

ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ

ಶೈಕ್ಷಣಿಕ ವಿಭಾಗ, ವಿಶ್ವವಿದ್ಯಾಲಯ ಕಾರ್ಯಾಲಯ, ಕುವೆಂಪು ಶತಮಾನೋತ್ಸವ ಭವನ,  
ಜ್ಞಾನಸಹ್ಯಾದ್ರಿ, ಶಂಕರಘಟ್ಟ - 577 451, ಶಿವಮೊಗ್ಗ ಜಿಲ್ಲೆ.

Re-Accredited by NAAC with "A" Grade, Ranked 73<sup>rd</sup> place in NIRF-2019 & 45<sup>th</sup> Place at National Level in SCIMAGO Rankings

ಸಂಖ್ಯೆ:ಕುವಿ:ಶೈ:ಎಸಿ-4(170): 989 : 2019-20

ದಿನಾಂಕ:22-05-2019

ಗೆ,

ಅಧ್ಯಕ್ಷರು,

ಸ್ನಾತಕೋತ್ತರ ಎಂ.ಎ. ಉರ್ದು, ಎಂ.ಎಸ್ಸಿ. ಗಣಕ ವಿಜ್ಞಾನ,

ಎಂ.ಸಿ.ಎ. , ಎಂ.ಎಸ್ಸಿ. ಪ್ರಾಣಿಶಾಸ್ತ್ರ, ಜೈವಿಕ ತಂತ್ರಜ್ಞಾನ, ರಸಾಯನ ಶಾಸ್ತ್ರ,

ವನ್ಯಜೀವಿ ಮತ್ತು ನಿರ್ವಹಣಾ , ಎಂ.ಬಿ.ಎ. (ಹೆಚ್.ಆರ್.ಎಂ.),

ಪಿ.ಜಿ. ಡಿಪ್ಲೋಮಾ ಇನ್ ಜಿ.ಎಸ್.ಟಿ. & ಇನ್ಟರ್ನ್ಯಾಲ್ ಅಕೌಂಟಿಂಗ್(ಎಂ.ಬಿ.ಎ.) ವಿಭಾಗಗಳು,

ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ,

ಜ್ಞಾನ ಸಹ್ಯಾದ್ರಿ,

ಶಂಕರಘಟ್ಟ,

ಮಾನ್ಯರೇ,

ವಿಷಯ:- ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮ ಅನುಮೋದನೆಗೊಂಡಿರುವ ಕುರಿತು.

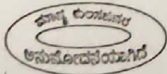
ಉಲ್ಲೇಖ:- 1. ದಿನಾಂಕ:14-05-2019ರಂದು ನಡೆದ ವಿದ್ಯಾ ವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ.

2. ಕುಲಸಚಿವರ ಆದೇಶದ ದಿನಾಂಕ 22-05-2019.

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ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, 2019-20ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ತಮ್ಮ ವಿಭಾಗದ ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿದ್ದು, ಸದರಿ ಪಠ್ಯಕ್ರಮಕ್ಕೆ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಪ್ರಾಧಿಕಾರಗಳಾದ ಅಧ್ಯಯನ ಮಂಡಳಿ, ನಿಕಾಯ ಹಾಗೂ ವಿದ್ಯಾ ವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಗಳು ಅನುಮೋದನೆ ನೀಡಿರುತ್ತವೆ. ಆದ್ದರಿಂದ ಪ್ರಸಕ್ತ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಸಂಬಂಧಿಸಿದ ಪಠ್ಯಕ್ರಮವನ್ನು ಅಳವಡಿಸಿಕೊಳ್ಳಲು ಮುಂದಿನ ಕ್ರಮಕೈಗೊಳ್ಳಬೇಕಾಗಿ ತಿಳಿಸಲಾಗಿದೆ.

ಮುಂದುವರೆದಂತೆ, ಸದರಿ ಪಠ್ಯಕ್ರಮದ ಸಾಫ್ಟ್‌ವೇರ್‌ಗಳನ್ನು ಇ ಮೇಲ್ ಮೂಲಕ ಶೈಕ್ಷಣಿಕ ವಿಭಾಗಕ್ಕೆ ಮಾಹಿತಿಗಾಗಿ ಹಾಗೂ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಅಂತರ್ಜಾಲದಲ್ಲಿ ಅಪ್‌ಲೋಡ್ ಮಾಡಲು ಸಾಫ್ಟ್‌ವೇರ್‌ಗಳನ್ನು ಸಂಯೋಜನಾಧಿಕಾರಿಗಳು , ಯು.ಸಿ.ಸಿ.ಎಫ್. ಕೇಂದ್ರ, ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಶಂಕರಘಟ್ಟ ಇವರಿಗೆ ಕಳುಹಿಸಿಕೊಡಲು ಕೋರಲಾಗಿದೆ.



ತಮ್ಮ ವಿಶ್ವಾಸಿ,

ಉಪಕುಲಸಚಿವರು  
ಉಪ ಕುಲಸಚಿವ

ಶೈಕ್ಷಣಿಕ ವಿಭಾಗ,  
ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ

ಜ್ಞಾನ ಸಹ್ಯಾದ್ರಿ, ಶಂಕರಘಟ್ಟ-577451  
ಶಿವಮೊಗ್ಗ ಜಿಲ್ಲೆ

ಪ್ರತಿಗಳು :

1. ಸಂಯೋಜನಾಧಿಕಾರಿಗಳು , ಯು.ಸಿ.ಸಿ.ಎಫ್. ಕೇಂದ್ರ, ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಶಂಕರಘಟ್ಟ - ಇವರಿಗೆ ಮಾಹಿತಿಗಾಗಿ ಮತ್ತು ಮೇಲ್ಕಂಡ ಎಲ್ಲಾ ಸ್ನಾತಕೋತ್ತರ ವಿಭಾಗಗಳ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮವನ್ನು ವಿಶ್ವವಿದ್ಯಾಲಯದ ಅಂತರ್ಜಾಲದಲ್ಲಿ ಪ್ರಕಟಿಸಲು ಕ್ರಮಕೈಗೊಳ್ಳುವುದು.
2. ಕಛೇರಿ ಪ್ರತಿ

**KUVEMPU UNIVERSITY**  
**DEPARTMENT OF WILDLIFE AND MANAGEMENT**

**REVISED COURSE CONTENTS, SCHEME OF MARKS / ASSESSMENT (CBCS)-**  
**M.Sc., Course in WILDLIFE AND MANAGEMENT**  
**With effect from Academic year- 2019-2020 (August -2019 onwards)**

**I SEMESTER**

Paper Code	Theory Papers	Teaching / week	IA	Exam	Total	Credits
HC-1.1	Systematics and Forestry	04 hrs.	25	75	100	4
HC-1.2	Wildlife Ecology	04 hrs.	25	75	100	4
HC-1.3	Field Techniques in Wildlife Studies	04 hrs.	25	75	100	4
SC- 1.4(a)	Aquatic Ecology	04 hrs.	25	75	100	4
SC- 1.4(b)	Terrestrial Ecology					
	Practical papers					
HC-1.5	Based on theory paper HC – 1.1	4 hrs	-	50	50	2
HC-1.6	Based on theory paper HC – 1.2	4 hrs	-	50	50	2
HC-1.7	Based on theory paper HC – 1.3	4 hrs		50	50	2
SC- 1.8(a)	Based on theory paper SC 1.4(a)	4 hrs	-	50	50	2
SC- 1.8(b)	Based on theory paper SC 1.4(b)					
				Total	600	24

**II SEMESTER**

Paper Code	Theory Papers	Teaching / week	IA	Exam	Total	Credits
HC-2.1	Remote Sensing, GIS and Advanced Techniques	04 hrs.	25	75	100	4
HC-2.2	Entomology, Herpetology and Ichthyology	04 hrs.	25	75	100	4
SC-2.3a	Biodiversity and Conservation of Natural Resources	4 hrs.	25	75	100	4
SC-2.3b	Environmental Pollution, EIA and Ecotoxicology					
EL-2.4	Wildlife Conservation	02 hrs.	10	40	50	2
	Practical papers					
HC-2.5	Based on theory paper HC – 2.1	4 hrs	-	50	50	2
HC-2.6	Based on theory paper HC – 2.2	4 hrs	-	50	50	2
SC-2.7(a)	Based on theory paper SC 2.3(a)	4 hrs	-	50	50	2
SC-2.8(b)	Based on theory paper SC 2.4(b)					
				Total	500	20

### III SEMESTER

Paper Code	Theory Papers	Teaching / week	IA	Exam	Total	Credits
HC-3.1	Wildlife Conservation and Management	04 hrs.	25	75	100	4
HC-3.2	Mammalogy and Ornithology	04 hrs.	25	75	100	4
SC 3.3(a)	Human dimensions in wildlife Management	04hrs	25	75	100	4
SC 3.3(b)	Wildlife Ecotourism					
EL-3.4	Ornithology	02 hrs.	10	40	50	2
	Practical papers					
HC-3.4	Based on theory paper HC – 3.1	4 hrs	-	50	50	2
HC-3.5	Based on theory paper HC – 3.2	4 hrs	-	50	50	2
SC 3.6(a)	Based on theory paper SC 3.3(a)	4 hrs	-	50	50	2
SC 3.3(b)	Based on theory paper SC 3.3(b)					
					<b>Total</b>	<b>20</b>
					500	

### IV SEMESTER

Paper Code	Theory Papers	Teaching / week	IA	Exam	Total	Credits
HC-4.1	Wildlife Health and Management	04 hrs.	25	75	100	4
HC-4.2	Applied Wildlife Science	04 hrs.	25	75	100	4
HC-4.3	Major Project work	4 hrs	25	75	100	4
	Practical papers					
HC-4.4	Based on theory paper HC – 4.1	4 hrs	-	50	50	2
HC-4.5	Based on theory paper HC – 4.2	4 hrs	-	50	50	2
					<b>Total</b>	<b>16</b>
					400	

- Total Marks for the Course : 2000
- Total Credits for the Course : 80 + 3 (Soft Skills) = 83
- Dissertation (Major project work) should be based on experimental / review work and valued by two examiners (one external and one internal).
- Educational tour is compulsory in the II and IV Semester. Tour report should be submitted for internal assessment.
- Field visits are compulsory in all semesters. Field study report should be submitted for internal assessment.
- Each candidate shall have to complete one Credit each in Communication Skill, Computer applications and Personality development within first two semesters.

#### Internal Assessment for papers

- Two session tests : 10 marks
- Seminar/Tutorial/Group discussions/Tour Report : 05 marks
- Assignment/Field study report : 05 marks
- Regularity and attendance : 05 Marks

## I SEMESTER

### HC-1.1: SYSTEMATICS AND FORESTRY -64 hrs

**Unit 1: Biogeography-** History of Biogeography, Classical Biogeography concepts- Continental drift, dispersal, Bio-geographical realms and provinces, Ecology of dispersal and faunal exchange, dispersal barriers, Theory of Island Biogeography, Mechanisms of dispersal, Corridors and their importance, threats and solutions, Applied biogeography, Biogeographical realms, Endemism, refugia and eco-regions, Differences between plant and animal geography, Origin of Indian fauna and flora, Biogeographic classification of India, Concept of speciation. **12hrs**

**Unit 2: Plant Systematic:** History of Plant Classification, Ancient Indian contribution to systematic. Artificial systems, Natural systems, Phylogenic system. Bentham and Hooker system of Classification, Engler and Prantle System of Classification, Hutchinson System of Classification, Armen Takhtajan System of Classification, Arthur Cronquist system of plant Classification. Modern Trends in Taxonomy, Herbarium techniques, Botanical nomenclature and principles of ICBN, names of taxa, type, method, author citation, valid publication, rejection of names, Names of hybrids, Taxonomy of major plants, Plant identification and use of Taxonomic literature, Floral diversity and botanical regions of India. Plant conservation issues and strategies. Principles of vegetation classification. Major vegetation types of India. Structural and functional attributes of vegetation. Plant succession: concepts and processes. Techniques of vegetation surveys and quantification. **12hrs**

**Unit 3: Animal systematic-** Animal Taxonomy, Development of modern taxonomy, Linnean System of Classification, Revised Linnean system, Binomial Nomenclature, major Evolutionary Divergences among animals, Classification and characteristics of invertebrates up to orders with suitable examples, Characteristics and classification of Mammals, Reptiles, Amphibians, Fishes and Birds up to orders with suitable examples. Taxonomic significance of invertebrates and vertebrates- morphology, symmetry, Nervous system, respiratory system and reproductive system. **10hrs**

**Unit 4: Forestry-** Introduction to forestry, Production forestry- Actual production, uses of wood, potential productivity, planning, increased production, Wood technology- anatomical, physical and mechanical properties, pulp, paper and rayon, saw milling and preservation, Defects in Wood, Forest Utilization- Logging and extraction techniques and principles, transport, storage and sale, Non wood forest produces – definition and scope, gums, resins, oleoresins, fibres, oil seeds, nuts, rubber, canes, bamboo, medicinal plants, charcoal, honey, lac and shellae, tassar silk, beedi leaves, collection, processing and disposal of non wood forest produces. **10hrs**

**Forest mensuration:** Methods of measuring diameter, girth, height and volume of trees, form factor, volume estimation of stand, sampling methods, yield calculation, current annual increment, mean annual increment, sample plots, yield and stand tables, scope and objectives of forestry inventory. **10hrs**

**Forest Management:** Objectives and principles, techniques, sustained yield rotation, yield regulation, working plan preparation, General forest protection against fire, pests and

diseases, Biological and chemical control. Forest soils and their conservation, Forest soils-classification, factors affecting soil formation, physical and chemical properties, causes of erosion, soil conservation, Types-wind and wind erosion, shelter belts, fixation sand dunes, reclamation of alkaline, saline water logged and other waste lands, waste land development, watershed management.

**Silviculture:** Principles of silviculture, ecological, physiological factors influencing vegetation, natural and artificial regeneration of forests, nursery techniques, seed-technology, collection, storage, pretreatment and germination, establishment and tending, Silvicultural system- types, clear felling, uniform, shelter, section, coppice and conservation system, Silviculture of some economically important species of India such as *Pinus roxuburhii*, *Acacia species*, *Dalbergia sp.* *Tectona grandis*, *terminalia sp*, etc.

**10hrs**

### **Practicals:**

1. Systematic study of common plants, Field and Herbarium techniques.
2. Study of campus flora, Status of litter layer in various forest types.
3. Study the various types of Fruits, Inflorescence, Stem modifications, root modifications, inflorescence and leaf types.
4. Taxonomic study of different plant species.
5. Techniques of vegetation surveys and quantification.
6. Study of different types of vegetative propagation.
7. Using photographs / paintings / coloured drawings to identify and study the characteristics & ecological role of minor and major forest products (representative species only) Wood: *Tectona grandis*, *Artocarpus integrifolia*, *Eugenia janbusina*, *Terminalia paniculata*, *Michalia champaca*
8. Non forest products: *Garcinia indica*, *Acacia consinna*, *Emblica officinale*, *Withania somnifera*, *Coffee arabica*, *Sapindus trifoliatus*, *Semecarpus anacardium*, *Abrus precatorinus*, *Vetiveria zizanioides*, *Pipper nigrum*, *Cinnamomum zaydenicam*.
9. Identify the some economic important plant species and their silvicultural importance
10. Class based discussion with faculty and a range of conservation activists. Review of literature. Preparation of conservation statements.
11. Class based discussion with faculty and a range of conservation activists. Review of literature. Preparation of conservation statements. This particular practical does not match title and contents.
12. Taxonomic and silvicultural characters of Tree species.
13. Using photographs / paintings / coloured drawings identify and study the classification, Characteristics & ecological role of characteristic plant and animal species (representative species only).
14. Study and identification of invertebrates and vertebrates
15. Density and relative density of plant species.

### **Reference and suggested readings**

1. Antony Joseph Raj and S. B. Lal., 2013. Forestry Principles and Applications. Scientific Publishers (India), New Delhi.
2. Chandra P. Singh. 2015. Forestry and Agro-forestry. Agrotech Press, Jaipur.
3. Dennis W. Woodland., 2000. Contemporary Plant Systematics. Andrews University Press, US.

4. Fatik Baran Mandal. 2013. Vertebrate Zoology. Oxford and IBH Publishing Corporation, New Delhi.
5. Manikandan, K and S. Prabhu. 2018. Indian Forestry: A Breakthrough Approach to Forest Service. Jain Brothers Publishers.
6. Mark, V. Lomolino, Brett, R. Riddle and Robert, J Whittakar. 2017. Biogeography. Sinauer Associates, Sunderland USA.
7. Nandita Singh. 2018. Biogeography and Biodiversity. Random Publications, New Delhi.
8. Praveen Taank. 2010. Forest Product and their utilization. Cyber Tech Publications, New Delhi.
9. Ralph D. Nyland. 2015. Silviculture Concepts and Applications. CBS Publishers and Distributors, New Delhi.
10. Ram Parkash. 2001. Forest Management. International Book Distributions, Dehra Dun.
11. Sheelwant Patel, 2005. Indian Forests. Pointer Publishers, Jaipur.
12. Singh, S.K. 2015. Textbook of Wildlife Management. International, CBS Publishers.
13. Suniti Sharan, 2011. Plant Taxonomy. Pacific Books international, New Delhi.
14. Vinod Kumar. 2011. Nursery and Plantation Practices in Forestry. Scientific Publishers (India), New Delhi.

### **HC 1.2: WILDLIFE ECOLOGY -64 hrs**

**Unit 1: Basics of ecology-** Basic concepts of ecology, structure of ecosystems- Abiotic and biotic components, climatic and edaphic regimes, nutrients and mineral, producers, consumers and decomposers, Communities, populations, groups and individuals, Functions of ecosystem: energy flow, food chain, food web and bio-geo-chemical cycles, Concepts of productivity, types of productivity, GPP, NPP, Secondary productivity, community productivity. Ecological efficiencies, producer and consumer level efficiencies, Ecological niche, succession, Eutrophication, Biological magnification. **16hrs**

**Unit 2: Behavioral Ecology-** Concepts of behavioral ecology, instinctive behavior, fixed action pattern, learning, habituation, imprinting, memory, infanticide, reflex and complex behavior, sign stimuli, group living, altruism, leks, reception and its types, kin selection, Polygamy, monogamy, Time- activity budgets, Ethograms, Social interaction, matrices and their analysis, pheromones.

Social Organization in primates, Territoriality, Dominance, Courtship, Animal migration, Communication and its types, Animal aggression, Animal deception, Animal inception, intelligence, Plant – animal interactions, Shelter and Nesting by animals, Effect of grazing and browsing, Protection strategies of plants for sustaining populations, One plant – One animal dependence, insectivorous plants with examples.

**16hrs**

**Unit 3: Population ecology-** Definition and concept, importance of population in wildlife studies, Characteristics of population ecology, population attributes and their analyze, life tables- definition, construction and importance in wildlife management, concept of growth rate, exponential and logistic growth rates, Population regulation and monitoring, density independent and density dependent population regulation, predator prey models, concept of carrying capacity, r and K selected species, Animal movement, concept of home range and its

territory, Theories of population dispersal, population dynamics, Population Genetics.

**16hrs**

**Unit 4: Community ecology-** Definition, Organismic and individualistic concepts, characteristics, compositions of community, structure and organizations of community- Qualitative and quantitative structures, types of communities, Measurement of species richness, diversity and evenness, Community structure, organization and its stability (guilds, resource partitioning, niche, competitive exclusion), Species interactions- Types of interactions, competition, mutualism, commensalism, proto-cooperation, parasitism and predation, Factors governing species diversity, Simple community models, Models of competition, Concept and measurement of niche, Trophic interactions, top-down and bottom-up processes, Null models and their application in ecology, Energy and productivity and its implications for species diversity, Functional diversity and food webs, Evolution of communities and neutral theory.

**16hrs**

#### **Practicals:**

1. Study of Chemotaxis by using first, second and third instar larve of *Drosophila melanogaster*.
2. Study of Phototaxis by using first, second and third instar larve of *Drosophila melanogaster*.
3. Study of Habituation by using snail.
4. Study of Social Organization in termites.
5. Study of some pioneer communities in succession; Lichen and their types, mosses and their types, coral and their types.
6. Adaptations in animals: use pictures or photographs with suitable labels.
7. Adaptations in plants: use pictures or photographs with suitable labels.
8. Life tables exercise and Population structure exercise.
9. Time activity budget exercise.
10. Exercise to understand differential niches of two related taxa.
11. Exercise to determine home-range of species.
12. Exercises on productivity.

#### **Reference and suggested readings**

1. Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly, 2006. Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.
2. Edward, J. Cormondy. 2017. Concepts of Ecology. 4<sup>th</sup> Edition. Pearson Education. India.
3. Harsh Vardhan Bhaskar. 2009. Animal Ecology. Campus Books International, New Delhi.
4. John Alock. 2018. Animal behavior. Oxford university Press, Sinuaer Associates Press, USA.
5. Kaul, B.L. 2007. Advances in Fish and Wildlife Ecology and Biology. Daya Publishing House, New Delhi.
6. Krebs, J.R. and Davies, N.B. An introduction to Behavioural Ecology. 3<sup>rd</sup> Edition. Blackmell Scientific Publications.
7. Manning A and Dawkins M. An Introduction to Animal Behaviour- IV Ed., Cambridge Univ. Press.
8. Michael, D Breed and Janice Moore. 2016. Animal Behaviour. All Academic Press, Elseviee, London.

9. Rajeev Tyagi. 2010. Understanding Wildlife. Discovery Publishing House Pvt. Ltd., New Delhi.

### **HC 1.3: FIELD TECHNIQUES IN WILDLIFE STUDIES -64hrs**

**Unit 1: Field surveys and useful equipment's-** Census- Direct and indirect methods, Data- Primary data and Secondary Data, Sampling methods- probability and non-probability sampling, Field surveying, Mapping and its principles, Field note book and its records, Field kit and its usage, Cameras, binoculars, range finder, GPS, Camera traps, Compass, Field collections & Field preservations (Invertebrates & planktons), Regulatory permissions for field observations. **12hrs**

**Unit 2: Techniques in Wildlife studies-** Different methods of transects & quadrats, Census operations for mammals, amphibians, reptiles, fishes, birds and invertebrates (block counts, dung counts, water hole census, use of calls for birds and other species, Pugmark census and tracing, total count, Arial survey, camera trapping, electro-fishing, noosing, mist netting, radio telemetry, satellite tracking, histological techniques), Sampling designs for population estimation, Distance based Sampling Methods, Mark-Recapture for Closed Population, Indices, and Estimation of Demographic parameters, Encounter rate, Absence and presence of species, Occupancy survey, and diversity indices, drones in habitat management and wildlife census. **16 hrs**

**Unit 3: Animal identification and Observation-** Identification of wild animals based on their natural markings on the body, Back profiles, tail types, tusk types, animal coats with natural marks- stripes, dots, rosettes, rings etc., Use of rings / tags, Color codes for Color marking on animals, types of marking on animals for different study purpose, Temporary markings, permanent markings and semi-permanent markings, role of wildlife ethics in marking the animals for research. **12hrs**

**Unit 4: Statistical Methods** (Use examples from wildlife, forestry and field experiments) Introduction, Definition, function, categories, limitations, mean, median, mode, standard deviation, Tabulation of data, Graphical representation of data, frequency distribution, coefficient of variance, range, probability, regression analysis, dispersion, Student t-test, Z-test, Mann-Whitney U test, Wilcoxon test for matched pairs. Analysis of variance, one way ANOVA, Kruskal Wallis one way ANOVA, Friedman two way ANOVA, Correlation and regression, Spearman Rank correlation coefficient, Coefficient of determination, Significance of r, Chi-square test, Goodness of Fit Test, Abundance, density, frequency, standard error, degrees of freedom, confidence limit. **24hrs**

#### **Practicals:**

1. Estimation of abundance of wild animals by Line transects method.
2. Estimation of abundance of carnivores.
3. Estimation of pellet group densities.
4. Study and identification of pugmark and tracing.
5. Sampling techniques for collection and observation of planktons.
6. Calculate density, frequency, abundance and encounter rate of the surveyed data.



7. Identification and observation of Invertebrate.
8. Demonstration and study of the working principles of common instruments used in wildlife studies.
9. Application of transect and quadrat methods for animal abundance estimation.
10. Following the individual animal to mark its home range.
11. Scat Encounter rate.

### Reference and suggested readings

1. APHA, AWWA and WEF. Standard Methods for Examination of Water and Wastewater, XVIII Ed, American Public Health Association. NY, USA
2. Giles, R.H Jr. 1984, Wildlife Management Techniques, 3<sup>rd</sup> ed. The Wildlife Society, Washington, D.C. Nataraj Publishers, Dehra Dun, India
3. Giles, R.H Jr. 2000. Wildlife Management Techniques, 3<sup>rd</sup> ed. The Wildlife Society, Washington, D.C. Nataraj Publishers, Dehra Dun, India.
4. Jim Fowler, Lou Cohen and Phil Jarvis. Practical Statistics for Field Biology. John Wiley and Sons. New York. England.
5. LLC. 2018. Theory, Practice and Techniques in Zoology. E-learning, USA.
6. Manju Pandey. 2019. Biostatistics. MV Learning.
7. Ncholas, J. Gotelli and Aaron M. Ellison. 2004. A primer of Ecological statistics, Sinauer Associates INC. Publishers, Sunderland, USA.
8. Neil, F. Payne and Fred C. Bryant, Techniques for Wildlife Habitat Management of Uplands. McGraw-Hill, Inc. USA.
9. Stephen, H.B. and V.B. Saharia. 2000. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
10. William Sutherland. Ecological census techniques, Cambridge publisher.

### SC 1.4 (a): AQUATIC ECOLOGY -64hrs

**Unit 1: Freshwater ecosystem-** Introduction, Classification of Habitats, Upland and low land, lentic and lotic. Limnology, abiotic and Biotic factors affecting freshwater ecology, Importance of freshwater ecosystem, Freshwater communities (Lakes, ponds, rivers and streams), still water animals, freshwater lentic communities and animals, extinction of freshwater fauna, aquatic bio-monitoring and its importance, Pollution in freshwater ecosystem, conservation of freshwater ecosystem.

**14hrs**

**Unit-2: Marine Ecosystem:** Definition, Types of marine ecosystems- Salt marsh, Mangroves, Intertidal Zones, Estuaries, Lagoons, Coral Reefs, Deep Sea and sea floor, Ecosystem services, Threats to Marine ecosystems.

**8hrs**

**Estuary ecosystem-** Definition of estuary, estuary formation, Characteristics, classification of estuary by geomorphological features and by water circulation patterns, A healthy estuary, Life in estuary, benefits of estuarine ecosystem, Indian estuarine ecosystem. Issues of Indian Estuarine ecosystem- water flow, pollution and water quality, recreation and tourism, ports and shipping, land use, commercial fishing and aquaculture, climate change.

**7hrs**

**Coral reefs-** Definition, features, Formation of Coral reefs, Classification of Coral reefs, Coral reef zones and its habitat, Ecosystem services of Coral reefs, Protection and restoration

of coral reefs, Threats and causes for loss of coral reefs, Conservation strategies for prevailing loss of coral reefs, distribution of coral reef in India. **7hrs**

**Mangroves-** Definition, Characteristics, Adaptation of mangroves, Mangrove profile in India, Role of Mangroves, animal dependency on mangroves, threats and causes for exploitation and conservation efforts. **10hrs**

**Unit 3: Wetland ecosystem-** Wetland ecosystem, Definition, Characteristics of wetland ecology and ecosystem, Functions of wetlands, Types of wetlands, India's wetlands and its conservation, Ecology of inland wetlands, mangroves and coral reefs, Wetland hydrology and water budget, Wetland soil and biogeochemistry, Wetland vegetation, plant production, and succession, Environmental flow and methods of flow determination. Wetlands laws and acts, Impacts of climate change on wetlands, Wetland ecosystem services and valuation of wetlands, Measuring wetland variables including water quality and biomass production, Wetland fauna with special reference to monitoring of aquatic vertebrates, Wetland water quality and sediment properties, Criteria for identification of wetland of national importance, Montreux record, Ramsar Convention.

**18hrs**

#### **Practicals:**

1. Estimation of primary production/physico-chemical characteristics of water samples from different aquatic habitats. (CO<sub>2</sub>, DO, total hardness, calcium hardness, Chloride, alkalinity, total acidity, organic matter)
2. Using suitable diagram / picture identify zonation in a pond ecosystem and study the species distribution.
3. Using suitable diagram / picture identify zonation in a sea-shore ecosystem and study the species distribution.
4. Collection and preservation of water sample from the nearby pond/lake using plankton net.
5. Observation and identification of Phytoplankton and Zooplankton in the collected water sample.
6. Mapping and distribution of Mangroves vegetation in India
7. Mapping and distribution of Coral reefs in Indian peninsula
8. Studying the profile of a lotic system.
9. Studying the profile of a lentic system.

#### **Reference and suggested readings**

1. Bhupad Joshi. 2019. Freshwater Fisheries Ecology. Agrotech press, New Delhi.
2. David, W. Townsend. 2012. Oceanography and Marine Biology. Sinauer Associates Inc. Publishers, Sunderland, USA.
3. Edward, J. Cormond. 2017. Concepts of Ecology. 4<sup>th</sup> Edition. Pearson Education. India
4. Hosetti, B.B and Arvind Kumar, 2002. A Textbook of Aquatic Biology. Daya Publishing House, New Delhi.
5. Kaul, B.L., 2007. Advances in Fish and Wildlife Ecology and Biology. Daya Publishing House, New Delhi.
6. Stanley Cain. 2018. Freshwater Biology. Larsen and Keller, USA.

7. Trivedi, P.R and Gurudeep Raj. 2001. Environmental Ecology. Akashdeep public House, New Delhi.

### **SC 1.4 (b): TERRESTRIAL ECOLOGY -64hrs**

**Unit 1: Tundra-** Definition, types of Tundra, Arctic tundra and Alpine tundra, distribution of tundra regions in India, adaptation of animals and plants found in this region, Ecological services of tundra. **12hrs**

**Unit 2: Forest ecosystem-** Definition, types- Coniferous forest, Temperate deciduous forest, Temperate evergreen forest, Temperate rain forest, Tropical rain forest, Tropical seasonal forest and Subtropical rain forest.

**Indian forest types-** Tropical wet evergreen forests, Tropical semi-evergreen forests, Tropical moist deciduous forests, littoral and swamp, Tropical dry deciduous forest, Tropical thorn forest, Tropical dry evergreen forest, Sub tropical broad-leaved forest, Sub tropical pine forest, Sub tropical dry evergreen forest, Montane Wet temperate forest, Himalayan Moist temperate forest, Sub alpine forest, Moist alpine forest, Dry alpine scrub. Deforestation-causes and effects, Afforestation, Indian state of forest report.

**22hrs**

**Unit 3: Grassland ecosystem-** Definition, Types of grasslands, adaptations, animal dependency on grasslands, ecological roles of grasslands, distribution of grasslands in India, economic importance of grasslands, Impact of grazing, Role of fire.

**12hrs**

**Unit 4: Desert ecosystem-** Concept of Desert ecosystem, Adaptations of plants and animals in desert region, plant and animal interaction for survival. Indian desert- Thar desert (hot), flora and fauna of Thar desert, Cold/temperate Desert- characters, major desert dwelling reptiles, birds and mammals, animal and plant adaptations for survival in the extreme temperatures, Desertification- causes, status of Indian desertification, control measures.

**18hrs**

#### **Practicals:**

1. Study of percentage of canopy study in different vegetation
2. Mapping and study of different forest types, grasslands, tundra regions, desert in India
3. Estimation of water holding capacity of different types of forest soils in India
4. Study of morphological and adaptive characteristics of various laboratory specimens found in desert and grassland ecosystems.
5. Study of plant and animal interaction for survival in different ecosystems.
6. Profile diagram of a forest.
7. Profile diagram of a woodland or grassland.
8. Drawing the vegetation profile of Evergreen forest, moist deciduous, dry deciduous, scrub, grassland and desert.

#### **Reference and suggested readings**

1. Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly, 2006. Wildlife Ecology, Conservation and Management. Blackwell Publishing, U.S.A.

2. Edward, J. Cormondy. 2017. Concepts of Ecology. 4<sup>th</sup> Edition. Pearson Education. India
3. Edward, J. Cormondy. 2017. Concepts of Ecology. 4<sup>th</sup> Edition. Pearson Education. India.
4. Harsh Vardhan Bhaskar. 2009. Animal Ecology. Campus Books International, New Delhi.
5. John Alock. 2018. Animal behavior. Oxford university Press, Sinuaer Associates Press, USA.
6. Kaul, B.L. 2007. Advances in Fish and Wildlife Ecology and Biology. Daya Publishing House, New Delhi.
7. Smita. 2018. Introduction to Ecology. Diamond Creation, New Delhi.
8. Trivedi, P.R and Gurudeep Raj. 2001. Environmental Ecology. Akashdeep public.House, New Delhi.

## **II SEMESTER**

### **HC 3.1: REMOTE SENSING, GIS AND ADVANCED TECHNIQUES -64hrs**

**Unit 1: Remote Sensing-** Introduction, Principles, Basic concepts, Electromagnetic spectrum, energy sources and radiation principles, Energy interaction with air, water, soil, rock and vegetation, Remote sensing data acquisition systems, Concept of spectral and spatial resolution in remote sensing. Micro wave remote sensing

**10hrs**

**Unit 2: Aerial Remote Sensing:** Introduction to basics, Aerial photography, Geometric characteristics of aerial photographs, Film and filter combination techniques of photography, Instrumentation in aerial photography, vertical exaggeration and radial triangulation, Principle keys to interpretation of aerial photographs.

**10hrs**

**Unit 3: Satellite Remote sensing:** Indian remote sensing missions, Satellite data products, Hard copy and soft copy data and their uses, Interpretation of satellite data, Visual and Digital data, Visual interpretation keys. Digital image processing, Analysis of remote sensing data.

**10hrs**

**Unit 4: Geographic Information System (GIS):** Introduction, fundamentals and functions of GIS, Components of GIS. Data models (Raster and Vector models), Resolution, orientation, Zones, Over-laying techniques, GIS analysis. Inputs – outputs, Meta data and conceptual design, GIS system integration and application development.

**10hrs**

**Unit 5: Application of Remote sensing and GIS:** Forestry and wildlife monitoring and management. Forestry – classification of forest types, inventory and mapping of forestland, Forest cover monitoring, damage detection and assessment and forest area development and planning, Wildlife Management – Wildlife habitat evaluation, Mapping of corridors, Network of wildlife reserves and mapping of potential habitats, forest fire monitoring and prediction through Remote Sensing and GIS.

**10hrs**

**Unit 6: Advanced Techniques:** Molecular Techniques- Applications of Genomics and Proteomics in wildlife studies, Genetic diversity in wildlife - molecular markers – mtDNA, ribosomal DNA, Nuclear DNA markers.

**Applications of Proteomics in wildlife studies-** Extraction and assessment of Proteins- Peptide mass fingerprinting (e.g. Venom proteins, Plant proteins); SDS-PAGE, Western Blotting Protein characterization

**Wildlife software and models-** Various software platforms for modeling, Collection of data for modeling, Applications of modeling, Case studies- e.g. Keoladeo National Park, Serengeti, Velavadar etc. **14hrs**

### **Practicals:**

1. Study Arc-catalogue and Arc-map
2. By using Satellite imageries map the important protected areas, vegetation type, soil type, wetlands etc.,
3. Use of GPS
4. Running of GIS software(QGIS and Google earth)
5. Mapping of roads, cities, waterholes.
6. Geo-referencing of Topo sheets by using GIS software.
7. Hands on participatory tools and techniques for social survey.
8. Population Estimation data collection and use of software DISTANCE, MARK and PRESENCE and R Program.
9. Understanding of probability distributions curves.
10. Identifying wildlife corridors through maps, Google maps.

### **Reference and suggested readings**

1. Chang – Kang, Tsung, 2002. Introduction to Geographic Information Systems, Tata McGraw -Hill Publishing Company Limited, New Delhi,.
2. Ganesh Prasad. 2019. Statistics, An Introduction Using R. Oxford Book Company, New Delhi.
3. John C Antenucci, Geographical Information System : A Guide to Technology — Van Norstrand Reinhold Publications
4. Shiv N.Pandey, Photogeology and Image Interpretation –, Wiley Eastern, New Delhi.
5. Chang – Kang, Tsung, Introduction to Geographic Information Systems, Tata McGraw -Hill Publishing Company Limited, New Delhi, 2002.
6. John C Antenucci, Geographical Information System : A Guide to Technology — Van Norstrand Reinhold Publications
7. Chouhan T.S and K.N.Joshi, Applied Remote Sensing and Photo Interpretation — Vignan Prakasan, Jaipur.

## **HC 2.2: ENTOMOLOGY, HERPETOLOGY AND ICHTHYOLOGY -64hrs**

**Unit 1: Entomology-** Introduction to Entomology, History and evolution of insects, Insect classification, taxonomy and diversity, Characteristics and classification of Insects with special reference to orders- Hymenoptera, Lepidoptera, Coleoptera, Anisoptera and Zygotera, Morphology of insects, Mouth parts of insects, Development of insects (metamorphosis), Respiration in insects, Reproduction in insects, Life duration of insects economic importance, ecological roles, adaptation, Insects as indicator for biodiversity

monitoring.

**12hrs**

**Forest entomology, Insect types-** polyphagous, oligophagous and monophagous, beneficial and adverse functions of insects, forest pests, their life cycle, and management, Pests control measures- silvicultural, biological, mechanical, insect behavior regulators, insect growth regulators, chemical control. Specific case studies on forest infestation by Sal borer and other forest pests and their life cycle and management.

**10hrs**

**Unit 2: Herpetology-** Introduction to Herpetology, History and evolution of Reptiles/amphibians, general characteristics of reptiles and amphibians, Classification up to orders along with suitable examples, Adaptations in animals- Thermo-regulation, its role, aestivation, hibernation and other eco-physiological adaptations, Role of temperature in sex determination in reptiles, Water regulation, shapes and size, locomotion, senses in reptiles, Systematics and Zoogeography of amphibians and reptiles, Factors affecting distribution and abundance of amphibian and reptilian fauna of Indian sub-continent.

Biology of major Indian amphibians, fresh water and marine turtles, crocodilians, lizards and snakes, An overview of conservation problems and issues of herpeto-fauna of Indian sub-continent, Case studies of conservation efforts. **22hrs**

**Unit 3: Ichthyology-** Classification and evolution of major groups of fishes in India, Ichthyogeography and diversity of freshwater fishes of India, foods, digestion, nutrition and growth of fishes, respiration, excretion and reproduction in fishes, Ecology and adaptation of fishes in different ecosystems, Economic importance of sport fishes of India, Threats and conservation prospects of fish in India and world, Threatened fishes of India, Methods to study ecology of fish diversity, abundance, growth and their habitats.

**20hrs**

### **Practicals:**

1. Study of animal architecture (photographs / diagram / abandoned specimen), Hive of honey bee, nest of paper wasp, nest of potter wasp, Mound of termites.
2. Individual identification of snakes (Venomous and Non venomous)
3. Individual identification of Anurans( Frogs and Toads)
4. Study and identification of individual species of orders- Hymenoptera, Lepidoptera, Coleoptera, Anisoptera and Zygoptera.
5. Study of major forest pests and their life cycle
6. Fish morpho-metric study (in lab), and Methods for fish ecological studies (in field).
7. Study of fish scales (lateral side of body) from different marine and freshwater fishes.
8. Examination and drawing of museum materials: skins (molted), skulls, feet, eggs.
9. Insect collection methods, identification, equipments used, preservation and storage.
10. Specific case studies on forest infestation by Sal borer and other forest pests and their life cycle and management.

### **Reference and suggested readings**

1. Abhishek Shukla, 2009. A Handbook on Economic Entomology. New Delhi, Daya Publishing House.
2. Chapman, R.F., 2016. The Insects Structure and Function. New Delhi, Cambridge University Press.
3. Chawla, D.N. 2014. Environmental Biology of Fishes. New Delhi, Astha Publishers and Distributors.

4. Chinmoi Goswami and B. D. Patnaik. 2017. Handbook of Entomology. Wisdom Press, New Delhi.
5. Denis Vieiria de Andrade, Catherine R. Bevier and Jose Eduardo de Carvalho. 2016. Amphibians and Reptile adaptations to the Environment. CRC Press, Taylor and Francis Group.
6. George P. Peterson. 2018. Elements of Insect Ecology. Medtech.
7. Gurudarshan Singh and H. Bhaskar., 2003. An Introduction to Ambhibia. New Delhi, Campus Books International.
8. Gurudarshan Singh and H. Bhaskar., 2003. An Introduction to Reptiles. New Delhi, Campus Books International.
9. Harvey Pough, F, Robin M. Andrews, Martha L. Crump, Alan H. Savitzky, Kentwood D. Wells, and Matthew C. Brandley. 2015. Herpetology. Sinauer Associates, an imprint of Oxford University Press
10. Nitish Shekhar. 2012. Insect Ecology. New Delhi, Sonali Publications.
11. Nouratan Singh. 2018. Insect Pathology. Book Enclave, Jaipur India.
12. Robinson, D.H., 2012. Entomology Principles and Practices. Jodhpur, Agrobios (India).
13. Roy, D.N and A.W.A. Brown, 2007. Entomology. New Delhi, Biotech Books.
14. Sanjay N. Shinde. 2018. Fundamentals of Entomology. Oxford Book Company. New Delhi.
15. Sharan, P.K., 2010. Basic Entomology. New Delhi, Campus Books International.

### **SC 2.3a: BIODIVERSITY AND CONSERVATION OF NATURAL RESOURCES - 64hrs**

**Unit 1: Biodiversity-** Introduction to Biodiversity, Levels of biodiversity: Genetic diversity, species diversity, ecosystem/community diversity, Measurement of Biodiversity- Species richness- Alpha, Beta, and Gamma Diversity, species evenness, Biodiversity and food web, Biodiversity services, ecosystem services, biological services and social services, Diversity Indices- Definition, richness, Shannon index, Simpson index, Berger- parker index, application of indices in research.

**16hrs**

**Unit 2: Indian Biodiversity:** Natural terrestrial ecosystem of India- forest biodiversity, Grassland Biodiversity, wetland biodiversity, desert biodiversity, agro-biodiversity, floral diversity of livelihood, Faunal diversity for livelihood, Bio-cultural diversity, Types of Biodiversity, Climatic Zones and Biodiversity, Biodiversity as a natural resource, Vegetational Zones, Zones of faunal distribution, Major protected areas and their importance, protection of Biodiversity of India- Government initiatives, NGO's initiatives and Communities' initiatives, Cause of Biodiversity loss- Natural and Man-made, Habitat loss, Hunting, exploitation, introduction of exotic species, accidental mortality, climate change etc., Biodiversity conservation, Modes of conservation.

**18hrs**

**Unit 3: Global Biodiversity:** Major Biodiversity areas of the world, Mega Diversity Countries, Biodiversity Hot Spots, Global Initiative- Man and Biosphere Programme, Biosphere Reserves, National Biosphere Reserve program, World Heritage Sites.

**14hrs**

**Unit 4: Natural Resources-** Definition, Classification, Resources Extraction, Depletion of Resources, Protection and Management of Natural Resources, Indian Natural resources.

**Natural resource conservation:** Conservation verses preservation. forest as natural resources, Conservation movement in India, socio-economic and political realities, different phases of the conservation and how it has impacted people, Concept of stakeholders, International conservation bodies- IUCN UNDP, FAO, WWF.

**Natural resource economics:** Need for integrating environment and economics, the economic reasons for over-exploitation of natural resources, ecosystem functions and services, cost and benefits of biodiversity conservation. Need for ecosystem service valuation.

**16hrs**

### **Practicals:**

1. Study of Vegetation by Quadrat method
2. Determination of minimum quadrat size by Species area curve method
3. Determination of percentage, frequency, density and abundance of plant communities using quadrat method
4. Rank abundance
5. Diversity indices and its application.
6. Diversity and relative diversity of plant and animal species
7. Plant animal interaction
8. Study of different medicinal plants inside Kuvempu University campus

### **Reference and suggested readings**

1. Asish Ghosh. 2007, Biodiversity Conservation. APH Publishing Corporation, New Delhi,
2. Kasthuri Reddy. 2010. Biodiversity and Land Conservation. Pacific Publication, New Delhi.
3. Pawan Kumar 'Bharti', Avinash Chauhan, Kaoud, H.A.H. 2013. Aquatic Biodiversity and Pollution. Discovery Publishing House, New Delhi.
4. Pullaiah, T. 2006. Biodiversity in India. Regency Publications, New Delhi.
5. Sharma, B.D, Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
6. Trivedi, P. R. 2004. Natural Resources Conservation. APH Publishing Corporation, New Delhi.

## **SC 2.3b: ENVIRONMENTAL POLLUTION, EIA AND ECOTOXICOLOGY -64hrs**

**Unit 1: Environmental Pollution-** Concept of Biosphere and its components, hydrosphere, atmosphere and lithosphere,

**Water pollution-** Definition and sources, Types and classification of pollutants, Effects of Water Pollution

**Air pollution-** Definition and sources, Primary and secondary air pollutants, Biological effects of NO<sub>x</sub>, SO<sub>x</sub>, SPM, Hydrocarbons, acid rain, global warming, photochemical smog and ozone depletion, Effects on biota and Control measures.

**Solid waste and Hazardous waste-** Types, Sources, collection, transport, treatment, Disposal and recycling methods, Soil Pollution- Soil pollutants and their effects, and their control measures, Noise Pollution- Sources, biological effects, control measures, Radiation pollution: Sources, types, effects, atmospheric fallout and their control measures.



**Environment Monitoring** - Abiotic parameters to be monitored for various types of habitats, Keystone species & Indicator species, Continuous & seasonal monitoring, various monitoring techniques and methods. **22hrs**

**Unit 2: Environmental Impact Assessment (EIA)**- Concept of EIA, The need for EIA, Indian policies requiring EIA, The EIA cycle and procedures, Components of EIA, Key elements of an initial project description and scoping, EIA in the Indian system- drawbacks and recommendations, Environmental supplement plan (ESP). **10hrs**

**Unit 3: Eco-toxicology**- Introduction, fundamentals and scope of toxicology, Toxicity and its types, toxins and their classification, poison, types of poisoning, mechanism and factors influencing toxicity, antagonism, synergism, Bioassay methods, Acute, chronic and reproductive toxicity, Factors and dose response relationships, factors affecting toxicity.

**Pesticides:** Introduction, classification, basic aspects of pesticide Toxicity, Fertilizer-complete and incomplete, Mechanisms of Bioaccumulation, Bio-magnification, Bio-amplification, Bio-concentration, Effects of heavy metals like Arsenic, Cadmium, Lead and Mercury.

**Natural toxicants**- Animal venoms and poisons, Toxins produced by fishes, insects, Microbial (Algal and bacterial) and plant toxins, Safety standards and regulatory provisions. **32hrs**

**Practicals:**

1. Test of Soil samples for- pH, Texture, Total organic content.
2. Test of Soil samples for- N, P, K contents.
3. Test of Water samples for- Dissolved Oxygen, BOD, and COD.
4. Test of Water samples for- Salinity, pH, hardness, Calcium, Magnesium, pH, conductivity, TDS etc.
5. Design a self-guided trail for a nature reserve / biodiversity park and submit a report.
6. Demonstration of LC50 & LD50
7. Estimation of Glycogen
8. Estimation of Protein (Total, Soluble and Structural)
9. Estimation of Inorganic phosphates in tissues
10. Estimation of catalase activity
11. Estimation of Transaminase enzymes
12. Bioaccumulation studies.

**Reference and suggested readings**

1. Ferah Deebe. 2017. Ecology and Environmental Biology. Centrum Press, New Delhi.
2. Pawan Kumar 'Bharti', Avinash Chauhan, Kaoud, H.A.H. 2013. Aquatic Biodiversity and Pollution. Discovery Publishing House, New Delhi.
3. Rachel and thirgo. 2018. Eco-toxicology. CRC Press, New Delhi.
4. Vaishali, J. Patil and T.V, Sathe. 2003. Insect predators and Pest Management. Daya Publishing House, New Delhi.

**EL 2.4: WILDLIFE CONSERVATION -32hrs**

**Unit 1: Wildlife studies:** Definition of wildlife, values of wildlife, significance and scope of wildlife conservation, wildlife distribution, Global distribution, Indian wild fauna, wildlife byproducts and trade, Ethical value, Scientific value, medicinal value, game and recreation value, ecological value. **8hrs**

**Unit 2: Wildlife categories and causes of depletion:** IUCN Red list, Categories of wildlife; Extinct, Endangered, Threatened, Vulnerable, Data Deficient categories. Causes of wildlife depletion- Degradation and destruction of natural habitats, Exploitation for commercial purposes, Deforestation, Agricultural expansion and grazing, Urbanization and industrialization, Forest fires.

**8hrs**

**Unit 3: Wildlife conservation;** Historical background, Need for conservation projects in India, Ex- situ & in-situ conservation, National parks, Wildlife sanctuaries, wildlife reserves, Biosphere reserves, National parks and wildlife sanctuaries of Karnataka, Umbrella species, flagship species based conservation programs, Human- wildlife conflicts, Mitigation of human-wildlife conflicts.

**8hrs**

**Unit 4: Wildlife and legislation:** Constitutional provisions, Wildlife protection Act 1972, National and International guidelines and protocols.

**8hrs**

### **Reference and suggested readings**

1. Bose, N.K. 2009. Wildlife Management in India. Cyber Tech Publications, New Delhi.
2. Hosetti, B. B and M. Venkateshwaralu. 2001. Trends in Wildlife Biodiversity Conservation and management. Daya Publishing House, New Delhi.
3. John M. Fryxell, Anthony R. E. Sinclair and Graeme Caughley. 2014, Wildlife Ecology, Conservation and Management. Wiley-Blackwell, US.
4. Mallapureddi Vikram Reddy. 2008. Wildlife Biodiversity Conservation. Daya Publishing House, New Delhi.
5. Nithin Patil. 2016. Models for Planning Wildlife Conservation in Large Landscapes. Agrotech Press, Jaipur, New Delhi.
6. Ranga, M.M. 2012. Wildlife Management and Conservation. Agrobios (India).
7. Sharama, B.D., Indian Wildlife Resources Ecology and Development. Daya Publishing House, New Delhi.

## **III SEMESTER**

### **HC 3.1: WILDLIFE CONSERVATION AND MANAGEMENT -64hrs**

**Unit 1: Wildlife Conservation-** Introduction, importance of wildlife, ecological values, aesthetic values, recreation values, scientific and economic values, Indian Cultural ethos and wildlife Conservation, Wild life categories, approach of conservation, priority of conservation- unique species, monotypic species, keystone species, K-selected species, endangered and endemic species, Protected area network, Protected area management, Red list and Red data book, Wildlife Corridors and their management, Conservation practice and

Management, Eco-developments applications. Field Exercises in protected areas.

**10hrs**

**Unit 2: International conventions and conservation efforts-** World Heritage Sites, Convention of Biological Diversity, Ramsar Convention, Convention on Migratory Species, CITES, Chipko & Appiko movements, Global Tiger Forum. **10hrs**

**Unit 3: Individual species conservation projects-** Wildlife conservation projects (Aims, objectives, Threats, Mitigation, success rate) Project Tiger and NTCA, Project Lion, Project Hangul, Project crocodile, Project Musk deer, Project Elephant, Project great Indian bustard, Project gibbon, Siberian crane project, Project Shangil, Project swamp deer, Project wild ass, Project blackbuck, Pigmy Hog conservation program, Dolphin conservation program, Olive Ridley turtle conservation program, Project golden langur, Indian Rhino vision 2020 and Project Snow leopard. **10hrs**

**Unit 4: Role of Organizations-** IUCN, UNEP, UNDP, FAO, WWF, UNESCO, WII, IBWL, ICFRE, TRAFFIC, WCS and NCS, BSI, ZSI, FRI, National forest policy, Man And Biosphere (MAB) program, BNHS, Indian Institute of forest management.

**10hrs**

**Unit 5: Wildlife Policies and legislations-** Constitutional provisions, Wildlife (Protection) Act, 1972, Environmental (Protection) Act, 1986, National Forest Policy 1988, Biological Diversity Act 2002, Schedule Tribes and Other Forest Dwellers Act 2006, Coastal Regulation Zone, Wetland rules 2010, Nation Green Tribunal, Ozone depleting Substances Rules, National and international guidelines and protocols.

**10hrs**

**Unit 6: Human-wildlife conflict-** Causes, impacts, reason behind the human and wildlife interaction, results of human wildlife conflict, solutions to reduce human interaction and wildlife conflict, preventive strategies, mitigative strategies. Major animals responsible for conflicts- Human-elephant Conflict, Human-Tiger Conflict, Human-leopard conflict, Human-Monkey conflict. Human-sloth bear conflict etc.

**Human-tiger conflict-** major conflict zones in India, causes, impact of conflict on humans, preventive strategies, and mitigative solutions, case studies in relative to Indian context..

**Human-elephant conflict-** regions prone to conflict, causes for conflict, mitigative measures adopted by government and stakeholders in conflict zones, compensatory solutions, case studies.

**Human-leopard conflict-** causes, impacts of conflicts, preventive measures and mitigative strategies undertaken, case studies.

**Human-monkey conflict-** damages and loss due to conflict, mitigative measures undertaken by the farmers. **14hrs**

### **Practicals:**

1. On a map of India locate & demarcate major tiger reserves/ national parks/ wildlife sanctuaries.
2. Identify and describe false color images of land use patterns from a satellite image; City, reservoir, forest, agricultural land, sea-shore.
3. Using photographs / paintings / colored drawings identify and study distribution and ecological role of Endangered species of India

4. Using photographs / paintings / colored drawings identify and study distribution and ecological role of Endemic species of Western Ghats.
5. Using photographs / paintings / colored drawings identify and study the extinct species of globe.
6. Exercise on human wildlife conflict; questionnaire survey.
7. Making mock plans for conserving or reforming wildlife corridors.

### Reference and suggested readings

1. Giles, R.H Jr., 2001, Wildlife Management Techniques, 3<sup>rd</sup> ed. The Wildlife Society, Washington, D.C. Nataraj Publishers, Dehra Dun, India
2. Gopal, Rajesh. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
3. Hosetti, B.B. 2005. Concepts in Wildlife Management. Daya Publishing House. New Delhi.
4. Jawalikar, J.A and Pratik Sanjay Talawad. 2015. Willdife Damage Control. Oxford Book Company. Jaipur.
5. Kadambari Sharma. 2010. Human Conflict and Wildlife Conservation. Jnanada Prakashan. New Delhi.
6. Mallapureddi Vikram Reddy. 2008. Wildlife Biodiversity Conservation. Daya Publishing House. New Delhi.

### HC 3.2: ORNITHOLOGY AND MAMMALOLOGY -64hrs

**Unit 1: Ornithology-** Avian systematic: classification of birds, Habitat ecology of Indian birds, Coastal birds, Inland water birds, Birds of high altitude and deserts, Distribution of birds in India, and their affinities, Ecological and economic values of birds, Feeding ecology- insectivores, frugivores, nectarivores, granivores, carnivores and scavengers, Territoriality- functions and types of territoriality, sizes and shapes of territory, defense and site fidelity, Songs and calls- functions of voice, nature of song, non-vocal songs.

**16hrs**

**Unit 2:** Nesting- Functions, choice of nest sites, colonial nesting, types of nests, nest materials and nest building and multiple nests, Reproduction- Breeding seasons, Factors influencing breeding seasons, seasonal reproductive cycles, photo-periodism, sexual dimorphism, courtship and display, sexual selection, pair bonding, mating systems, polyandry, polygyny, promiscuity, Co-operative breeding, brood parasites, Egg laying-timing of egg laying, clutch size, incubation patterns, hatching, parental care- feeding, nest sanitation, Feathers and moulting – Types, functions, growth, moulting, Bird migration, Endangered and threatened birds.

**16hrs**

**Unit 3: Mammalogy-** History of Mammalogy, Evolution of mammals and morphology, Mammalian characteristics and origin of mammals, Classification of mammal up to orders, Adaptations in mammals- Hibernation, torpor, aestivation, locomotion and water regulation. Metabolism and thermoregulation- ectothermy, homeothermy and cold stress, body size versus homeothermy, Body size variation in mammals and its influence on life history, metabolic rate, weight constraints, feeding behavior, niche width and reproduction, Mammalian skin and its derivatives.

**16hrs**

**Unit 4:** Behavior and social organization in mammals, social and mating systems, territories, animal communication, Mammalian diet, digestive systems- anatomy, morphology and function, Reproductive systems of herbivores and carnivores (in specific to tiger and elephant). **16hrs**

**Practicals:**

1. Study of few lab vertebrate specimens.
2. Study of epidermal derivatives.
3. Comparative morphology of dentition.
4. Comparative morphology of skull.
5. Mapping the distribution of primates, carnivores and ungulates in Karnataka/India.
6. Study on different wild animal coats.
7. Examination and drawing of museum materials: skulls, feet, beak and eggs
8. Study of morphology and identification of birds based on their feathers
9. Study and identification of birds based on their calls
10. Study of different bird nesting pattern.
11. Study of composition of abandoned bird nest: contents and weights in priority.
12. Mapping and distribution of primates, carnivores and ungulates.

**Reference and suggested readings**

1. Arora, B.M. 2002. Reproduction in Wild Mammalia & Conservation ., AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.
2. Bhamarh, H.S and Kavita Juneja. 2002. An Introduction to Birds. Anmol Publication, New Delhi.
3. Douglas, J. Futuyma and Mark Kirkpatrick. 2017. Evolution. Sinauer Associates INC. Publishers, Sunderland, USA.
4. Gerld Mayr. 2017. Avian Evolution. John Wailey and Sons Ltd. Newyork, England.
5. Gurudarshan Singh and H. Bhaskar. 2003. An Introduction to Birds. Campus Book International, New Delhi.
6. Gurudarshan Singh and H. Bhaskar. 2003. An Introduction to Mammals. Campus Books International, New Delhi.
7. Khanna, D.R and P.R, Yadav, 2005. Biology of Birds. Discovery Publishing House, New Delhi.
8. Mevin, B. Hooten, Devin S. Johnson, Brett T. McClintock and Juan M. Morales. 2017. Animal Movement. CRC Press.
9. Rahmani, Asad R. & Ugra, Gayatri. Birds of Wetlands and Grasslands. Bombay Natural History Society, Mumbai.

**SC 3.3a- HUMAN DIMENSIONS IN WILDLIFE MANAGEMENT -64hrs**

**Unit 1: Indian Wildlife-** Importance of Wildlife, Indian Flora and Fauna, Important Indian wildlife, Protected areas in India, Protected Indian Wildlife, Problems of Wildlife management in India, Methods of Wildlife conservation in India, conservation strategies adopted in Indian scenario.

**Wildlife Organizations and Institutions-** National Initiative- The animal welfare Board of India, Central Zoo Authority, The National Biodiversity Authority, WCCB, NLCP, NGRBA,

Wildlife Trust of India, IBWL, National Wildlife Action plan, National Afforestation and Eco-development board, CAMPA, Joint Forest Management, Social Forestry, National Bamboo Mission, CEPI. Global initiative- Man and Biosphere, Convention on Biological Diversity, Ramsar Convention on wetlands, CITES, TRAFFIC, CMS, CAWT, Global Tiger forum, UNFF, IUCN. **24hrs**

**Unit 2: Wildlife conservation challenges-** Review of community based conservation initiatives- reasons for failure, success and lessons learnt; Conservation induced displacement and rehabilitation, Community survey methods including participatory tools and techniques. Costs and benefits of protected areas for local livelihoods-displacement, changes in land tenure and community structures, restricted access to resources, human-wildlife conflicts and degradation of resources, ecotourism, payments for ecosystem services, sustainable resource management and development initiatives, Quantifying the costs and benefits of Pas, Community natural resource management institutions. Village micro planning, Quantifying the costs and benefits of protected areas economic costs benefit analyses, attitudinal surveys, direct impact studies. **15hrs**

**Unit 3: People Participation in Conservation:** Park-people interface conflict and objectives of human dimensions in management; Eco-development-what, why, where, and whether; Community participation; Conservation-Development linkages; Livelihood analysis; Stakeholders in conservation; Conflict management; PA-People Mutual Influence Zone Analysis and village prioritization for pilot eco-development projects; Project planning, monitoring and evaluation. **15hrs**

**Unit 4: Climate change-** Global warming, Green house effect, Green house gases, Climate forcing, Global warming potential, receding glaciers, Impact of Climate change on Ecosystem and Biodiversity.

**India and Climate change-** India's position on climate change, observed climate and weather change in India, current actions for adaptations and mitigation, India's National action plan on climate change- NMEE, national mission on sustainable habitat, NWM, NMSHE, National mission for green India, NMSA, NMSKCC, National bio-energy mission, INDC, Impact on India's Biodiversity and wildlife.

**Mitigation strategies-** Carbon Sequestration, Carbon sink, Carbon credit, Carbon tax, Carbon offsetting, geo-engineering.

**10hrs**

### **Practicals:**

1. Carbon fixation/ Sequestration by individual plants in forest ecosystem.
2. Carbon fixation/ Sequestration by individual plants in aquatic ecosystem.
3. Carbon fixation/ Sequestration by individual plants in grassland ecosystem.
4. Village micro planning; Quantifying the costs and benefits of protected areas economic costs benefit analyses.
5. Attitudinal surveys.
6. Human animal conflict studies.
7. NTFP collection studies.
8. PBR Studies.

### **Reference and suggested readings**

1. Arora B. M. , Editor, Indian Wildlife Yearbook, AIZ & WV, Bareilly and Central Zoo Authority, New Delhi , 2002

2. Brander, A.A, Wild Animals in Central India, Natraj Publisher, Dehradun.
3. Bruce, C. Glavovic, Mic Kelly Robert Kay and Ailbhe Travers. 2015. Climate Change and the Coast. CRC Press, Taylor and Francis Group.
4. Kadambari Sharma. 2010. Human Conflict and Wildlife Conservation. New Delhi, Jnanada Prakashan.
5. Mallapureddi Vikram Reddy. 2008. Wildlife Biodiversity Conservation. New Delhi, Daya Publishing House.
6. Vashishta, M. K. 2018. Oxford Book Company, New Delhi.

### **SC 3.3b: WILDLIFE ECOTOURISM -64hrs**

**Unit 1: Wildlife Ecotourism-** Basic concepts, importance and scope, Sustainable development in wildlife tourism, Negative impacts: Disturbing breeding patterns, Disruption of parent-offspring bonds, increased mortality; vanity hunts, and poaching, increased vulnerability, disturbing feeding patterns. **Positive impacts:** Habitat restoration by eco-lodges and other tourism operations, Conservation breeding, Quality interpretation, Culls and Population Maintenance Conservation Hunting/Harvest, Anti-poaching.

**18hrs**

**Unit 2: Major Wildlife tourism spots in India-** Wildlife Sanctuaries, National Parks and Natural Reserves in India (Jim Corbett Tiger Reserve, Bharatpur Bird Sanctuary, Valley of Flowers, Kanha, Kaziranga, Sasan Gir, Dachigam, Ranthambhore and Keoladeo Ghana) Hill Stations: Mussoorie, Srinagar, Shimla, Munnar and Ooty.

**14hrs**

**Unit 3: Wildlife tourism in Karnataka-** Bandipur tiger reserve and national park safari; Bhadra tiger reserve forest; Anshi National Park; Bannerghatta National Park: Dandeli Wildlife Sanctuary, Kudremukh National Park, Mookambika Wildlife Sanctuary, Nagarhole National Park (Rajiv Gandhi National Park), Ranganathittu Bird Sanctuary, Pilikula Nisargadhama, Dubare Elephant Camp, Kabini National Park/Wildlife Sanctuary.

**14hrs**

**Unit 4: Conservation Communication and Outreach-** Writing popular articles, press releases and news stories, interacting with media, wider communication, Oral communication, Presentation skills, Developing outreach material, Media appearances in TV and radio, Tutorial classes, written assignments.

**8hrs**

**Unit 5: Planning for ecotourism:** Feasibilities, prospects and scope, site selection, reconnaissance survey and final selection, landscaping at the site, publicity, providing facilities to the eco-tourists., visitor carrying capacity.

**10hrs**

#### **Practicals:**

1. Visits to surrounding ecotourism destinations.
2. Prepare ecotourism activity maps.
3. Preparation of route maps to important National parks and sanctuaries of India.
4. Preparation of information procedure about wildlife tourist spots in India.
5. Exercises on the preparation of location-specific model eco-tourism plans
6. Planning for recreational use of forested areas.
7. Unique geo-morphological regions as recreation sites.
8. Conducting a nature walk and report.
9. Engaging and conducting eco-tourists with with natural history information.

10. Visitor behaviors and expectations; questionnaire survey.
11. Studying the impacts of ecotourism under different levels of pressures and management.
12. A small hands-on exercise, conducting a small ecotourism excursion (may be for fellow-students of campus) and self-earning from that.

### Reference and suggested readings

1. Dileep. 2018. Tourism. IK International Publishing House Pvt. Ltd., New Delhi.
2. Jagbir Singh. 2010. Eco-tourism. IK International Publishing House Pvt. Ltd., New Delhi.
3. Mishra P.K and J.K Verma. 2018. Tourism in India. New Century Publications. New Delhi.

## EL 3.4: ORNITHOLOGY -32hrs

**Unit 1: Habitat ecology of birds:** Habitat ecology of Indian birds; Coastal birds, Inland water birds, Birds of high altitude and deserts, Distribution of birds in India.

**5hrs**

**Unit 2: Feeding ecology of Birds-** Insectivores, Frugivores, Nectarivores, Graminivores, Carnivores and Scavengers. **5hrs**

**Unit 3: Territoriality and Nesting;** Functions and types of territoriality, sizes and shapes of territory, Defense and site fidelity, Songs and calls; Functions of voice, nature of song, non vocal songs. Nesting; Functions, choice of nest sites, colonial nesting, forms of nests, nest materials and nest building and multiple nests. **10 hrs**

**Unit 4: Reproduction and Migration-** Breeding seasons, Factors influencing breeding seasons, seasonal reproductive cycles, photo periodism, sexual selection, pair bond, sexual dimorphism, mating systems, polyandry, polygyny, promiscuity, courtship and display, cooperative breeding, brood parasites, Egg laying- Timing of egg laying, clutch size, incubation patterns, hatching, Parental care- Feeding, nest sanitation, Feathers and Moulting-Types, Functions, growth, Moulting, Birds Migration, Economic values of birds, endangered and threatened birds. **12hrs**

### Reference and suggested readings

1. Ali, Salim (1997). The Book of Indian Birds, Oxford University Press, Mumbai.
2. Bhamarh, H.S and Kavita Juneja. 2002. Introduction to Birds. Anmol Publication pvt ltd . India.
3. Gurudarshan Singh and H. Bhaskar. 2003. An Introduction to Birds. Campus Book. New Delhi.
4. Khanna, D.R and P.R, Yadav, 2005. Biology of Birds. Discovery Publishing House. New Delhi.
5. Rahmani, Asad R. & Ugra, Gayatri. Birds of Wetlands and Grasslands. Bombay Natural History Society, Mumbai.
6. Sirsat CV. 2017. The Birds. Oxford Book Company, New Delhi.



## IV SEMESTER

### HC 4.1: WILDLIFE HEALTH AND MANAGEMENT -64hrs

**Unit 1: Wildlife health-** Introduction to disease and epizootiology, Determinants of disease and disease transmission, Disease and population dynamics, Occasional epizootics causing large-scale mortality, Importance of wildlife health studies in population management, evaluation of animal health and condition through direct observations of free living animals, physical examination of animals and collection of baseline data on health parameters, Quarantine, Quarantine Act. **12hrs**

**Unit 2: Common diseases in Indian Wildlife-** Review of major viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibians and reptiles, Disorders- nutritional diseases, poisoning, stress, shock, capture myopathy, physical trauma, Emerging and re-emerging diseases, Zoonoses, Assessment of condition, health and nutritional status in free-ranging populations, Diseases of periodic occurrence, diseases outbreaks caused by ecological and biological disturbances and other miscellaneous infectious diseases, Disease control operations, Investigation of disease outbreaks including biological sampling and laboratory analysis, Planning and management of wildlife health programmes. **16hrs**

**Unit 3: Capture and handling of wild animals-** Capture and handling of animals - purpose, restraint techniques, different capture methods and animal barriers, Drug immobilization - drug delivery equipment and accessories. **8hrs**

**Unit 4: Drug immobilization-** action, dosage, response and side effects, safety measures, complications. Central Zoo Authority (CZA) protocol of Handling and transport of wild animals, designing sledge, crate and holding enclosures, Chemical capture techniques; drug delivery system, basic physiological and biological concepts related to chemical capture, nature and classification of drugs used in chemical operations, factors affecting chemical capture. **14hrs**

**Unit 5: Wildlife health management-** Wildlife-livestock interface and conservation, Biodiversity loss, climate change and its impact on wildlife health, Introduced/Invasive species issues and ecosystem health monitoring, Introduction to the problems of locally over-abundant wild animal population causing damage, control versus conservation, animal damage control techniques; biological, chemical and mechanical, Management of waterholes in wildlife disease control. **14hrs**

#### Practicals:

1. Demonstration of equipment used in capturing and handling of wild animals.
2. Major viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibian and reptiles.
3. Study of Drug immobilization procedure in the capture of wild animal.
4. Species identification through morphometry of hair.
5. Research Paper Presentation on specific topics of animal behavior and community ecology.
6. Record of treatment of an ill/ injured wild animal.

## Reference and suggested readings

1. Amrita Saxena. 2017. Wildlife Management Concept, Analysis and Conservation. Daya Publishing House. New Delhi.
2. Arnold C. Long. 2009. Wildlife and Diseases in India. Cyber Tech publications. New Delhi.
3. Arora, B. M, Srivastava, A.K, Rajeev Singh, Rajesh Agrawal and prabhakar Kumar. 2009. Recent Advance in Zoo and Wild animals Health and Mangement. Vinayak Publishing House. Jaipur.
4. Ashok Kumar. 2009. Textbook of Animal Diseases. Sonali Publications. New Delhi.
5. Davis, J.W and Anderson, Infectious diseases of wild mammals. The Iowa State Univ. Press. Iowa
6. Dobson, 2002. The Ecology of Wildlife Diseases. Oxford University Press, Oxford.
7. George, L. Ford. 2018. Textbook of Veterinary Anatomy. Agrotech press, New Delhi.

## HC 4.2: APPLIED WILDLIFE SCIENCE

**Unit 1: Physiology and Nutrition-** Energy content of foods, digestive system, alimentary canal, modification in herbivores and carnivores, teeth and jaws; digestibility of food, chemistry of digestion, classification of enzymes, factors controlling the rate of enzyme reactions, mechanism of enzyme action, absorption of food and nutrients. Metabolism and Thermoregulation: metabolic rate, BMR, factors affecting metabolism, Role of hormones in co-ordination of growth and metabolism, Thermoregulation, ectothermic and endothermic vertebrates, special problems of endotherms living in climatic extremes, mechanism of temperature regulation, Receptors- Receptor organs, photo, phono, mechano and chemo receptors. **6hrs**

**Reproductive biology:** Reproduction in birds and mammals: Birds- physiology of egg formation, physiological changes during incubation, Mammals- secondary sexual characters, reproductive cycles, Physiology of gestation, lactation, weaning, hormonal control and inbreeding. **4hrs**

**Plant Physiology:** Biochemistry of Plants- Constituent elements and pigments, Signals and Regulators- Plant Hormones, Photomorphogenesis, Photoperiodism and flowering. Plant Environmental Physiology. Trophism and nastic movements, Plant Diseases, Economic Application- Food production, Water relation- Evapotranspiration, Mineral Nutrition, ion transport and Mineral Deficiency, Photosynthesis- phot chemical reactions, photophosphorylations and Carbon Pathway. **6hrs**

**Unit 2: Captive wildlife management-** Zoo and Safari, history, Aims of Zoos, different types of zoos, food sources and storage, diet food supplements for herbivores and carnivores, zoo sanitation, Zoo master Plan, Zoo policy, Central zoo authority, tourism management, World Zoo Conservation Strategy, tourism zone management, tourism resource inventory, visitor carrying capacity, visitor feedback and its evaluation, interpretative planning, signage, education methods and materials- preparing the brochures, organizing nature camps, objects for display and demonstration, simple display techniques in zoos. **12hrs**

**Unit 3: Wildlife utilization-** Non-consumptive and consumptive utilization, their economic benefit, Game ranching and controlled off-take from wild populations: rationale, management design, harvesting by management or hunting licenses, marketing procedures, Use of wildlife products- skins, meat, musk, etc., Wildlife Tourism- objectives, planning and economics.

**12hrs**

**Unit 4: Wildlife genetics:** Introduction to Bio-molecules-DNA, RNA and Proteins; Central Dogma of Molecular Biology- Replication, Transcription and Translation, Mendelian Genetics- Mendal's Laws, Genetic Code- Characteristics and feature of genetic code; Molecular markers, PCR, DNA Sequencing, Genotyping; Allelic variation, Interpretation of genetic data; Application of genetics for wildlife conservation, Loss of genetic diversity, Resolving taxonomic uncertainties. **10hrs**

**Wildlife Forensics-** Overview, various forensic protocols for species identification, Molecular markers used in wildlife forensics, Wildlife forensics based on DNA analysis and morphometry, Wildlife crime case studies. **4hrs**

**Unit 5: Current Issues-** Gadgil committee (Kasthurirangan report), Human- wildlife Conflicts, Habitat fragmentation and destruction, wildlife committee in India, Use of ICT by illegal Wildlife traders, Habitat destruction, new projects undertaken for wildlife conservation in national and global level. **10hrs**

#### **Practicals:**

1. Working principle of PCR
2. Estimation of Cholesterol in the given liver or skeletal muscle sample.
3. Estimation of Glucose in the given liver or skeletal muscle sample.
4. Estimation of Glycogen in the given liver or skeletal muscle sample.
5. Estimation of Protein in the given liver or skeletal muscle sample.
6. Estimation of Chlorides in the urine sample.
7. Morphological Study of *Drosophila melanogaster* (Male and female).
8. Isolation of DNA from plant tissue.
9. Isolation of DNA from Animal tissue.
10. Quantification of isolated DNA'
11. Instrumentation: Centrifuge, Spectrophotometer, Gel Electrophoresis Unit, Electrophoresis Unit (Horizontal and Vertical).

#### **Reference and suggested readings**

1. Arora B. M., 2002. Editor, Indian Wildlife Yearbook, AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.
2. Arora, B. M, Srivastava, A.K, Rajeev Singh, Rajesh Agrawal and prabhakar Kumar. 2009. Recent Advance in Zoo and Wild animals Health and Mangement. Vinayak Publishing House. Jaipur.
3. Arora, B.M. 2001. Dietary Husbandry of Wild Mammalian AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.
4. Arora, B.M. 2001. Indian Wildlife Diseases and Disorders. AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.

5. Arora, B.M. 2007.Rehabilitation in free living wild animals. AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.
6. Govindaswamy Agoramoorthy. 2009. Wildlife Issues and Crisis in a Changing World. Daya Publishing House. New Delhi.
7. Harsh Vardhan Bhaskar. 2008. Animal Physiology. Campus Books International. New Delhi.
8. Jan Bundschuh. 2018. Wildlife Forensic Investigation, Principles and Practice. Oxford Book Company. Jaipur, India.
9. Mariakuttikan, A and N. Arumugam. 2013. Animal Physiology. Saras Publication, Tamilnadu.

**H.C. 4.3 Major Project work - 64 hrs**