesonephros and Metanephros with examples. Comparison of Urogenital system of frog, Pigeon and rabbit.

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Arumugam N. (2014).*Animal Diversity - Volume - 2 - Chordata*,Saras Publication, Nagercoil, Tamilnadu.
2	Kulshrethra SK. (2002). *Comparative Anatomy of Vertebrates*, Anmol Publications Pvt Ltd. New Delhi.

Reference Books

1	Kotpal RL Sasthry and Shukla. (2019-2020). *Comparative Anatomy andDevelopmental Biology,* Rastogi Publications, Meerut.
2	EkambaranathaAyyar and T.N. Ananthakrishnan. (1995).*Manual of Zoology Vol – II*, S. Viswanathan Pvt. Ltd. Chennai.
3	Waterman AJ. (1971). *Chordate Structure and Function.* Macmillan Co. London.
4	Saxena RK and SumithraSaxena.(2008). *Comparative Anatomy of Vertebrates,* Viva Books Private Limited, New Delhi.
5	A. Thangamani A, Prasannakumar S, Narayanan LM, Arumugam N.(20180. *A Text Book of Chordates,* Saras Publication, Nagercoil,Tamilnadu.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	M	M
CO3	M	M	M	S	M	M	M	M	S	M
CO3	M	M	M	M	S	M	S	M	S	M
CO4	S	M	M	M	M	M	M	S	M	M

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

Course code		**ENTOMOLOGY**	**L**	**T**	**P**	**C**
Core/Elective/ SBS		**Skill Based Course I**	**3**	**0**	**0**	**3**
Pre-requisite		Knowledge on Arthropods	**Syllabus Version**		**2021-2022**	

Course Objectives:
1. To give an introduction to diverse world ofInsects.
2. To make aware of the various protocols inentomology.
3. To prompt the students to undertake entomology as profession orpassion.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concept of entomology	K1
2	Identify insects and Butterflies	K2
3	Identify insect damages	K2
4	Understand Apiculture and Sericulture	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**MORPHOLOGY**	**8hours**

General Body plan – Structure of head, wings thorax, abdomen, appendages and genetalia. Types of mouth parts. Classification & habitat of insects up to orders with examples.

Unit:2		**BEHAVIORAL ENTOMOLOGY**	**9 hours**

Reproductive behavior in insects (mate finding, courtship, territoriality, parental care, parental investment and sexual selection) - Role of different signals in host searching (plant and insects) and host acceptance, ovipositionalbehaviour, pollination behaviour, coevolution of plants and insect pollinators

Unit:3		**DAMAGE AND CONTROL**	**9 hours**

Insect Damage and Sign Categories - Bark beetles and wood borers - Gall makers & defoliating insects - Fluid-feeding insects - Terminal and root insects - Seed and cone pests Insect sampling in a forest ecosystem - Forecasting and assessing risk of insect outbreaksInsects andsilviculture – Insect Control methods (Synthetic & Biological – Brief outline).

Unit:4		**COMMERCIAL ENTOMOLOGY**	**8 hours**

Principles and practice of Apiculture & Sericulture. Applications of entomology in Wildlife forensics.

Unit:5		**BUTTERFLIES AND MOTHS**	**9 hours**

Butterflies & Moths – Body parts of Butterfly - Identification of types of Swallowtails: Club tails – Roses - Bird wings – Mime –Mormon – Raven - Helen - peacock – Jay – Blue bottles – Sword tails – Zebra. Whites, sulfurs and orange-tips.

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45hours**

Text Book(s)

1	Imms AD.(1972). *Text book of Entomology Vol. I & II.* Ed. By Richard and Owen. ELBS
2	Nair K.K.Anandhakrishnan TN & David BV. *General and applied Entomology.* Tata Mc.Graw Hill Publ. Delhi.

Reference Books

1	Kehimkar ID. (2008).*Book of Indian butterflies.* Oxford University Press.
2	Metcalf RL, Luckmann WH, editors. (1994). *Introduction to insect pest management.* John Wiley & Sons.
3	Jayashree KV, Tharadevi CS &Arumugam N.(2014). *Apiculture,* SarasPublication Nagercoil,Tamilnadu.
4	Pedigo LP.(1989). *Entomology and pest management.* Macmillan Publishing Company.
5	Eikichi Hiratsuka. (2000). *Silkworm breeding,* Oxford and IBH publications, New Delhi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Applied Entomology https://swayam.gov.in/nd2_cec20_bt02/preview
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	M	M	S	S
CO2	M	S	M	M	S	M	S	S	M	M
CO3	S	M	M	M	M	S	S	M	M	S
CO4	S	M	M	M	M	S	S	M	M	S

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

Fourth Semester

Course code		ECOLOGY, EVOLUTION AND ZOOGEOGRAPHY	L	T	P	C
Core/Elective/ SBS		Core Course IV	**4**	**0**	**0**	**4**
Pre-requisite		Knowledge on Animal diversity & Taxonomy	**Syllabus Version**	**2021-2022**		

Course Objectives:

1. To develop awareness about the environment and the interaction of variouscomponents.
2. To develop an idea of the adaptations and its significance in relation toevolution.
3. To make the students aware of how organic evolution occurred and how the various life forms come intoexistence.
4. To make the students aware of the historical periods during the evolution of earth and status of fauna during the particularage.
5. To develop and idea of the distribution of the various faunalcomponents.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The students will be able to present an overview of diversity of life forms in an ecosystem, will be able to differ between Qualitative & Quantitative study.	K2
2	The learner can correlate choice of habitat for organisms to Abiotic Factors, aspects of energy transfer and will be able to explain the necessity for and adaptations, providing examples.	K3
3	Students will be able to describe the history and development of evolutionary thought, list and describe the evidence for evolution and its required corollaries & mechanisms by which evolution occurs.	K4
4	Students will be able to describe the history of life on earth.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**ECOLOGICAL CONCEPTS**		**15hours**

Ecosystem structure & function. Limiting factors. Biogeochemical cycles: Carbon, Nitrogen, water and Phosphorous. Concept of Species, Population dynamics and Growth curves. Food web Pyramids & Trophic levels. Animal relationships: - Mutualism, commensalism, parasitism, Competition, predation.

Unit:2		**ECOSYSTEMS**		**14hours**

Habitat ecology: Freshwater, Estuarine and Terrestrial ecosystems (Detailed study). Ecotone& edge effect. Air, Water, Noise & thermal Pollution. E-Waste – definition and management. Fundamentals of Machine Learning.

Unit:3		**THEORIES OF EVOLUTION**		**15hours**

Theories of Organic evolution. Fossils – types and formation.   Evidences ofevolution Convergent & Divergent evolution. Natural selection – Isolation & Speciation.

Unit:4		**GEOLOGICAL TIME SCALE**		**14hours**

Hardy Weinberg Equilibrium & Genetic drift. Colouration - Mimicry types &Significance. Geological time scale (Pre-cambrian Eon; Up to periods for Paleozoic & Mesozoic era; up to epoch for Cenozoicera).

Unit:5	**ZOOGEOGRAPHY**	**15hours**
Zoogeographical regions – Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions - their Climatic and faunal peculiarities.Wallace line, Discontinuous distribution - Continental Drift. Brief outlines of Humanevolution.	
Unit:6	**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, Online Seminars – Webinars/Field Study	
	Total Lecture hours	**75hours**

Text Book(s)

1	Arumugam N. (2014). *Concepts of Ecology*, Saras Publication, Nagercoil, Tamilnadu.
2	Verma PS and VK.(2004). *Cell Biology, Genetics, Evolution and Ecology*, S Chand Publishers, New Delhi.

Reference Books

1	Gupta PK. *Cytology, Genetics and Evolution*, Rastogi Publications, Meerut.
2	VermaPS and Agarwal VK. (2001). *Environmental Biology: Principles of Ecology*, S Chand Publishers, New Delhi
3	Sharma PD. (2018-19). *Elements of Ecology*, Rastogi Publications, Meerut.
4	Odum EP.(1971). *Fundamentals of Ecology*, W.B Saunders College Publishing, Philadelphia.
5	Benton AH and Werner WE. (1976).*Field Biology and Ecology*, Tata McGraw Hill, New Delhi.
6	Ridley M. (2003). *Evolution*, Blackwell Publishing.
7	Barton NH, Briggs DEG, Eisen JA, Goldstein DB and Patel NH. (2007). *Evolution*. Cold Spring, Harbour Laboratory Pres. US.
8	Hall BK and Hallgrimsson B. (2008). *Evolution*, Jones and Bartlett Publishers.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	Wildlife Ecology https://swayam.gov.in/nd1_noc20_bt38/preview
4	Evolutionary Biology https://swayam.gov.in/nd2_cec20_bt06/preview

Course Designed By:

1. **Dr. R. SANIL, Associate Professor, GAC,Ooty.**
2. **Dr.K.SARASWATHI, Assistant Professor, ChikkaiahNaickerCollege,Erode.**

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	M	S	M	S	M	S
CO2	M	S	M	S	M	S	M	M	S	M
CO3	M	M	S	M	S	S	M	M	M	S
CO4	S	S	S	S	S	M	S	S	S	M

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

Course code		ORNITHOLOGY	L	T	P	C
Core/Elective/ SBS		**Skill Based Course II**	**3**	**0**	**0**	**3**
Pre-requisite		Knowledge on Chordata diversity	Syllabus Version		2021-2022	

Course Objectives:
1. To give an introduction to bird science.
2. To make aware of the various protocols inornithology.
3. To prompt the students to undertake ornithology as profession orpassion.

Expected Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	Appreciate the diversity of birds of the world and understand how birds are classified.	K2
2	Learn how birds evolved and are still evolving.	K3
3	Recognize someoftheways that birds are communicate, find food, and attract mates	K4
4	Understand the role of birds in the world and how they interact with humans.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**BIRD DESCRIPTION**	**8hours**
	Terms used in description of Birds Plumage & parts – Types of Bills – Types of feet – Identification of birds in the field based on tail, bill, crest, leg &colour.		

Unit:2		**BIRD WATCHING AND MIGRATION**	**8hours**
	Bird watching equipment – Field guides – Photography – identification of calls – Feet and beak modification in Birds, Bird migration - Methods to study migration - Common migrants of southIndia.		

Unit:3		**FORAGING, MATING AND SONG**	**9hours**
	Diversity of foods and foraging behaviors - Social foraging - mating preferences - Pair-bonds, courtship, and divorce - Production and control of song - Song variation in space and time - Functions of bird song.		

Unit:4		**BREEDING**	**9hours**
	Timing of breeding - Breeding territories - Nests and nest building - Eggs & Clutch size - Clutch and egg replacement - Incubation & Hatching - Altricial and precocial young - Parent/offspring recognition - Caring for young.		

Unit:5		**DEMOGRAPHY**	**-9hours**
Avianpopulationschange-overtimeandspace-Methodsofestimation-Classifyingbird speciesassemblages-Recentavianextinctions-Causesofavianpopulationdecline-Major threats to bird populations - Conservation solutions - Value of wild birds-eBird data access.			

Unit:6		**CONTEMPORARY ISSUES**	**2 hours**
Expert lectures, online seminars – webinars/ Field observations			
		Total Lecture hours	**45hours**

Text Book(s)	
1	Salim Ali and S. Dillon Ripley. (1973). *Handbook of the Birds of India and Pakistan,* Volume 9. Oxford University Press.
2	Podulka S, Rohrbaugh RW and Bonney R. (2004). *Handbook of bird biology.* Cornell Lab of Ornithology.
Reference Books	
1	Ali S and Ripley SD. (1983). *Handbook of the birds of India and Pakistan.* Compact edition. Oxford University Press and BNHS, Mumbai.
2	Caughley G, Sinclair AR. *Wildlife ecology and management.* Blackwell Science.
3	ChinnaSathan and Bal Pandey*, The Nesting behaviour of Indian Birds,* Sugeeth Publications.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	Cornell Lab All about Birds https://www.allaboutbirds.org/guide/
Course Designed By:Dr. R. SANIL, Associate Professor, GAC, Ooty	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	M	M	M	M	M	M
CO2	M	M	M	M	M	M	M	M	M	M
CO3	M	S	S	M	S	S	S	S	M	M
CO4	M	M	M	M	S	M	M	M	S	M

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

Course code		ANATOMY, ECOLOGY AND EVOLUTION	L	T	P	C
Core/Elective/ SBS		**Core Practical II**	**0**	**0**	**2**	**2**
Pre-requisite		Knowledge of Animal anatomy, ecology and evolution	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. To develop skill in anatomy ecology &evolution
2. To develop hands on skill in doing ecologicalexperiments
3. To understand adaptions and evolutionarymechanism

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Able to analyse various ecological parameters	K3
2	Able to identify the animals based on call sounds	K3
3	Able to understand the anatomy of animals	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

MAJOR PRACTICAL

1. Estimate the density of planktons in givensample.
2. Prepare a square ($1m^2$) quadrate and construct a rectangular ($0.5m^2$) and circular (1m radius) quadrate inside the square quadrate estimate the density and project it for 1square km and compare theresults.
3. Estimate the Net primary productivity of water sample (Assuming the experiment taking place at an aquatic ecosystem) using dark and light bottleexperiment.
4. Estimate the pH, Carbonate & Bicarbonates in given water samples and state the relationship.
5. Estimate the salinity at three different temperature and Plot the temperature salinitygraph.
6. Demonstration of Vertebrate (Frog / Rat) **dissection using Multimedia** – Digestive, Brain, 5th Cranial, 10th Cranial, Urinogenital System (Wherever possible digital dissections recommended).

MINOR PRACTICAL

1. Identification of call of at least five birds from the given 20 call sounds. (For examination the call sound can be projected using audiodevise).
2. Identification of call of at least five birds from the given 20 call sounds. (Forexamination the call sound can be projected using audiodevise).
3. Estimation of Temperature of Given WaterSamples
4. Identification of Zoogeographical realms from the world Map & Describe the specificfauna
5. Demonstration of usage of M-Stripes app and Distance software in wildlifecensus.

VISIT AND SUBMISSION

Report of Visit to Zoological park (minimum two days or two zoos) and report should be submitted with description of scientific name and habitat of animal displayed should be submitted with exam. Other than this field study or tour spending minimum 20 hours is compulsory

Report of participation in a wildlife census or 5 day participation in a nature camp or 5 day internship in a sanctuary/ reserve / in an institute or research lab (internal of external) of wildlife significance with description of daily activities, procedures followed and observations should be submitted individually.

SPOTTERS	
A. Identify the given Vertebrae / Skull - Fish, Frog, *Calotes*, Pigeon,Rat B. Identify the Fore/Hind Limb: - Fish, Frog, *Calotes*, Pigeon,Rat C. Comment of Animal Relation Ship: *Sacculina*on Crab /Hermit Crab &SeaAnemone. D. Ecological Adaptation: *Chameleon, Balanus, Chaetopterus, Anabas* E. Comment on the Evolutionary Significance; Fossil, Limulus, Analogousorgans, Homologousorgans.	

QUESTION PATTERN: (50 +50 MARKS)

External: Major: 15, Minor: 10, Record: 5, Spotter: 15 (5 spotters each carry 3 marks), Zoo visit Report: 5 marks. **Internal:** Census or equal training: 5 marks, Field study (minimum 20 hr.): 5 marks, Model Practical: 30 Marks, Record 5 marks, Attendance:5 marks.

		Total Practical hours	**60hours**

Text Book(s)

1	Slingsby, D and Cook C. *Practical Ecology,* Palgrave Macmillan publications
2	Practical Zoology Volume 1,2,3, Saras Publications, Nagercovil

Course Designed By: Dr. R. Sanil, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	S	M	S
CO2	M	M	M	S	M	S	S	M	S	M
CO3	S	S	M	M	S	M	M	S	M	S

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

Fifth Semester

Course code		**CELL BIOLOGY ANDMICROBIOLOGY.**	**L**	**T**	**P**	**C**
Core/Elective/ SBS		Core Course V	**4**	**0**	**0**	**4**
Pre-requisite		Knowledge on Animal Diversity	**Syllabus Version**		**2021-2022**	

Course Objectives:

The main objectives of this course are to:
1. To give an insight to the ultra-structure of cellularcomponents.
2. To give an idea about theMicrobiology.
3. To give a clear idea about the how the various cell organelles function inside thecell.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the structures and purposes of basic components of cells, especially biomolecules, membranes, and organelles.	K2
2	Students will develop an idea how cellular components are used to generate and utilize energy in cells.	K3
3	Explain the cellular components underlying mitotic cell division.	K4
4	Able apply their knowledge of cell biology to selected examples of changes or lossesincellfunction.Thesecanincluderesponsestoenvironmentalor physiological changes, or alterations of cell function brought about by mutation.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**INTRODUCTORY CYTOLOGY**	**15hours**

Cell theory - Prokaryotic and Eukaryotic cells. Cytological techniques: Fixation– Sectioning & Staining. Principles & Resolving power of compound microscope, Confocal microscope and electron microscope. Cell Junctions - Ultrastructure and functions of plasma membrane.

Unit:2		**CELL ORGANELLES**	**15hours**

Nucleus & Nucleolus. DNA structure and function - DNA Replication - Chromatin – Nucleosome. Chromosomes: – Structure, types, giant chromosomes. Ultrastructure and functions of Endoplasmic reticulum, Golgi body &Ribosomes.

Unit:3		**METABOLISM AND CELL CYCLE**	**15hours**

Ultrastructure and functions of Lysosomes, centrosomes, Mitochondria. Glycolysis and Krebs cycle. Electron transport chain and formation of ATP. Cell cycle - Mitosis, Meiosis -regulation. Apotosis& Cancer (brief outlines).

Unit:4		**PROTEIN SYNTHESIS**	**14 hours**

Types & role of RNA- Structure of t-RNA. Ultra structure, function and types of ribosome. Properties of Genetic code - Detailed study of Protein synthesis – Polysome – differences in eukaryotes – Short outline of post transcriptional modifications.

Unit:5		**MICROBIOLOGY**	**14hours**

Characters and basic classification of Kingdom Monera and Fungi. Systematic position of Virus – classification - Structure of bacteriophage & HIV. Viroids and Prions. Ultra structure of *E. coli*.- - bacterial cell wall. General structure offungi.

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75hours**

Text Book(s)

1	Arumugam N. (2014). *Cell Biology and Molecular Biology,* Saras Publications, Nagercoil, Tamilnadu.
2	Arumugam N. (2014). *Cell Biology*, Saras Publications, Nagercoil, Tamilnadu.

Reference Books

1	DeRobertisEDP and De Robertis EMF.(1987).*Cell and Molecular Biology*,Lippincott WilliamsandWilkins.
2	Gupta PK. *Cell Biology,* Rastogi Publications, Meerut.
3	Pawar CB.(2018).*Cell Biology*, 3rd edition, Himalaya Publications.
4	Verma PS and Aggarwal VK. (2016). *Cell Biology,* S. Chand Publishers, New Delhi.
5	Mani A, SelvarajA.M, Narayanan L.M ,Arumugam A. (2014). *Microbiology,* SarasPublication,Nagercoil,Tamilnadu.
6	Pelczar MJ, Chan EC, Pelczar MF. (2001). *Elements of microbiology.* McGraw-Hill International Book Company.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Cell Biology https://swayam.gov.in/nd2_cec19_bt12/preview
2	General Micro biology https://swayam.gov.in/nd2_cec19_bt11/preview
3	National Digital Library of India https://ndl.iitkgp.ac.in/
4	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	M	S	S	M	S	M
CO2	M	M	M	M	M	M	M	S	M	S
CO3	M	M	S	M	S	S	M	M	M	S
CO4	S	M	S	M	S	M	S	M	M	S

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

Course code		CONSERVATION BIOLOGY	L	T	P	C
Core/Elective/ SBS		Core Course VI	4	0	0	4
Pre-requisite		Knowledge of Animal diversity & Ecology	Syllabus Version		2021-2022	

Course Objectives:

1. To give the student a state-of-the-art insight of scientific developments in Conservation Biology.
2. To learn to use this information in an integrativeway.
3. To study the various conservation measures adopted inIndia.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Analyse and interpret the problems in conservation Biology.	K5
2	The learner will be able to understand the distribution and diversity of fauna.	K2
3	Explain the various strategies adopted in conservation of various species.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	BIODIVERSITY AND CONSERVATION	14hours

Biodiversity – Classification with examples – *in situ* &*ex situ* conservation methods – Sanctuary – National Parks – Tiger reserves (examples) – Zoo's – botanical gardens – germ plasm conservation – DNA libraries – Tissue culture & cloning. Conservation reserves – Sacred Grooves – Corridors - People participation inConservation.

Unit:2	WETLAND ECOSYSTEM	14hours

Distribution of Teleosts, Anura&Squamata in India. Conservation of wetlands **-** Estuarine habitats in India – Backwaters –Mangroves & significance – impacts of dams. Detailed study of Pitchavaram Mangroves, Kuttanad Ecosystem, Sundarbans.-Migration of Fishes, Hill stream adaptations in fishes.

Unit:3	AMPHIBIANS AND REPTILES	15hours

Parental care in amphibians, Origin of Amphibians- Aquatic reptiles in India, Conservation & threats to tortoise & turtles - Evolution & Adaptive radiation of Reptiles, Dinosaurs the extinct reptiles, Identification of Poisonous and non-poisonous snakes, Poison apparatus and types of poison.

Unit:4	DIVERSITY OF MAMMALS	15hours

Diversity of Marsupials – Aquatic mammals and adaptation - Adaptive radiation in Mammals, Endemic & endangered mammals of south India - Dentition in mammals **-** Diversity of Small cats in India, Diversity of Civets & Mongoose in India-NTCA and Tiger monitoring.

Unit:5	CONSERVATION OF MAMMALS	15hours

Distribution and conservation of Old World Monkeys, Distribution and conservation of Indian ungulates, Project tiger and its implications - Project elephant and status.Conservation of Indian Rhino - Breeding biology & feeding ecology of Elephants – Human Animal conflicts & Mitigation in Indian landscape – Understanding National Biodiversity portal.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars / Field studies		
	Total Lecture hours	**75hours**

Text Book(s)

1	Arumugam N. (2014). *Animal Diversity - Volume - 2 - Chordata*, Saras Publication, Nagercoil,Tamilnadu.
2	EkambaranathaAyyar and Ananthakrishnan TN.(1993).*Manual of Zoology Vol – II*, S. Viswanathan Pvt. Ltd. Chennai.

Reference Books

1	Indraneil Das. (2008).*Snakes and other reptiles of India* NatrajPublicationS, Delhi.
2	Kartikshanker and Choudhury BC.(2007). *Marine turtles of the Indian subcontinent*, Natraj Publications, Delhi.
3	Kotpal RL.(2015). *Mordern Text Book of Zoology Vertebrates,* Rastogi Publications, Meerut.
4	Prater SH. (1971). *The book of Indian animals* Natraj Publications, Delhi.
5	Romulus Whitaker and Ashok captain. (2004).*Snakes of India: the field guide,* Natraj Publications, Delhi.
6	Thangamani A, Prasannakumar S, Narayanan LM, Arumugam N. (2018). *A Text Book ofChordates,* Saras Publication, Nagercoil, Tamilnadu.
7	Verma PS. (2010).*Chordate Zoology*, S Chand Publishers, New Delhi.
8	Anderson J andSlater DL. (1981).*Catalogue of Mammals, Vols. I and II,* Cosmo Publications, NewDelhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Wildlife Conservation https://swayam.gov.in/nd1_noc20_bt39/preview
2	National Digital Library of India https://ndl.iitkgp.ac.in/

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	S	S	S	M	M
CO2	M	S	S	S	M	S	M	M	S	M
CO3	M	S	M	S	S	M	S	S	M	S

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

Course code		GENETICS AND BIOTECHNOLOGY.	L	T	P	C
Core/Elective/ SBS		Core Course VII	**4**	**0**	**0**	**4**
Pre-requisite		Knowledge in animal diversity, cytology and ecology is a must.	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. Students will learn the basic principles of inheritance at the molecular, cellular and organismallevels.
2. Students will understand causal relationships between molecule/cell level phenomena ("modern" genetics) and organism-level patterns of heredity ("classical"genetics).
3. Students will learn the mechanism of Mutation and will able to understand how mutations bring changes in anorganism.
4. The course will give an insight to basic concepts ofBiotechnology.
5. The course will give an awareness of the mechanism, types and concepts regarding biotechnology.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Students will be able to describe and apply the principles of Mendelian genetics.	K2
2	Describe the flow of genetic information from DNA to RNA to protein.	K3
3	Students will be capable to clarify how genes are regulated.	K4
4	Able to give details how mutation occur and how its role in adaptation and speciation.	K4
5	The course will give an insight to the current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, animal andforensics.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		FUNDAMENTALS OF GENETICS		14hours

Importance of drosophila in genetics – Culture methods - sex identification – common mutations. Mendelian Laws of Inheritance & Non mendalian inheritance(Incomplete dominance – Co-dominance – Polygenic inheritance – Epistasis –Lethal genes). Crossing over – Linkage in drosophila.

Unit:2		RECOMBINATION AND GENETICAL DISORDER		14hours

Recombination in bacteria: – Transformation – Conjugation – F factor -Sexduction – Transduction –Generalised and Specialised - Plasmids. Chromosome variation (Ploidy) - Euploidy – Aneuploidy – Gene Balancing – Gynandromorphs – Barr bodies –Chromosomal abberations- Non disjunction - Klinefelter, Turner & Down syndrome.

Unit:3		MUTATION		15hours

Gene Mutations – Types of Mutations – Physical & Chemical mutagens – DNA repair. Sickle cell anemia – Alkaptonuria – Phenyl ketonuria – albinism. Operon concept- Lac &trp operons (outlines)

Unit:4		RECOMBINANT TECHNOLOGY		15hours

Restriction endonuclease – sequence recognition. DNA Ligase. Identification & isolation of gene of interest-Cloning vectors and recombination–.Screening of recombinant DNA. Application of recombinant DNA technology. Commercial production of Insulin. Whole Genome Projects.

Unit:5	APPLICATIONS OF BIOTECHNOLOGY	15hours
Methods to isolate DNA – PCR types, Principle & applications. Electrophoresis – types and Principle. Blotting – types – applications. DNA finger printing and its applications –RAPD – FISH- RFLP-Genome Editing - DNA probes & diagnosis.		
Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars/visit to institutions.		
	Total Lecture hours	75hours

Text Book(s)

1	Meyyan RP. (20140. Fundamendals of *Genetics*, Saras Publication Nagercoil, Tamilnadu.
2	Verma PS and Agarwal VK. (2010). *Genetics,* S. Chand Publishers, New Delhi.

Reference Books

1	Gardner EJ. (1991). *Principles of Genetics.* John Wiley & Sons, Inc, London, UK.
2	Primrose SB and Twyman R.(2013). *Principles of Gene Manipulation and Genomics,* John Wiley & Sons, London, UK.
3	Kumaresan V. (2009). *Biotechnology*, Saras Publication Nagercoil.
4	Verma PS and Agarwal VK.(2009).*Genetic Engineering,* S. Chand Publishers, New Delhi.
5	Strickberger MW.(2019). *Genetics,*3rd edition, Pearson publishers, NY.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9
3	Genetics and Genomics https://swayam.gov.in/nd2_cec20_bt03/preview
4	Principles of Biotechnology https://swayam.gov.in/nd2_cec20_bt07/preview

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	M	M	M	S	M	S
CO2	M	S	M	M	M	M	M	M	S	M
CO3	M	S	M	S	S	M	S	M	M	S
CO4	S	S	S	S	M	S	M	S	M	M
CO5	M	M	S	M	S	M	M	M	S	M

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

Course code		FORESTRY		L	T	P	C
Core/Elective/ SBS		**Elective Course I**		**3**	**0**	**0**	**3**
Pre-requisite		Basic knowledge about forest ecosystems		**Syllabus Version**		**2021-2022**	

Course Objectives:
1. The Forestry course is designed to teach technicalknowledge.   2. To develop skills for a learner of wildlifesciences.

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Gain knowledge and develop a good idea about silviculture.	K2
2	Familiarize and aware with social forestry and agroforestry & its management.	K2
3	Understand and able to carry our forest survey.	K3
4	The learner can involve in forest management and preparation inventories.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

Unit:1		**SILVICULTURE**		**8hours**
Factors influencing vegetation – Regeneration of forests – Methods of propagation – grafting - Nursery & Planting techniques - Clear felling, coppice and conversion systems – Silviculture management in India.				

Unit:2		**MENSURATION & SURVEY**		**8hours**
Methods of measuring - diameter, girth, height and volume of trees - form-factor - volume estimation of stand - annual increment. Sampling methods and sample plots. Methods of forest survey – map reading.				

Unit:3		**FOREST MANAGEMENT**		**9 hours**
Types of forests in India – identification and dominant flora - Sampling methods and sample plots – Forest survey - map reading – Preparation of inventories – Management of forest plantations – commercial forests – forest cover monitoring.				

Unit:4		**SOCIAL FORESTRY & MANAGEMENT**		**9hours**
Agroforestry – Scope & necessity. Social/Urban Forestry – Joint Forest Management – Tribal participation in forest management. Soil conservation – causes of erosion – role of forests. Watershed management &environmental function of forests.				

Unit:5		**FOREST RESOURCE UTILIZATION**		**9hours**
Harvesting practices – logging and extraction - Non timber forest products – Wood seasoning and preservation – Composite woods - Anatomical structure of wood - defects and abnormalities. Timberidentification.				

Unit:6		**CONTEMPORARY ISSUES**		**2 hours**
Expert lectures, online seminars – webinars				

		Total Lecture hours	**45hours**

	Text Book(s)
1	ArumugamNandKumaresan V. (2014). *Environmental Studies,* Saras Publication Nagercoil, Tamilnadu.
2	Agarwala VP. (1980). *Forests in India.* Oxford and IBH Publishing Co., New Delhi.
	Reference Books
1	Puri GS, Meher VM, Gupta RK and Puri S.(1981). *Forest Ecology.* Oxford and IBH Publishing Co., New York.
2	Stebbin EP. (1977). *A Manual of Elementary Forest Zoology For India*. International Book Distributors, Dehra Dun.
3	Sukachev V and Dlis N. (1964). *Fundamentals of Forest Biogeocoenology,* Oliver and Boyd, Edinburgh.
4	Tiwari KM and Singh RV. (1980). *Social Forestry Plantations.* Oxford and IBH Publishing Co., New Delhi.
5	Warning RH and Schlesinger WH. (1985). *Forest Ecosystems: Concepts andManagement.* Academic Press, New York.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	Forest Biometry https://swayam.gov.in/nd1_noc20_bt04/preview
2	Forests and their Management https://swayam.gov.in/nd1_noc20_bt01/preview
3	National Digital Library of India https://ndl.iitkgp.ac.in/
	Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	M	M	M	M
CO2	M	S	M	M	M	M	M	M	S	M
CO3	S	M	M	L	M	L	M	M	L	M
CO4	M	M	M	M	L	M	M		S	S

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

Course code		**INDIAN WILDLIFE LAWS & FORENSICS.**	**L**	**T**	**P**	**C**
Core/Elective/ SBS		**Elective course II**	**3**	**0**	**0**	**2**
Pre-requisite		Basic knowledge on wildlife conservation	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. To make the student get aware with various legislations related to wildlife and conservation.
2. To make the student get familiar with wild life forensics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Able to follow and interpret various rules and regulations related to wildlife.	K2
2	Identify various crimes and give necessary information to public regarding the wildlife conservation.	K3
3	The learner will be able to identify the necessity of forensics related to wildlife crimes.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**BIODIVERSITY ACT**	**8hours**

History of Wildlife laws in India – Highlights of Biological Diversity Act, 2002 & Biological Diversity Rules, 2004.

Unit:2		**WPA AND CONSERVATION**	**9hours**

Introduction to wildlife Protection Act (over view of Chapters) - Declarations & regulations related to Sanctuaries National parks & Closed areas – Central Zoo Authority & recognition of Zoos.

Unit:3		**WPA-TRADE**	**8hours**

Prohibition of trade related to wildlife – Prevention & detection of offences. Introduction to animal involved in Schedule I to V. Plants in Schedule VI. Overview of Amendments.

Unit:4		**WILDLIFE TRADE**	**9hours**

Wildlife trade – important species and parts traded - special reference to turtles, reptiles, birds and mammals. Collection of physical and biological evidences from crime scene. Radio isotopes in forensics

Unit:5		**WILDLIFE FORENSICS**	**9hours**

Forensic entomology in wildlife crimes - wildlife toxicology - cyber forensics in wildlife - forensic veterinary pathology - forensic photography - role of diatoms in wildlife forensics – Introduction to molecular forensics – species, sex and geo-referencing samples – FINS.

Unit:6		**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars – webinars, Field visit

		Total Lecture hours	**45hours**

Text Book(s)
1	Lawmann . (2017).*Wildlife Protection Act 1972,* Kamal Publishers, New Delhi.
2	Majumdar AB (Author), Nandy D, Mukherjee S. (2013). *Environment and Wildlife Laws in India*, LexisNexis Publishers.

Reference Books
1	Huffman JE and Wallace JR. (2018). *Wildlife Forensics Methods and Applications,* Willey Blackwell Publishers, UK.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	The Indian Wildlife (Protection) Act 1972 http://envfor.nic.in/legis/ **wildlife/wildlife1.html**
2	https://Indiacode.nic.in/bitstream/123456789/1726/1/197253.pdf

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

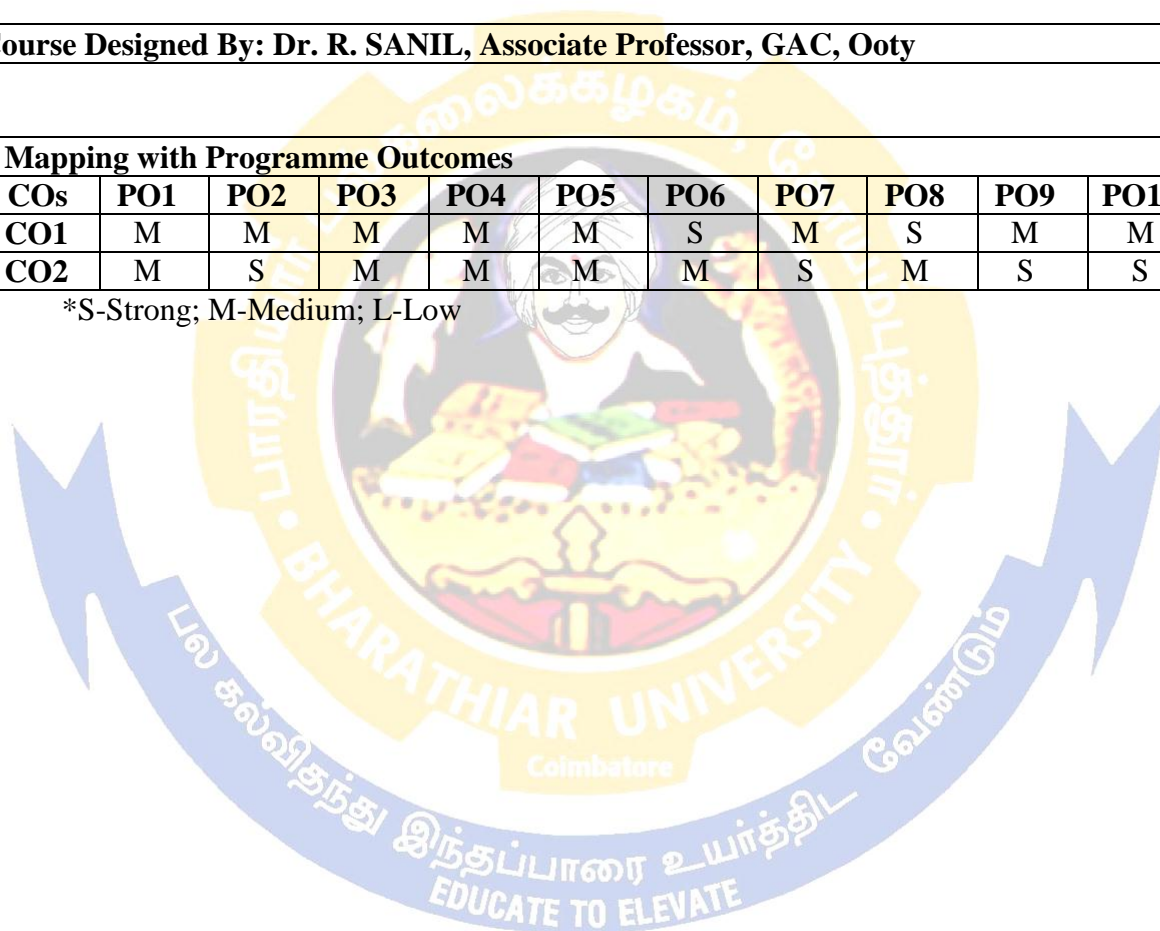| COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	S	M	M	S	M
CO2	M	S	M	S	M	S	M	S	M	S
CO3	M	S	M	S	M	M	M	M	S	S

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

Course code		BIOSTATISTICS AND COMPUTER APPLICATIONS	L	T	P	C
Core/Elective/ SBS		**Skill Based Course III**	**3**	**0**	**0**	**3**
Pre-requisite		Aptitude in basic Mathematics & Biology	Syllabus Version		2021-2022	

Course Objectives:
1. To develop awareness about the application of statistics inZoology.
2. To train how the biological data are processed and interpretations aremade.
3. To give an introduction to computer and databases.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The course will give an idea how data should be managed & Processed.	K2
2	The course will develop the research aptitude of the students.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**SAMPLING AND GRAPH**	**8 hours**

Types of Sampling –Concept of Sampling in Biology. Frequency distribution – Individual, discrete & Continuous series. *Drawing practice*: Histogram, Ogive, Bar, Pie chart.

Unit:2		**MEASURES OF CENTRAL TENDENCY**	**9hours**

Concept & equations of Mean & deviation (individual, discrete & continuous series)
Problem Solving: (individual series alone) Mean, median, mode and Standard Deviation.

Unit:3		**CORRELATION AND REGRESSION**	**9hours**

Concept & types of Co-relation & regression.
Problem Solving: Co-efficient of Correlation, Regression for X on Y & Y on X.

Unit:4		**TEST OF SIGNIFICANCE**	**8hours**

Concept of Students "t", Chi square.
Problem Solving: "t" test – independent & dependent, Chi square.

Unit:5		**COMPUTER- APPLICATION**	**9hours**

Central Processing Unit – Output & Input devices – Storage devices – Software & hardware – Basic operation of MS Word, Excel & Power Point – Browsers & Search engines – Introduction to Biological databases – significance of NCBI –Taxonomic browser.

Unit:6		**CONTEMPORARY ISSUES**	**2 hours**

Expert lectures, online seminars – webinars

		Total Lecture hours	**45hours**

Text Book(s)

1	Ramakrishnan P. (2015). *Biostatistics* ,Saras Publication Naftion Nagercoil, Tamilnadu.
2	Arumugam N. (2015).*Basic Concepts of Biostatistics,* Saras Publication Nagercoil, Tamilnadu,

Reference Books	
1	Banerjee PK. (2014). *Introduction to Biostatistics*, 5th edition, S. Chand Publication, New Delhi.
2	Pandey M. (2015). *Biostatistics Basic and Advanced,* Publishers Viva Books, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Introduction to Biostatistics https://swayam.gov.in/nd1_noc19_bt19/preview
2	Biostatistics and Design experiments https://swayam.gov.in/nd1_noc20_bt11/preview
3	National Digital Library of India https://ndl.iitkgp.ac.in/

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	S	M	S	M	M
CO2	M	S	M	M	M	M	S	M	S	S

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

Sixth Semester

Course code		ANIMAL PHYSIOLOGY.	L	T	P	C
Core/Elective/ SBS		Core Course VIII	4	0	0	4
Pre-requisite		Knowledge on animal systems and organisation	Syllabus Version		2021- 2022	

Course Objectives:

1. To familiarise students with the principles and basic facts of AnimalPhysiology.
2. To give students an insight about the molecular and cellular basis of physiological functions inanimals.
3. To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.
4. To make aware of the students about how the structure-function relationships synchronise along with the molecularsignals.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Able to explain how the various organ systems are coordinated and controlled.	K2
2	Understand and list the functions of various organs in relation to physiological process.	K3
3	Develop the idea of multilevel controlling and feedback mechanism in relation to various physiological functions.	K4
4	Gain knowledge and develop the idea of multilevel controlling and feedback mechanism in relation to various physiological functions.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	NUTRITION AND RESPIRATION	14hours

Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Mineral & Vitamins – its deficiency. Hormonal control of digestion. Respiratory pigments- structure of haemoglobin, TransportofO2&CO2-Bohreffect-Regulationofrespiration-carbonmonoxidepoisoning, bronchitis, asthma.

Unit:2	CIRCULATION AND EXCRETION	15hours

Blood- composition and functions of blood plasma and formed elements, Mechanism of blood clotting, Types of Hearts – Heartbeat & pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, - Excretory products,Osmo-regulation in fishes.

Unit:3	MUSCLE AND NERVE PHYSIOLOGY	14 hours

Brief account of types of muscles - Ultra structure of striated muscle, Muscle contraction & properties. Neurons – structure & types - Impulse propagation, synaptic transmission, neuro transmitters - Reflex action.

Unit:4	SENSE ORGAN	15 hours

Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision – Colour and black and white vision in various mammals - Structure of ear and mechanism of hearing - Olfactory, gustatory and tactile sense organs – lateral line sense organs – Jacobson's organ.

Unit:5	REPRODUCTIVE PHYSIOLOGY	15hours

Puberty, adolescence, pregnancy, parturition, lactation. Endocrine glands in man - Hormones, action and disorders - Feed-back mechanism, Outlines of mechanism of hormonal activity – Rolofe of hormones in hunger management, Parental care & migration.

Unit:6	CONTEMPORARY ISSUES	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	75hours

Text Book(s)

1	Arumugam N and Mariakuttikan A. (2014).*Animal Physiology*, SarasPublications, Nagercoil, Tamilnadu.
2	Bhagavan NV.(2002).*Medical biochemistry*, fourth edition Academic Press.

Reference Books

1	Guyton AC and Hall JE.(2017). *Text Book of Medical Physiology*, Elsevier
2	Jain AK. (2016). *Textbook of Physiology*. Avichal Publishing Company.
3	Lehninger AL, MichaelCox, NelsonDL. (2017).*Principles ofBiochemistry*, 7[th]edition, Macmillan, London.
4	Tyagi BS, Agarwal VK and Verma PS. (2000). *Animal Physiology*, S. Chand Publishers, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Animal Physiology https://swayam.gov.in/nd1_noc20_bt42/preview
2	National Digital Library of India https://ndl.iitkgp.ac.in/
3	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9

Course Designed By: Dr. R. SANIL , Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	M	M	S	M	M	S
CO2	M	S	S	S	M	M	M	M	S	M
CO3	S	M	M	S	S	S	S	S	M	M
CO4	M	M	S	M	M	S	S	M	M	S

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

Course code		DEVELOPMENTAL BIOLOGY	L	T	P	C
Core/Elective/ SBS		Core Course IX				
Pre-requisite		Knowledge on animal diversity and organ systems	**Syllabus Version**	**2021-2022**		

Course Objectives:

The main objectives of this course are to:
1. To make aware of the students about the theories, concepts and basics of Developmental Biology.
2. To provide students the idea of sex cells, fertilization, cleavage, differentiation and development oforgans.
3. To make aware of the induction, organizers and development of extra embryonic structures.
4. To provide adequate explanation to students about the late embryonic developments and post embryonic development andageing.
5. To give students idea about teratogenesis, invitro fertilization, stem cells and amniocentesis.

Expected Course Outcomes:

	On the successful completion of the course, student will be able to:	
1	The learner will be able to understand methodological approaches to the study of embryonic development and the characteristics of the principal experimental models.	K2
2	The students will be able to identify embryonic structures in preparations, photographs and diagrams.	K3
3	The students will be able to develop an idea, how to arrange sequences in developmental processes in order.	K4
4	The learner will be able to understand the derivatives of embryonic structures.	K5
5	The students will be attain a basic conceptual knowledge of the principal cellular mechanisms of development and identify the genetic and molecular elements that are involved.	K5
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create		

Unit:1	GAMETES AND FERTILIZATION	15hours

Basic concepts of developmental biology – theories - Structure human Spermatozoa - Structure of mammalian egg - Egg membranes Patterns of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism and significance – Parthenogenesis. Introduction- Fundamentals-Need for Artificial Intelligence.

Unit:2	BLASTULATION AND GASTRULATION	14hours

Cleavage - Planes & Patterns of cleavage - Factors controlling cleavage - Fate map. Blastulation – Morphogenetic movements - gastrulation frog & chick.

Unit:3	ORGANOGENESIS	14hours

Development of Brain, Eye and Heart in frog. Development of Nervous system in chick &Foetal membranes in chick & Mammals.

Unit:4	APPLIED EMBRYOLOGY	15hours
Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation-teratogenesis–Regeneration:types-eventsandfactors.Transgenicmice- Retroviral method – Microinjection method - Embryonic stem cell method. Methods to culture embryo.		

Unit:5	PLACENTATION AND TECHNIQUES	15hours
Placentation in Mammals – Oestrous cycle and period of heat in mammals - Menstrual cycle in primates–mating season and gestation period in Lion, tiger wild dog, leopard, elephants&Ungulates–Assisted Reproductive Technology – Embryo transfer – Amniocentesis.		

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		

	Total Lecture hours	75hours

Text Book(s)

1	Arumugam NA.(2014). *Text Book of Embryology,* Saras Publication Nagercoil.
2	Balnisky BI. (1975). *An Introduction to Embryology*, W.B. Saunders and Co, US.

Reference Books

1	Berril NJ and Kars G. (1986). *Developmental biology,* McGrawHills, New Delhi.
2	Gilbert SF (2010). *Developmental Biology*, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
3	Majumdar NN. (1985). *Vetebrate embryology*, Tata McGraw-Hill, New Delhi.
4	Verma PS and Agarwal VK. (1975). *Chordate Embryology,* S. Chand Publishers, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9
3	Introduction to Developmental Biology https://swayam.gov.in/nd1_noc20_bt35/preview
4	Developments Biology MOOC Course (saaylor.org)

Course Designed By:
1. Dr. R. SANIL, Associate Professor, GAC, Ooty.
2. Dr. ROSILINE MARY, Asst. Prof, Nirmala College For Women,Coimbatore.

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	S	M	M	M
CO2	M	M	M	M	M	M	M	M	S	S
CO3	M	S	M	M	M	M	M	S	S	S
CO4	S	M	M	S	M	M	S	M	S	S
CO5	M	M	S	M	M	S	M	M	M	M

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

Course code		ANIMAL BEHAVIOUR		L	T	P	C
Core/Elective/ SBS		**Core Course** **X**		**4**	**0**	**0**	**4**
Pre-requisite		Knowledge of Animal ecology and evolution		**Syllabus Version**		**2021-2022**	

Course Objectives:

1. The course will give a basic idea of different type of animal behavior and itssignificance.
2. The course also give an insight to the students about the reason for various types of behavior.
3. The course also explain how different animals adapt different behavior in order to over different strategies and how it is used inadaptation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The student will be able to explain the basic concepts of animal behavior.	K2
2	Observe and understand the reasons of various strange behaviour in animals.	K2
3	Analyse the various animal relations in an interdisciplinary approach.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1		**INTRODUCTION TO BEHAVIOUR**		**14hours**

Historical out lines – patterns, objectives & mechanism of behavior. Reflex action - types - reflex arch - complex behaviour. Kinesis: orthokinesis&klinokinesis. Taxis: kinds of taxis -sun-compass orientation, dorsal- light reaction – Biological rhythms.

Unit:2		**LEARNING AND MOTIVATION**		**15hours**

Learning &Instinct: conditioning, habituation, sensitization, reasoning -classical and modern concepts with examples.Motivation – types, models & examples – Motivational conflict – decision making & displacement. Hormones& Pheromones inbehaviour.

Unit:3		**ALTRUISM AND SEXUAL SELECTION**		**15hours**

Altruism and evolution-reciprocal altruism - group selection - kin selection - inclusive fitness, cooperation.Parental care & Cost benefit analysis. Courtship - Male rivalry – Female choice – Infanticide – Mate guarding – Cryptic mate choice -Polygamous sexual conflicts.

Unit:4	**SOCIAL ORGANISATION AND COMMUNICATION**		**15hours**

Social Organisation in honey bees –foraging – Bee dance. Echolocation in bats – Herd composition in elephants – Migratory path and concept of corridor. Social behavior in Felids – Predation. Pack formation and splitting in Wild dogs. Social Spacing– Communal defense-Aggression - territory defending.

Unit:5		**COMMUNICATION**		**14hours**

Song of Birds&behaviour– role in mating – territory defending & others. Vocal communication in mammals – interspecies and intraspecific significance. Alarm Calls in animals - Signals &cues.Crypsis& Mimicry — Evolution of sex – Methods to study behavior.

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75hours**

Text Book(s)	
1	Arumugam NA and Natarajan P. *Animal Behaviour – Ethology,* Saras Publication Nagercoil,Tamilnadu.
2	Ridley M. (1986). *Animal Behaviour - A concise Introduction* , Blackwell Scientific Publications, Oxford.

Reference Books	
1	Leshner AI, (1978).*An Introduction to Behavioural Endocrinology,* Oxford UniversityPress, New York.
2	Slater P J B.0(1985). *An Introduction to Ethology,* Cambridge University Press, Cambridge.
3	Wallace R A. (1979). *The Ecology and Evolution of Animal Behaviour,* Goodyear Publishing Company Inc., Santa Monica, California.
4	Wilson E O. (1978). *Sociobiology,* The Belknap Press, Harvard University Press, Cambridge, MA.
5	Manning A and Dawkins MS.(2012). *An Introduction to Animal Behaviour*, 6th edition, Cambridge University Press, UK.
6	Marler P and Hamilton J.(1966). *Mechanism of Animal Behaviour,* John Wiley & Sons, USA.
7	David McFarland. (1985).*Animal Behaviour,* Pitman Publishing Limited, London, UK.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	National Digital Library of India https://ndl.iitkgp.ac.in/
2	SwayamPrabhahttps://www.swayamprabha.gov.in/index.php/program/archive/9
3	Animal Behaviour MOOC Course https://www.mooc-list.com/tags/animal-behaviour
Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty.	

Mapping with Programme Outcomes									
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	M	M	S	S	M	M
CO3	M	S	M	M	S	S	M	S	M	S
CO3	S	M	M	M	M	M	S	M	S	S

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

Course code		QUANTITATIVE METHODS IN WILDLIFE.	L	T	P	C
Core/Elective/Supportive		Elective course III	3	0	0	3
Pre-requisite		Basic knowledge in statistics	Syllabus Version		2021-2022	

Course Objectives:

1. To give a foundation of various quantification methods used in wildlifescience.
2. To give a idea about various software and its usage in handling wildlifedata.
3. To give an insight to the advanced statistics and its application inwildlife.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and able to handle and interpret the wildlife data.	K2
2	The learner will develop skill in identifying the various quantitative that can be send in wildlife data analysis.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1		SAMPLING DESIGN	9hours

Sampling and experimental design - Sampling designs for population estimation - population estimation methods - Distance based Sampling Methods, Capture-recapture based estimation of Closed Population – Indices - estimation of Demographic parameters.

Unit:2		ESTIMATES IN SOFTWARE	8hours

Analysis of Abundance data using distance – Mark, Capture Software – Introduction & Usage of R.

Unit:3		PROBABILITY DISTRIBUTION	8hours

Introduction to probability – Addition and multiplicationtheory. Distributions: Binomial, Normal & Poisson – Applications in wildlife.

Unit:4		HYPOTHESIS TESTING	9hours

One tailed & Two tailed tests in Biology – Hypothesis testing & Comparison – Parametric & Non parametric tests – ANOVA and Post hoc comparisons.

Unit:5		ADVANCED STATISTICS	9hours

Introduction to Bayesian Statistics – Data transformations – Boot strap &Jack-knife procedures – Applications in wildlife sciences. Occupancy concept – brief overview of Single Season & Multi Season Models by MacKenzie.

Unit:6		CONTEMPORARY ISSUES	2 hours

Expert lectures, online seminars – webinars

		Total Lecture hours	**45hours**

Text Book(s)

1	Arumugam N.(2015). *Basic Concepts of Biostatistics*, Saras Publication Nagercoil.
2	Silvy N.J. *Wildlife Techniques Manual Vol 1 and 2*. The John Hopkins University Press, Maryland.

	Reference Books
1	BanerjeePK. (2014).*Introduction toBiostatistics*, 5[th]edition,S. ChandPublication, New Delhi.
2	Williams B, Nichols J and Conroy M. (2002).*Analysis and Management of Animal Populations*, 1[st]edition,Academic Press, NY.
3	John Skalski Kristin Ryding Joshua Millspaugh. (2005).*Wildlife Demography,* Academic Press.
4	McGarigal K, Cushman SA, Stafford S. (2002). *Multivariate Statistics for Wildlifeand Ecology Research,* Springer.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	MacKenzie PRESENCE User Manual. http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/dcp%20reports/2012/PRESENCE_Occupancy_Statistics%20_Soft ware_Manual_20121112.pdf.
2	https://en.wikipedia.org/wiki/Main_Page(for R, Mark & Capture)
	Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

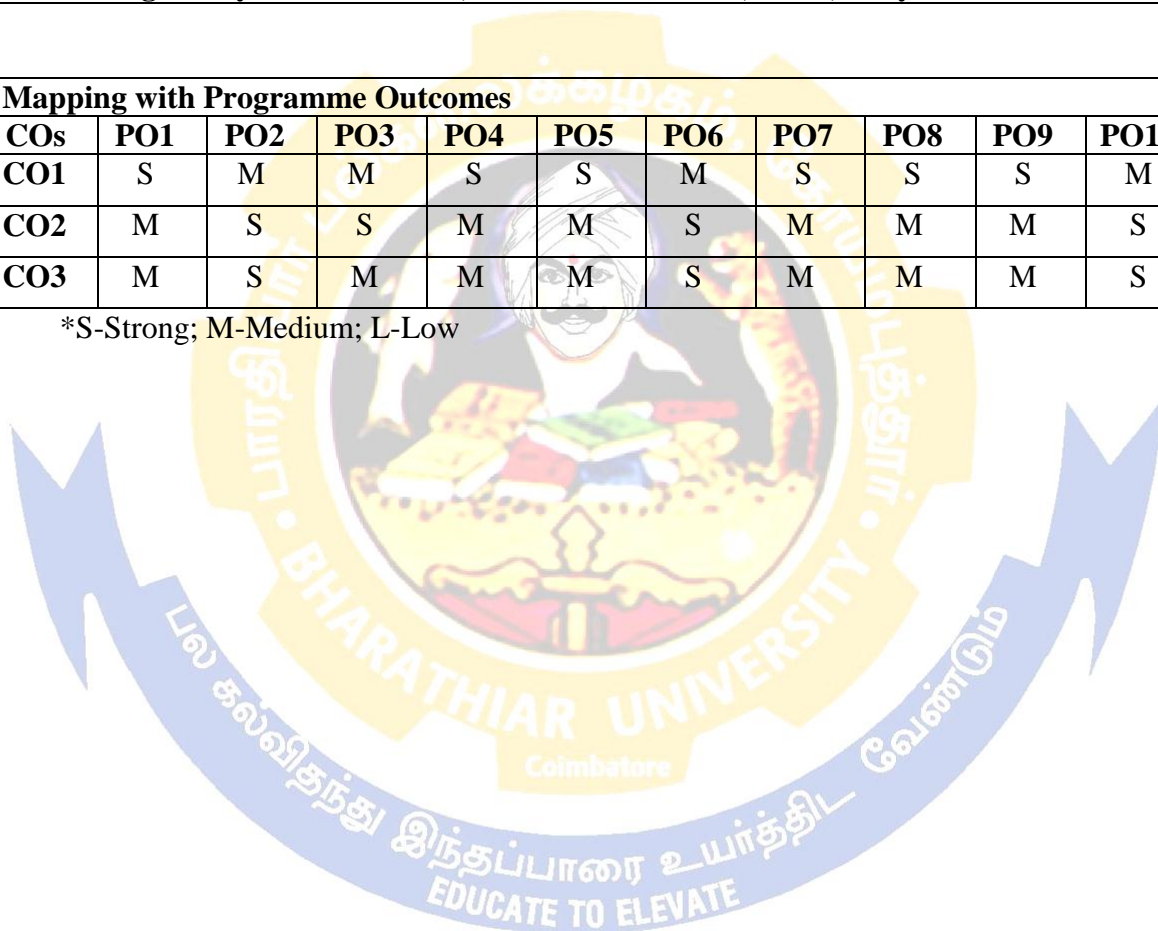| **Mapping with Programme Outcomes**										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	L	M	M	L	M	S	M	S	M
CO2	L	M	S	L	M	L	M	S	M	S

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

Course code		GEO-INFORMATICS		L	T	P	C
Core/Elective/ SBS		**Elective IV**		3	0	0	3
Pre-requisite		Knowledge of ecology and statistics		**Syllabus Version**		**2021-2022**	

Course Objectives:

1. To give an introduction to basicgeology.
2. To give idea about the usage of GISsoftware.
3. To train the students in the creation ofmaps.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the use of geological principles in wildlife sciences.	K3
2	Able to geo-reference the data in cartograms.	K3
3	The students will able overlay layers in maps and generate it.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		**INTRODUCTORY GEOLOGY**		**9hours**

Digital images& pixels – Latitudes & longitudes - Topography maps – Contour lines – Colours& symbols – Scale –types & measuring distance – Mountains & Plateaus in India – Major rivers in India. Satellite images and availability.

Unit:2		**GPS**		**9hours**

GPS - applications in identifying locations mapping & Navigation. Introduction to GIS maps – Digitization of Maps and Projection. Brief outlines to Arc View – Mapinfo& QGIS.

Unit:3		**DATA ANALYSIS**		**9hours**

Data Entry and Preparation, Spatial Data Generation, Concept of Database and Metadata, Spatial Modelling and Data Visualization.

Unit:4		**MANAGING DATA SOURCE**		**8hours**

Opening Data –CRS – OTF – XML files – Shape files – Delimited text files / CSV files - creating layers – Exploring data formats and fields.

Unit:5		**MAP MAKING**		**8hours**

Working with Raster and Vector data in GIS software. Usage of general tools in Q- GIS - transferring of GPS data to GIS. Map making.

Unit:6		**CONTEMPORARY ISSUES**		**2 hours**

Expert lectures, online seminars – webinars

		Total Lecture hours		**45hours**

Text Book(s)

1	Kang-tsung. (2006).*Chang Introduction to Geographic Information Systems.* Mcgraw Higher Ed,NY.
2	Chipman LK. (2015). *Remote Sensing And Image Interpretation.* 7th edition.Willey.

Reference Books	
1	Elangovan K GIS: *Fundamentals, Applications and Implementations*, New India Publishing Agency

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Q GIS User Guide Release 2.8. https://docs.qgis.org/2.8/pdf/en/QGIS-2.8-UserGuide-en.pdf.
2	Map Info Professional. https://en.wikipedia.org/wiki/MapInfo_Professional.
3	ArcGIS https://en.wikipedia.org/wiki/ArcGIS.

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	S	S	S	M
CO2	M	S	S	M	M	S	M	M	M	S
CO3	M	S	M	M	M	S	M	M	M	S

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

Course code		WILDLIFE MANAGEMENT TECHNIQUES	L	T	P	C
Core/Elective/ SBS		**Skill Based Course IV**	**2**	**0**	**0**	**2**
Pre-requisite		Knowledge on Basic concepts of Wildlife	Syllabus Version		2021-2022	

Course Objectives:
1. To train the students in the usage of various techniques used in wildlifesciences.
2. To train the students to develop skill in using variousinstruments.
3. To train the students reading the population assessmentpractices.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Trained to assess various population assessment techniques.	K3
2	The students will be trained in the usage of various wildlife instruments.	K3
3	Able to identify all the indirect signs related to wildlife.	K5
4	In total the student will develop skill in wildlife techniques	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1		**INSTRUMENTATION**		**5hours**

Pedometer – usage in wildlife. Field compass – back & front bearing – construction of transect lines. Range finder –distance measuring - angle of citing.Camera traps – fixing,maintenance – modes of operation – significance. GPS – mode of operation. Radio-collaring – methods &significance.Drones – monitoring terrain & wildlife.

Unit:2		**SIGN SURVEY AND OCCUPANCY**		**6hours**

Identification of Pug marks & hoof marks of various animals. Identification of scats, dung, pellet based on structure. Other indirect signs of animal presence. Herbivore sign survey and estimation of density – Occupancy analysis based on indirect signsurvey.

Unit:3		**POPULATION ESTIMATION**		**6hours**

Quadrat sampling – different types and estimation of density & abundance. Transect lines and sampling- estimation of abundance. Planning of ideal census methods – sample counts – Block counts – Roadside counts – Dung count – Pugmark & waterhole census (Calculation for population number estimation in these methods).

Unit:4		**VEGETATION ANALYSIS**		**5hours**

Survey & mapping water sources – rain gauge setting – Floristic inventory – Ground cover sampling – Shrub & tree layer measuring - Vegetation mapping – Fire as a tool. Human Wildlife conflict assessment – Human pressure classification – Trail survey in boundary.

Unit:5		**DARTING AND POSTMORTEM**		**6hours**

Chemical restraints: Advantage & Disadvantage –syringes & darts –planning operation. Wildlife health monitoring – Body condition evaluation – Monitoring infection -Infectious diseases. Postmortem – External examination – internal examination – examination of abnormalities – Preservation & diagnosis of specimen.

Unit:6	CONTEMPORARY ISSUES	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**30hours**

	Text Book(s)
1	Dasmann RF. *Wildlife Biology,* John Wiley & Sons, New York.
2	Gilas RH Jr.(ed.), *Wildlife Management Techniques, 3rd ed. The Wildlife Society,*Washington D.C., Nataraj Publishers, Dehra Dun.
	Reference Books
1	Robinson W L and Eric G Bolen. (2002). *Wildlife Ecology and Management,* Maxmillan Publishing Company, New York.
2	Rodgers WA. (1991). *Techniques for Wildlife Census in India - A Field Manual:* 5. Technical Manual - T M - 2. WII.
3	Saharia VB. (1982). *Wildlife of India,* Natraj Publishers, Dehra Dun.
4	Teague RD (ed.),(1987).*A Manual of Wildlife Conservation* (The Wildlife Society, 8. Wsashington D.C.). Nataraj Publishers, Dehra Dun.
5	WII. A Guide to Chemical Restraint of Animals.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	Ecology &Wildlife MOOChttps://www.mooc-list.com/course/ecology-and-wildlife-conservation-futurelearn
2	SwayamPrabhahttps://swayamprabha.gov.in/index.php/program/current/9/272109
	Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty.

Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	M	M	M	M	M	M	M
CO3	S	M	S	M	M	S	M	M	M	M
CO3	M	M	M	M	S	M	M	S	M	M
CO4	M	M	M	M	M	M	M	M	M	S

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

Course code		FUNDAMENTALS OF WILDLIFE BIOLOGY - PRACTICAL	L	T	P	C
Core/Elective/ SBS		Core Practical III	**0**	**0**	**2**	**2**
Pre-requisite		Knowledge in basic concepts of wildlife sciences	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. Give an insight to basics of lifesciences
2. Handling experiments related to lifescience
3. Gain hands on experience inexperimentation

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Do basis experiments in life sciences	K3
2	Develop analytical skills in experimentation	K3
3	Making observations during experimentation	K3
4	Interpret the results of experiments	K3

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6** – Create

MAJOR PRACTICAL

1. Squash Preparation of Onion root tip – stages of Mitosis
2. Oxygen consumption of fresh waterfish
3. Analysis of excretory products- Ammonia, urea and uricacid.
4. Isolation of DNA from anyfruit/tissue.
5. Focal animal sampling & preparation ofethogram.
6. Multimedia demonstration of social behavior in monkeys, lions &elephants.
7. Multimedia demonstration of courtship and brood behavior inbirds.

MINOR PRACTICAL

1. Study of opercula movement of a fish at 10 degree increase andQ10.
2. Activity of Salivary Amylase(Qualitative).
3. Estimation of Carryingcapacity.
4. Paper chromatogram of any biologicalsample.

SPOTTERS

1. **Identify the given indirectSign**
   Pug mark (male & female), Scratch mark, rake mark of tiger, leopards, bear, wild dog and small cats.
2. **Comment on Embryologicalimportance**
   Spermatozoa, Ovum, Blastula, Gastrula.
3. **Identify the given Reserve plotted in the Map and comment on itsimportance.**
   MTR, PTR, PKTR, KMTR, Anamali, Sathyamangalam, Bandipur, Nagarhole, Panna, Manas, Rajaji, Corbet, Sunderbans, Sariska, Pench, Melghat&Kanha.
4. **Identify the WPA Schedule, IUCN Status andcomment.**
   Tiger, Wild Dog, Leopard cat, Elephant, Barking Deer, Sambar Deer, Blue Whale, Gangetic Dolphin, Peacock.
5. **Based on the Dental formula identify theMammal**
   Rat, Domestic cat, Tiger, Monkey, Spotted Deer, Horse & Rabbit.

SUBMISSION 1

A Photography training have to be undertaken and the candidate needs to submit a photo album of wildlife photography of self-experience (Minimum 15 hours need to be spend in field).

SUBMISSION 2	
The candidate need to submit a report of ecotourism of a locality or a report of candidates involvement in conservation effort or the report of candidates involvement in wildlife awareness programme or the report of a similar programme approved by the department.(Minimum 15 hours need to be spend in field).	
QUESTION PATTERN: (50+50 MARKS)	
External: Major: 20, Minor: 10, Record: 5, Spotter: 15 (5 spotters each carry 3 marks).**Internal:** Submission 1: 5 marks, submission 2: 5 marks, Model Practical: 30 marks, Record: 5 Marks, Attendance 5 marks..	
TotalPractical Hours	**30(Each Semester) x 2 = 60 Hours PerYear**
Text Book(s)	
PS Verma and Srivastava PC. (2012).*Advanced Practical Zoology,* S. Chand Publications, Chennai.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
https://www.pdfdrive.com/zoology-books.html	
Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	M	M	M	S
CO2	M	M	S	M	M	M	S	M	S	M
CO3	M	S	S	S	S	M	S	M	M	M
CO4	M	M	M	M	M	M	S	M	S	S

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

Course code		**CONSERVATION BIOLOGY AND FORESTRY - PRACTICAL**	**L**	**T**	**P**	**C**
Core/Elective/ SBS		**Core Practical IV**	**0**	**0**	**2**	**2**
Pre-requisite		Knowledge on conservation biology and forestry	**Syllabus Version**	**2021-2022**		

Course Objectives:
1. To create basic knowledge onConservation
2. To create awareness inforestry
3. To develop hands on practice inConservation,

Expected Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	Understand sampling techniques in wildlife science	K4
2	Understand population analysis protocol	K4
3	Understand basic methods in forestry.	K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create		

MAJOR PRACTICAL

1. Determination of optimum size of a quadrat using species area curve (Innovative lab methods can be used for practicalexamination).
2. Estimate the abundance and density using multiple square quadrates (Innovative lab methods can be used for practicalexamination).
3. Lay a line transect in two different habitat and compare the diversity and species richness of the two area (Innovative lab methods can be used for practicalexamination).
4. Estimate the density and deviation of Population using the Belt transectmethod.
5. Prepare a line transect and estimate the density of given individual herbivores based on the dung sample. (For examination purpose, picture of five repeated survey with five to ten quadrates (10x1m) can be given with presence of dungs and pellets indicated may be given and student should estimate the populationdensity).
6. Estimation of Avian population density using point count method (For examination above given protocol can befollowed).

MINOR PRACTICAL

1. Measurement of height of given tree by estimating sitingangle.
2. Calculate the log volume based onperimeter.
3. Estimate the canopy cover of given tree (both conical andcircular).

SPOTTERS

1. Comment onTaxonomy:
Casuarina, Cedrus, Dipterocarpus, Emblica, PinusPterocarpus, Shorea,Salmalia&Terminalis.

2. Comment on Silviculture importance:
Butea, Cassia, Largerstroemia, Pterocarpus, Albizzia, Anthocephalus

3. Comment on Ecological role:
Bamboo, *Elaeocarpus, Ficus, Rhododentron, Mahonia, Shizigium, Shola grass*

4. Comment of Commercialuse:
Sandalum, Dalbergia, Azadirachta, Tectona, Tamarindus

5. Comment onEradication:
Parthenium, Eupatorium, Lantana, Eucalyptus, Acacia

SUBMISSION 1
Report of the in depth study of a Reserve /Protected area regarding its administrative set up, habitats, conservation activities & disaster management.
SUBMISSION 2
Brief report of involvement in a research or report of small observation or report of biodiversity survey of an area.
QUESTION PATTERN: (50+50 MARKS)
External: Major: 20, Minor: 10, Record: 5, Spotter: 15 (5 spotters each carry 3 marks).**Internal:** Submission 1: 5 marks, Submission 2: 5 marks, Model practical: 30 marks, Record: 5 Marks, Attendance: 5 marks.

TotalPractical Hours	**30(Each Semester) x 2 = 60 Hours PerYear**

Text Book(s)	
1	Lindenmayer, David and Burgman, Mark. (2005). *Practical Conservation Biology.* 10.1071/9780643093102.
2	Pawar P and Bharadwaj.(2005).*SDHandbookofPracticalforestry*,Agrobios publications.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.mongabay.com/conservation-biology-for-all.html
Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	L	L	M	S	M	M	M	M
CO2	S	L	M	M	S	M	S	S	S	S
CO3	M	M	S	M	M	M	M	M	S	S

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

Course code		**GEO-INFORMATICS AND WILDLIFE FORENSICS - PRACTICAL**	**L**	**T**	**P**	**C**
Core/Elective/ SBS		**Elective Course V: Practical**	**0**	**0**	**2**	**2**
Pre-requisite		Basic knowledge in geo-informatics and forensics	**Syllabus Version**		**2021-2022**	

Course Objectives:

1. Train the students in GPS andgeo-informatics
2. To train the students in basic forensic concepts forensicanalysis

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Students will be able to read maps & GPS	K3
2	Students will be able to use Q GIS	K3
3	Students will be able to do Geo-referncing	K2
4	Students will be able to identify carnivore scats	K3
5	Students will be able to learn trichology	KX

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

MAJOR PRACTICAL

1. Given map is RF 1:50,000 or 1:25,000 top sheet, scan the image and convert it intoa GIS Map or three dimensionalmap.
2. Given is the scanned image of an area, convert the JPEG picture into a vector imageby assigning the GPS values given and plot a grid inside.Over lay two different sets of GPS points as different symbols over the map. Prepare the map, print andsubmit.
3. Given is a survey GPS points, plot it on the given vector image and overlay the given two layers estimate the distance between the GPS points in Km and submit a printout ofthemapgenerated.

MINOR PRACTICAL

1. Running of Presence Single season model using occupancy dataprovided.
2. Running Distance Software using the dataprovided.
3. Estimate the population using capture recapture theory (Concept: Population is closed, Capture animals are colored and reintroduced).
4. Read the six digit grid reference of the given two spots, calculate the altitude and estimate the distance between points based on a topographicsheet.
5. Convert the given contour line map draw hill shapes and mark the altitude represented by eachline.
6. In the given Topographic sheet mark steep slopes, gentle slopes, highest peak and other details mentioned inquestion.

SPOTTERS

1. **Comment on theInstrument**
   Pedometer, Field compass, Range finder, Camera traps, GPS & Drone
2. **Identifying featuresof**
   Scat of tiger, Leopard & Wild dog, Dung of Gaur, Pellet of Hare, Sambar Deer, Spotted Deer, Barking Deer, and Porcupine.
3. **Identify the Given hairsample**
   Hair of Sambar Deer, Langur, Boar, Gaur, Spotted Deer.
4. **Identify the type of forest in Photograph orProjection**
   Evergreen, Deciduous, Scrub Jungle, Shola-grassland, Mangroove

5. Identify they type of given map
  Political map, Physical map, Topographic map, Climatic map, Road map, Climatic map &
  Resource map.	

QUESTION PATTERN: (25 + 25 MARKS)
 External: Major: 10, Minor: 5, Record: 5, Spotter: 5 (5 spotters each carry 1
marks).**Internal:**Model practical: 15 marks, Record: 5 Marks, Attendance 5 marks.

TotalPractical Hours	**30(Each Semester) x 2 = 60 Hours PerYear**

Text Book(s)

1	Kang-tsung. (2006).*Chang Introduction to Geographic Information Systems,* 9th edition Mcgraw Higher Ed, NY.
2	Chipman LK. (2007).*Remote Sensing And Image Interpretation.* Publisers-Willey, US.

Reference Books

1	Elangovan K. (2006).*GIS: Fundamentals, Applications and Implementations,* New India Publishing Agency

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Q GIS User Guide Release 2.8. https://docs.qgis.org/2.8/pdf/en/QGIS-2.8-UserGuide-en.pdf.
2	Map Info Professional. https://en.wikipedia.org/wiki/MapInfo_Professional.
3	ArcGIS https://en.wikipedia.org/wiki/ArcGIS.

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Mapping with Programme Outcomes									
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	M	S	M	L	L	L
CO2	S	M	M	S	S	S	S	L	L	L
CO3	S	M	M	M	M	M	S	M	M	S
CO4	S	S	S	M	M	M	S	M	M	S
CO5	M	M	M	M	M	M	S	M	S	S

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

Value Added Course

Value Added Course	TIGER MONITORING	L	T	P	C
	Value Added Course - I				
Pre-requisite	Basic knowledge in Biology	**Syllabus Version**		**2021-2022**	

Course Objectives:
1. To train students as Biologists in reserves

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Well trained to be Biologists in reserves	K3
2	Gain knowledge about Monitoring and Assessment of habitats of animals.	K4
3	Understand and apply techniques in identifying dung pellets, scats and sampling.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

MODULE	**10 X 2 = 2=Hours**
Module 1.Methods of Sign Survey	
Module 2. Survey in line transects	
Module 3. Monitoring the preypopulation	
Module 4. Assessment of HabitatQuality	
Module 5. Monitoring of Tiger and co-predators using camera trapping	
Module 6. Recognising the tigers using stripping patterns.	
Module 7. Occupancy modeling for tiger and co-predators & use of co-variates	
Module 8. Concepts and estimation of Capture Mark and re capture techniques.	
Module 9. Estimation of Density**.**	
Module 10. Tracing of pugmarks**.**	

PRACTICAL	**5 X 2 =Hours**
1. Identification of carnivorescats	
2. Identification of herbivore Dungpellets	
3. Usage of CameraTraps	
4. Usage of Fieldcompass	
5. Transect laying and quadratesampling	

REFERENCE BOOKS
1.Karanth KU and Nichols JD Edited. (2002). Monitoring tigers and their prey: A manual for wildlife researchers, managers and conservationists in tropical Asia, Publishers Central for Wildlife Studies.
2. UllasKaranthK and James D Nichols Editor. (2017). Methods For Monitoring Tiger And Prey, Publishers Springer.
Course Designed By: Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	S	S	M	S	S	M	S	M
CO2	L	S	S	S	S	M	M	M	S	M
CO3	L	S	S	M	M	S	S	M	S	M

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

Value Added Course	**DATA MINING**	**L**	**T**	**P**	**C**
	Value Added Course - II				
Pre-requisite	Basic knowledge in Biology	**Syllabus Version**	**2021-2022**		

Course Objectives:	
The main objectives of this course are to:	
1. To train students as data analysist	

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Find job as data analysist.	K3
2	Able to analysis and apply various tool and techniques.	

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

MODULE	**5 X 3 = 15Hours**

1. Introduction – Concepts, Challenges andissues
2. Types of data, Quality of data, pre-processing ofdata
3. Decision tree induction - Rule based classifiers - Nearest neighbour classifiers -Bayesian classifiers-Artificial neural networks -Support vector machine -Ensemble methods - Model evaluation
4. Association analysis: Problem definition, Frequent itemset generation, Rule generation, Challenges, Interestingness measures, Generalization of associationpatterns
5. Cluster analysis: Similarity and distance - Density - Center based clustering techniques - Hierarchical clustering -Density based clustering, Other clustering techniques, Scalable clustering algorithms, Clusterevaluation.

PRACTICAL	**5 Hours**

Data visualization – Training on various visualization techniques

REFERENCE BOOKS

1.Charu C. Aggarwal. (2016).Data Mining: The Textbook, Publisher: Springer.

2.Jiawei Han, MichelineKamber,Jian Pei . (2011).Data Mining: Concepts and Techniques Publisher:Elsevier Science.

Course Designed By: Dr. R. SANIL, Associate Professor, GAC, ooty

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	M	L	M	S	S	S	S
CO2	L	L	L	M	L	M	S	S	S	S

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

Value Added Course	ECONOMICS OF CONSERVATION	L	T	P	C
	Value Added Course-III				
Pre-requisite	Basic knowledge in life sciences	**Syllabus Version**		**2021-2022**	

Course Objectives:

6. To create basic awareness about conservation
7. To create awareness to students explore biodiversity for new productdevelopment.
8. To create awareness to understand the economics aspects ofBiodiversity

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explore nature in search of new biodiversity products in field of medicine and agriculture.	K3
2	Able to understand the significance and need of conserving resources	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

MODULE	15 x 2 = 30Hours

Module 1. Concept of Biodiversity
Module 2. Ecosystems and Community structure
Module 3. Spatial and temporal aspects of biodiversity
Module 4. Causes of the global loss of biodiversity
Module 5. Invasive species and their impact on ecosystems and biodiversity
Module 6. Conservation biology: policy and management
Module 7. Ecosystem services and their importance for human societies
Module 8. Biodiversity products
Module 9. Economics of marine resources
Module 10. Biodiversity products from Animals.
Module 11. Biodiversity products from plants.
Module 12.Biotechnology in Biodiversity
Module 13.Isolation, identification and patenting Biodiversity Products
Module 14.Biodiversity as Career
Module 15. Eco tourism and possibilities.

Reference Books

1	Anderson J and Slater D L.(1981).*Catalogue of Mammals,* Vol. I and II. Cosmo Publications, New Delhi.
2	Hosetti BB, Ramkrishna S. (2016).*Biodiversity* : *Concepts and Conservation*, 1st edition, Aavishkar Publishers, Distributors, Jaipur
3	Prater S H. (1988). *The Book of Indian Animals*,Bombay Natural History Society, Bombay
4	Young J Z. (1950). *The Life of Vertebrates,*Clarendon Press, Oxford.

Course Designed By:Dr. R. SANIL, Associate Professor, GAC, Ooty

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	L	L	L
CO2	S	S	S	S	M	M	M	L	L	L

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

Value Added Course	INTELLECTUAL PROPERTY RIGHT	L	T	P	C
	Value Added Course-IV				
Pre-requisite	Basic knowledge to aware about IPR	**Syllabus Version**		2021-2022	

Course Objectives:
1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects inindustries.
2.To disseminate knowledge on patents, patent regime in India and abroad and registrationaspects
3.To disseminate knowledge on copyrights and its related rights and registrationaspects
4.To disseminate knowledge on trademarks and registrationaspects
5.To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registrationaspects
6.To aware about current trends in IPR and Govt. steps in fosteringIPR

Expected Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works	K2
2	During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations	K3
3	Pave the way for the students to catch up Intellectual Property(IP) as an career : a. R&D IP Counsel, Patent Examiner, Patent and Trademark agent, Entrepreneur	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

MODULE	15 x 2 = 30Hours

Module 1. Introduction and the need for intellectual property right (IPR)

Module2. Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties.

Module 3. Layout Design and Genetic Resources.

Module 4. Traditional Knowledge and Trade Secret.

Module 5. IPR in India.

Module 6. Patents - Elements of Patentability: Novelty, Non Obviousness.

Module 7. Patent office and Appellate Board, Registration Procedure, Remedies and Penalties.

Module 8. Nature of Copyright, Registration Procedure, Ownership and licence of copyright.

Module 9. Related Rights - Distinction between related rights and copyrights

Module10.Concept and Kinds of Trademarks (brand names, logos, signatures, symbols).

Module 11. Registration of Trademarks - Rights of holder.

Module 12. Design: Meaning and concept of Novel and Original.

Module 13.Geographical indication: Meaning, Difference between GI and trademarks.

Module 14. Plant variety protection: Meaning Benefit sharing and farmers' rights.

Module 15. Layout Design protection: Meaning, Procedure and Effect of registration.

	Text Book(s)
1	. Nithyananda, K V. (2019). *Intellectual Property Rights: Protection and Management*. India, IN: Cengage Learning India Private Limited.
2	2. Neeraj, P., &Khusdeep, D. (2014). *Intellectual Property Rights*. India, IN: PHI learning Private Limited.
	Reference Books
1	Ahuja V K. (2017). *Law relating to Intellectual Property Rights*. India, IN: Lexis Nexis.
	E-resources:
2	Subramanian, N., &Sundararaman, M. (2018). *Intellectual Property Rights – An Overview*. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
3	World Intellectual Property Organisation. (2004). *WIPO Intellectual property Handbook*. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
3	Journal of Intellectual Property Rights (JIPR): NISCAIR
	Related Online Contents
1	Cell for IPR Promotion and Management (http://cipam.gov.in/)
2	World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3	Office of the Controller General of Patents, Designs & Trademarks (http://www.ipIndia.nic.in/)
	CourseDesignedBy:Dr.A.RENI PRABHA, Assoc.Prof, ChikkaiahNaicker College, Erode

Mapping with Programme Outcomes

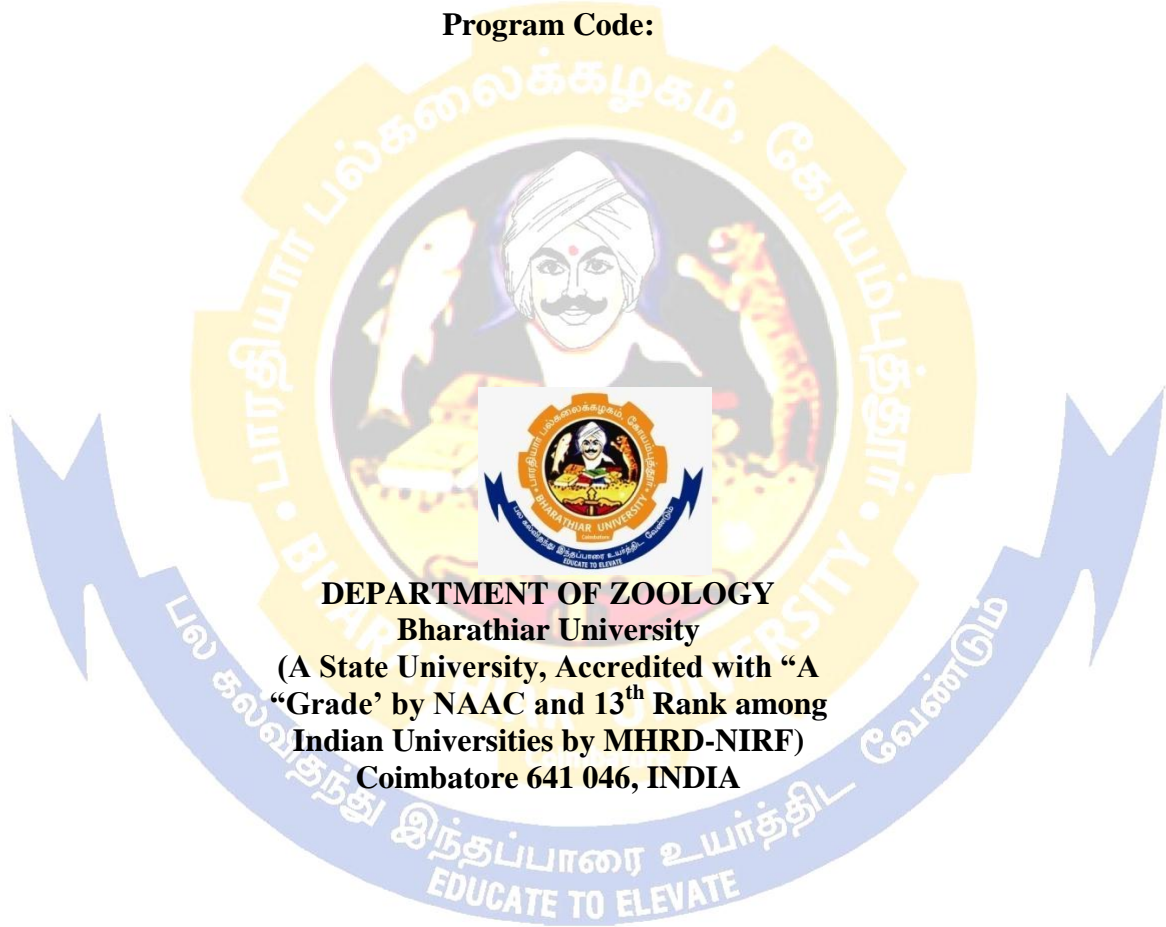| Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	M	M	L	M	S	M	S
CO2	L	L	L	M	M	L	M	S	S	M
CO3	L	L	L	M	L	M	S	S	S	S

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

Annexure

B. Sc ZOOLOGY (WILDLIFE BIOLOGY)

Syllabus
(With effect from 2020 - 2021 onwards)

Program Code:

DEPARTMENT OF ZOOLOGY
Bharathiar University
(A State University, Accredited with "A
"Grade' by NAAC and 13th Rank among
Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA

GUIDELINES FOR CONDUCTING VALUE
ADDED COURSES

Course Structure

1. The request for approval of syllabus by the concerned authorities ismandatory at least 15 days before the date of commencement of the course. The Syllabus (15/30 hours), Schedule and the Details of Faculty handling the course approved by the Departmental Committee and forwarded by Head of the Department should beenclosed.

    a. The course offered should not be the same as any course listed in the curriculum of the respective programme/ or any other programmeoffered in University/Colleges.

    b. The value added courses may be also conducted during week ends / vacationperiod.

    c. The course can be offered any semester in thePGProgrammes.

    d. Industry experts / eminent academicians from other Institutes are also eligible to offer the value addedcourse.

    e. The course can be offered only if there are atleast 10 students opting forit.

    f. The students may be allowed to take value added courses offered by other departments after obtaining permission from Head of the Department offering thecourse.

Duration

2. The duration of value added courses is 15 (30) periods of theory or a maximum of theory and Laboratory courses and the course can have a maximum of three hours perday.

    For the one (two) credit courses either 15 (30) periods of theory or a combination of theory and Laboratory may be offered.

    Where, **2 periods** of laboratory = **1 period** of theory

Evaluation

3. The value added courses shall carry 100 marks and shall be evaluatedthrough

    internal assessments only.

    a. Two Assessments shall be conducted preferably one in the middle and the other at the end of the course by the Department concerned.

    b. The duration of assessment is one hour each.

    c. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer.

    d. The Head of the Department may identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, staff handling the course (if available), coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The grades shall be assigned to the students by the above committee based on their relative performance.

e. The coordinator for the course is responsible for maintaining and processing the records with regard to assessment marks and results.

Passing Requirement and Grading

4. The passing requirement for value added courses shall be 50% of the marks prescribed for the course **(Internal assessmentonly)**

   a. The grades O, A+, A, B+, B obtained for the one/two credit shall figure in the Mark sheet under the title **'Value Added Courses'**. The other grades RA, SA **will not figure in the marksheet.**
   b. e credits earned through value added courses shall not be considered for calculating GPA andCGPA.
   c. The credits earned through value added courses shall not be considered for classification ofdegree.
   d. If the course is offered during any semester, it will appear in that semester's mark sheet. However if the course is offered in summer / winter vacations, the course will be included in the grade sheet of the subsequent semester.

Maximum Number of Courses

5. A student can earn a maximum of 3 credits during the entire programme of study by attending value added courses which would be over and above the required maximum number of credits for the award of thedegrees.

Financial Commitment

6. The expenditure to be incurred for the conduct of value added courses should be met from nominal fees collected from the students at a rate fixed by the University. However any additional expenditure may be supported by the funds of the Department.

APPLICATION FOR CONDUCTING VALUE ADDED COURSE

1. Name of theDepartment:
2. PGprogramme:
 **3.   Details of the Value
        AddedCourses:**
   a. Name of the Value
      AddedCourses
   b. Type of ValueAddedCourses   (Theory/
                                                    Lab/ Lab
                                                    integrated
                                                    Theory/other
                                                    s)
   c. ShortDescription   Enclosure 1 enclosed - YES
      /NO
   d. SyllabusincludingReference   Enclosure 2 enclosed - YES
      /NO
 4. Targetaudience:
   Semester (indicate if
   more than one)
   Others
 5. Details of Faculty handling thecourse:
   a. Name of the Faculty
      handling the Value
      Addedcourse
   b. Details including designationand expertise   Enclosure 3 enclosed - YES
      /NO
   c. Contactdetails
                    EmailID   :
                    PhoneNo   :

6. **Tentative Time Table** includingdates
   Ofinternalassessments   :   Enclosure 4 enclosed - YES /
   NO
7. Number of students opting for thecourse:
8. Department Consultative Committee-
   Minutes   :   Enclosure 5 enclosed - YES
   /NO
9. Name and Designation of the Coordinator:

Head of the Department (with date & seal)

_____
Note:
* **Fees ifany**

DETAILS OF COMPLETION OF VALUE ADDED COURSE

Name of the Department   :Name of the Value Added course offered
Name of the Faculty offered the course

                                                        : Academic / Industry

Name of the coordinator   :
            E-mail   :
            Contact   :

Details of students attended the course:

S.No	Name of the student	Reg.No.	Programme	Semester	Marks	Grade

(Faculty handling the (Senior Faculty nominated by HOD) Course (if available)

(Coordinator)   **(Head of the Department)**
  (with date &seal)

General Instructions:
1. **Value Added Courses:** Minimum 2 and maximum 5 for Each Department for Entire Program
2. **Job Oriented Certificate Courses:** Two Courses (Each one on First and Second Year)

Details for the Certificate Course

1	Name of the Course	
2	Name of the Department	
3	Name of the Faculty Member	
4	Inter/Intra Department	
5	Objectives of the Course	
6	Topics to be Covered	
7	Duration of the Course	
8	Eligibility	
9	Registration	
10	Description of the Course	
11	Job Opportunities	
12	Number of Candidates	
13	Course Fee	

DISTRIBUTION OF EXTERNAL AND INTERNAL MARKS FOR THEORY PAPERS

Table – 1(A): The following are the distribution of marks for **External** and **Internal** for University (external) examination and **Continuous Internal Assessment** and passing minimum marks for **Theory papers of UG programmes**.

Max. Marks	Comprehensive External Examinations (CEE)		Continuous Internal Assessments (CIA)		Overall Passing Minimum (Internal + External)
	Max. Marks	Passing Minimum	Max. Marks	Passing Minimum	
100	50	20	50	15	40
75	45	18	30	09	30
50	25	10	25	7.5	20

Table – 1(B): The following are the Distribution of marks for the **Continuous Internal Assessment** in the theory papers of **UG programmes**.

S. No	Component	Allotment of Internal Assessment marks for a maximum of	
		50	30
1	Tests(Average of two tests)	15	10
2	End semester model test (3 hours)	15	10
3	Assignments/Quiz/Group Discussion	10	05
4	Seminar	05	-
5	Attendance	05	05

DISTRIBUTION OF EXTERNAL AND INTERNAL MARKS FOR PRACTICALPAPERS

Table – 2(A): Distribution of marks for **External (CEE)** and **Internal (CIA)** University examinations and **Continuous Internal Assessments** and passing minimum marks for the **Practical Courses.**

Max. Marks	Comprehensive External Examinations (CEE)		Continuous Internal Assessments (CIA)		Overall Passing Minimum (Internal + External)
	Max. Marks	Passing Minimum	Max. Marks	Passing Minimum	
100	50	20	50	15	40
75	45	18	30	09	30
50	25	10	25	7.5	20

Table – 2(B): The following are the distribution of marks for the **Continuous Internal Assessment** in **UG practical** courses.

S. No	Component	Allotment of Internal Assessment marks for a maximum of		
		50	30	25
1	Record/ Submissions	15	10	10
2	Tests: One best test out of two tests/ Model.	30	15	10
3	Attendance (Minimum 10 experiments to be completed)	5	5	5

DISTRIBUTION OF MARKS FOR ATTENDANCE

Attendance	Marks
90% and above	5 marks
Between 85% and 90%	4 marks
Between 80% and 85%	3 marks
Between 75% and 80%	2 marks
Between 70% and 75%	1 marks

QUESTION PAPERPATTERN

The following question paper patterns shall be followed for **OBE** pattern syllabi for the candidates admitted from the academic year 2020-21 wherever applicable otherwise provided in syllabi itself.

MAXIMUM 50 MARKS – WHEREVER APPLICABLE			
Section A	Multiple choice questions with four options	10*1=10	10 questions – 2 from each unit
Section B	Short answer questions of either / or type like 1.a (or) b	5*3=15	5 questions – 1 from each unit
Section C	Essay-type questions of either / or type like 1.a (or) b	5*5=25	5 questions – 1 from each unit

MAXIMUM 45 MARKS – WHEREVER APPLICABLE			
Section A	Multiple choice questions with four options	10*1=10	10 questions – 2 from each unit
Section B	Short answer questions of either / or type like 1.a (or) b	5*2=10	5 questions – 1 from each unit
Section C	Essay-type questions of either / or type like 1.a (or) b	5*5=25	5 questions – 1 from each unit

MAXIMUM 25 MARKS – WHEREVER APPLICABLE			
Time: One Hours 30 Minutes			
Section A	Short answer questions of either / or type like 1.a (or) b	5*2=10	One question from each of the the five units
Section B	Essay-type questions of either / or type like 1.a (or) b	3*5=15	Six questions with internal choice (either/ or type) from all the five units