

# University of Mumbai



No. UG/ 89 of 2019-20

## CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, the Head of the University Departments and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/16 of 2014 dated 1<sup>st</sup> July, 2014 relating to the syllabus as per the (CBSGS) for the M.Sc. (Biodiversity and Wildlife Conservation and Management) degree programme.

They are hereby informed that the recommendations made by the Board of Studies in Zoology at its meeting held on 24<sup>th</sup> May, 2019 have been accepted by the Academic Council at its meeting held on 26<sup>th</sup> July, 2019 vide item No.4.3 and that in accordance therewith, the revised syllabus as per the (CBCS) for the M.Sc. Course in Biodiversity, Wildlife Conservation and Management (PSBWCM) Sem. I & II has been brought into force with effect from the academic year 2019-20, accordingly. (The same is available on the University's website [www.mu.ac.in](http://www.mu.ac.in)).

MUMBAI – 400 032

28<sup>th</sup> August, 2019

To

The Principals of the affiliated Colleges, the Head of the University Departments and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9<sup>th</sup> January, 2018.)

A.C/4.3/26/07/2019

\*\*\*\*\*

No. UG/ 89 -A of 2019-20

MUMBAI-400 032

28<sup>th</sup> August, 2019

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Zoology,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,

(Dr. Ajay Deshmukh)  
REGISTRAR



UNIVERSITY OF MUMBAISyllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	M.Sc. in Biodiversity, Wildlife Conservation and Management (PSBWCM)
2	Eligibility for Admission	B.Sc. in ANY subject or its equivalent. B.Sc. Veterinary science or its equivalent. B.Sc. Agriculture or Forestry or its equivalent.
3	Passing Marks	40 %
4	Ordinances / Regulations ( if any )	Nil
5	No. of Years / Semesters	Four Semesters, Two Years
6	Level	P.G. / <del>U.G.</del> / Diploma / Certificate ( Strike out which is not applicable)
7	Pattern	<del>Yearly</del> / Semester (Strike out which is not applicable) Credit Based, Semester and Grading System (CBSGS)
8	Status	<del>New</del> / Revised ( Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year 2019 - 20

Date:

Signature:

Name of BOS Chairperson / Dean:

(Dr. D. L. Bharama)



# **UNIVERSITY OF MUMBAI**



**Syllabus for  
Two years M.Sc. course  
in  
Biodiversity, Wildlife Conservation  
and Management  
(PSBWCM)**

**Revised for Sem I & II**

**(Choice Based Credit system with  
effect from the academic year 2019–2020)**

**M.Sc.**  
**BIODIVERSITY, WILDLIFE CONSERVATION AND MANAGEMENT**  
**SYLLABUS IN BRIEF**

**M.Sc.; Semester – I (from academic year 2019 – 2020)**

Paper	Code	Lectures	Credits	Code	Practical	Credits
Biodiversity: Global and Indian	PSBWCM 101	60	4	PSBWCMP 101	60	2
Biomes & Natural History	PSBWCM 102	60	4	PSBWCMP 102	60	2
Basics of Wildlife Biology	PSBWCM 103	60	4	PSBWCMP 103	60	2
Planning and execution of Field surveys	PSBWCM 104	60	4	PSBWCMP 104	60	2
<b>TOTAL</b>		<b>240</b>	<b>16</b>		<b>240</b>	<b>8</b>
<b>TOTAL CREDITS</b>			<b>24</b>			

# Note: Field Visits may be spread out in Semester I and their reports will be assessed as a part of internal assessment.

**M.Sc.; Semester - II**

Paper	Code	Lectures	Credits	Code	Practical	Credits
Animal Dispersions & Animal Populations	PSBWCM 201	60	4	PSBWCMP 201	60	2
Principles of Conservation Biology	PSBWCM 202	60	4	PSBWCMP 202	60	2
Planning and Implementing Conservation programmes	PSBWCM 203	60	4	PSBWCMP 203	60	2
Advanced Techniques in Field Studies	PSBWCM 204	60	4	PSBWCMP 204	60	2
<b>TOTAL</b>		<b>240</b>	<b>16</b>		<b>240</b>	<b>8</b>
<b>TOTAL CREDITS</b>			<b>24</b>			

# Note: Field Visits may be spread out in Semester II and their reports will be assessed as a part of internal assessment.

## SYLLABUS IN DETAIL

### NOTE:

- While teaching, examples from both plants and animals should be covered, wherever applicable.
- Case studies (Indian & foreign), wherever applicable should be discussed as a part of the syllabus
- Ensure that students are in touch with latest developments especially with respect to civil society's movements, Government policies, International agreements etc.

## SEMESTER I - THEORY

- **UNIT 101: Biodiversity: Global and Indian (60 lectures)**
  - 101.1: Fundamentals of Ecology & Biodiversity (15 lectures)
    - Concept of Ecology, Biotic & Abiotic factors
    - Species, Populations, Communities, Ecosystems
    - Ecological succession
    - Biodiversity - Concept & Types
    - Climatic Zones and Biodiversity - Global & Indian
    - Vegetation Types
    - Zoogeographic Realms
    - Biodiversity as a natural resource
  - 101.2: Basics of Plant Taxonomy (15 lectures)
    - An overview of types of classification
    - Basics of classification of
      - Bacteria,
      - Algae, fungi, bryophytes, pteridophytes (G. M. Smith),
      - Gymnosperms (Chamberlain) & angiosperms (Bentham & Hooker)
      - Major families – Magnoliaceae, Malvaceae, Rhamnaceae,
      - Myrtaceae, Umbelliferae, Asteraceae, Sapotaceae
      - Labiatae, Nyctaginaceae, Orchidaceae
  - 101.3: Basics of Non-chordate Taxonomy (15 lectures)
    - Classification of Protozoans
    - Classification of Non-chordates (major phyla upto classes)
    - Insects up to major orders
  - 101.4: Basics of Chordate Taxonomy (15 lectures)
    - Classification of Protochordates and Chordates (up to major orders)
- **UNIT 102: Biomes & Natural History (60 lectures)**
  - 102.1: Biomes & Biodiversity (15 lectures)
    - Biomes of the world
    - Characteristic flora and fauna
    - Threatened species within biomes
    - Biodiversity Hot Spots – Global & Indian
  - 102.2: Natural History (15 lectures)
    - Continental drift, plate tectonics, island biogeography
    - Pre-historic migration and dispersal of species
    - Natural History of major Flora & Fauna of India
    - Natural History of Western Ghats
  - 102.3: Coastal and Marine: Biodiversity & Management (15 lectures)

Zonation of the sea and related distribution of species  
Diversity of intertidal zones, mangroves  
Overexploitation of marine resources, bycatch and discards  
Protected marine areas in India  
Endangered species of coastal and marine ecosystems  
Climate change and threats to marine biodiversity

102.4: Urban Biodiversity (15 lectures)

Biodiversity in cities & towns  
Concept of opportunistic species  
Strays and feral populations  
Anthropological factors in species dispersal  
Impact of human activities on urban biodiversity:  
    e.g. Effect of plastic and mobile radiation  
Conservation practices of Urban Biodiversity

• **UNIT 103: Basics of Wildlife Biology (60 lectures)**

103.1.1: Plant Adaptations (15 lectures)

Plant adaptations to water, light, temperature, salinity  
Adaptations for association between plants & animals  
Concept of photoperiodism and thermo-periodism in plants  
Seed dormancy

103.2: Animal adaptations (15 lectures)

Physiological Basis of Animal adaptations to  
    water, temperature, salinity  
    Deep sea & diving adaptations in animals  
    Role of blubber in marine mammals  
Adaptations for association between animals  
Hibernation, aestivation, Circadian rhythms  
    Hypothalamo- Hypophyseal Axis and its role  
    Pineal gland and its role  
Orientation, navigation & migration in animals

103.3: Wild life diseases (15 lectures)

Major diseases and their control  
Domestic animals & wildlife diseases  
Governmental role in control of Wildlife diseases  
Sick animal refuges in protected areas

103.4: Evolution (15 lectures)

Theories of Evolution: Early Theories, Darwin's Theory, Modern Synthesis,  
Origin and evolution of life across various eras, Mutation and variation  
Mutation-Selection balance.  
Geological time scale  
Hardy-Weinberg's Principle, Red Queen Hypothesis, Mechanism of Evolution  
(Genetic variation and recombination, Random genetic Drift, natural and sexual  
selection, Gene flow, Reproductive Isolation), Adaptation, Co-evolution,  
Speciation and its types: Allopatric and sympatric speciation with suitable  
examples, Neutral Mutation  
Linking evolution to ecological adaptations and Behavioral  
adaptations; Examples: Darwin's finches, Insular fauna including plants

• **UNIT 104: Planning and execution of Field surveys (60 lectures)**

- 104.1: Field surveys & observations (15 lectures)
  - Sampling methods and identifying study sites
  - Techniques of field observation
    - Camouflages & observation stations
    - Non-intruding / non-interfering techniques of field observations
  - Methods of observing and recording animal behaviors
    - Sampling Behaviours, methods of observing Behaviour
    - Time- activity budgets, Ethograms, Social interaction matrices and their analysis
  - Ethics in Field Studies
  - Dos & Don'ts in field studies
    - Regulatory permissions for field observations
    - Field collections & field preservations
- 104.2: Recording & Evaluation of Data (15 lectures)
  - Field note book and its records
    - Qualitative & Quantitative data
  - Field kit and its usage
    - Cameras, binoculars, field scopes, camera traps, celphones, etc.
  - Different methods of recording field observations
  - Use of rings / tags, colour codes, colour marking on animals
- 104.3: Agricultural conservation (15 lectures)
  - Conserving indigenous agricultural species
  - Conservation of Live Stock species /varieties
  - Conservation of economically important aquatic species
  - Significance of gene banks and germplasm conservation
  - Use of wild species for producing improved hybrid varieties
  - Seed Banks & Artificial seeds in conservation
- 104.4: Statistical methods (15 lectures)
  - (use examples from wildlife, forestry and field experimentation)
  - Concept of Sample and Population, Determining sample size
  - Types of Data (Qualitative and quantitative and their subtypes) and its distributions: (Normal, Binomial, and Poisson)
  - Graphical representation (Pie, bar, line, histograms, frequency polygons, Kite diagrams etc.)
  - Measures of central tendencies and Measures of dispersion
  - Null Hypothesis and Hypothesis testing, Type I and II errors
  - Working on quantitative and qualitative data:
    - Parametric Tests: Z, t, F,
    - Non-Parametric Tests: Chi-Square,
    - Correlation and Regression analysis and its applications.
    - Concepts of Confidence interval and Power

## Semester I - PRACTICALS

### Note :

- Field visits will be integral part of the practical. Visits to nearby zoo, museum, forest, sea-shore, nursery, aquaria or any other relevant site must be arranged.
- The report of these visits will be submitted as part of the practical work.

### (PSBWCMP101)

1. Using photographs / paintings / coloured drawings identify and study the classification & characteristics (representative species only) from;
  - Protista – protozoans
  - Non-chordates – Porifera to Hemichordata - upto classes
  - Insecta – Orthoptera, Coleoptera, Lepidoptera, Hymenoptera, Diptera, Odonata
  - Pisces – Agnatha, Chondrichthyes, Osteichthyes,
  - Amphibia – Anura, Gymnophiona and Urodela
  - Reptilia – Chelonia (Testudinia), Squamata, Crocodilia
  - Aves – Passeriformes, Anseriformes, Falconiformes, Struthioniformes, Galliformes, Psittaciformes, Strigiformes, Columbiformes, Ciconiformes,
  - Mammalia – Proboscidea, Sirenia, Primates, Rodentia, Chiroptera, Perissodactyla, Artiodactyla, Pholidota, Carnivora
1. Using photographs / paintings / coloured drawings identify and study the classification & characteristics (representative species only) from;
  - Monera – bacteria, cyanobacteria, spirochetes
  - Algae – Chlorophyta, Rhodophyta, Phaeophyta, Cyanophyta:  
Study of different fresh water and marine algae; common species only.
  - Fungi (upto orders) – molds, mushrooms, yeasts, mildews, smuts
  - mosses, ferns, gymnosperms
2. Study of morphology of plants (use photographs / paintings / coloured drawings / preserved specimen/ herbarium / in field);
  - Leaf – morphology, modifications and phyllotaxy
  - Flower – morphology & modifications  
floral formula (*Hibiscus* & *Pancratium*)
  - Fruit – types & morphology
  - Seed – types, morphology and modifications for dispersal
3. Description of morphological characters of Angiosperm families prescribed in theory
4. Separate and identify different foraminifera from sand samples.
5. Field Report based on Paper PSBWCM 101



**(PSBWCMP102)**

1. Estimation of stomatal index in leaves (at least three different leaf types representing at least two different micro-climatic conditions e.g. sun loving, shade loving).
2. Uv-Visible spectrophotometer scan of extracted plant pigments; spinach leaves, marigold petals and *Tradescantia* leaves. Evaluation of the spectral characteristics.
3. Using suitable diagram / picture identify zonations in a pond ecosystem and study the species distribution.
4. Using suitable diagram / picture identify zonations in a sea-shore ecosystem and study the species distribution.
5. Using suitable diagram / picture identify stratification in a forest and study the species distribution.
6. Field Report based on Paper PSBWCM 102

**(PSBWCMP103)**

1. Estimate primary production using water samples from different aquatic habitats.
2. Adaptations in plants:  
Three hydrophytes:  
*Pistia* – offset & leaf; *Eichhornia* – leaf & petiole; *Nymphaea* – leaf & petiole;  
Three xerophytes: *Opuntia* – phylloclade; *Nerium* – leaf; *Casaurina* - leaf
3. Insectivorous plants: identification, morphological adaptations and ecological distribution.
4. Adaptations in animals: use pictures or photographs with suitable labels.
5. Identification and study of venomous & poisonous plants and animals, action of their venom - Stinging nettle, *Mucuna pruriens*, Physalia, scorpion, tarantula, honey-bee, *Conus*, scorpion fish  
First aid for snake bites - Cobra (spectacled & monocled), Common krait, Banded krait, Russell's Viper, Saw scaled Viper, Pit vipers (Bamboo, Green, Malabar)
6. Study of deep sea fauna and their ecological role; (pictures / diagrams only).
7. Study of some pioneer communities in succession;  
Lichen and their types, mosses and their types, coral and their types.
8. Field Report based on Paper PSBWCM 103

**(PSBWCMP104)**

1. Application of transacts and quadrants in simulated pictures / photographic sheets for data collection. Record & tabulate the data.
2. Instruments for sampling; water sampling bottles, plankton samplers, core samplers, bottom



samplers, air samplers – construction, working and application (photographs or specimens and diagrams).

3. Using a suitable hand held camera photograph the following (to record diagnostic features). Record the camera settings and take 5" X 7" prints on three different papers;  
butterfly / moth, house fly, dragonfly, a caterpillar,  
Fresh fish (from market), Mackerel, Rohu, catfish, or any other suitable subject
4. Collect matured leaves (minimum fifty for a class) from two different plants (e.g. Mango tree & False Ashoka). Measure and record the length (in cm.) along the midrib using a flexible thread. Tabulate the data into a frequency distribution table, make frequency polygon and calculate weighted mean.
5. Collect two sets of leaves (maximum 30 of each set). Each set different from the other set in morphology (length / breadth etc.). Measure and record the morphological character (length / breadth / area etc.) and obtain two sets of data. For each set, prepare a frequency polygon and estimate the mean and SD of the two grouped series. Apply "t" test to the data and evaluate the significance of the difference in the morphological parameter between the two sets of data. Comment on the "p" value
6. Take Ajinomoto (Chinese salt or Monosodium glutamate). Give a small pinch to a minimum of 50 volunteers to taste. Record the taste experienced by each volunteer (both male and female). Tabulate the data (Sex wise / Age groups) and apply Chi Square test to evaluate the significance of difference observed in the taste experienced. Comment on the "p" Value.
7. Using Vernier calipers make morphological measurements of Specimens (Any insect / fish / bird etc.), Skull, scales of reptiles, Wing and wing feathers etc. and record morphological data. Make a report and evaluate parameters like age, sex, species characteristics, etc.
8. Field Report based on Paper PSBWCM 104

## SEMESTER II - THEORY

- **UNIT 201: Animal Dispersions & Animal Populations (60 lectures)**
  - 201.1: Population dynamics (15 lectures)
    - Age & Sex distribution
    - Recruitment ratio & population sustenance (e.g. herbivores, fish & prawns)
    - Effect of natality, mortality & migration
    - Exponential & logistic growth curves,
    - Survivorship curves, k & r selected species
    - Interaction between populations;
      - Types of interactions
      - Predator – prey interactions
      - Fluctuations in populations
  - 201.2: Plant – animal interactions (15 lectures)
    - Shelter & nesting by animals
    - Effect of grazing & browsing



- Protection strategies of plants for sustaining populations
- Obligate plant – animal dependence – e.g. Fig wasp, Orchid mantis, etc.
- 201.3: Distribution & dispersal of plants & animals (15 lectures)
  - Vegetation and its effect on animal distribution
  - Pollination & seed dispersal
  - Vegetation preferences of animal species
  - Barriers to species distribution
- 201.4: Behavioural Ecology (15 lectures)
  - Definition & types of behaviors (including innate & learned)
  - Cues / triggers to behavior
  - Genetic basis of behavior
  - Sociobiology
    - Animal Societies
    - Establishment of hierarchies
    - Animal communications
    - Social behaviors and parental care
    - Kin selection, altruism, reciprocal altruism, Hamilton's rule

- **UNIT 202: Principles of Conservation Biology (60 lectures)**

- 202.1: Habitat ecology (15 lectures)
  - Types of habitats & their major ecological factors
  - Ecological succession & climax ecosystems (e.g. Sholas)
  - Maximizing usage of habitat resources by populations
  - Insular habitats & insular flora & fauna
  - Extreme habitats and their flora & fauna (dark caves, deep sea etc.)
- 202.2: Habitat selection in animals (15 lectures)
  - Concept of home range, familiar areas
  - Manipulating home ranges to increase population density
  - Territoriality and habitat utilization in animals
    - Concept of niches, its realization & its continuity
  - Micro-habitats: fallen log, treetop-puddles etc.
- 202.3: Wildlife habitats and human welfare (15 lectures)
  - Concept of carrying capacity
  - Limiting factors in habitats
  - Improving carrying capacity in wildlife areas e.g. Wildlife management for Game hunting & Fishing
  - Biomimetics
  - The Economics of Ecosystem and Biodiversity (TEEB)
  - Biodiversity as an Economic resource and its consideration in the national economic plans
- 202.4: Human – wildlife interactions (15 lectures)
  - Conservation Vs protection
  - Concept of buffer zones, core areas, wildlife corridors
  - Strategies to reduce human-wildlife interactions
  - Role of government and NGOs in controlling human-wildlife interactions
  - Socio-economic issues related to human-wildlife interactions

- **UNIT 203: Planning and implementing conservation programmes (60 lectures)**

- 203.1: Major protected areas & their importance (15 lectures)
  - Wildlife parks, wildlife reserves, privately owned wildlife reserves



- & Biosphere reserves
  - Single species / single habitat-based conservation programmes (e.g. Project tiger, Valley of flowers)
- 203.2: International conventions on conservation (15 lectures)
  - Important international conventions & treaties on nature & conservation
  - India's role & contribution (including VISION 2040)
  - Ex-situ & in-situ conservation
    - Conservation breeding (e.g. Vulture, Pygmy hog, Gharial etc.)
  - Institutions and their role in conservation;
    - Zoos, Botanical gardens, aquaria, natural history museums & collections
    - Zoological survey of India, Botanical survey of India,
    - Forest Research Institute, Survey of India,
    - Central Marine Fisheries Research Institute
- 203.3: People and conservation (15 lectures)
  - Traditional knowledge: Ethnobiology & Ecosystem people
  - Traditions & cultures
  - Tribes of Andaman & Nicobar, Arunachal
  - Women in conservation
  - Traditional societies (e.g. Bishnois)
- 203.4: Role of NGOs in conservation (15 lectures)
  - International NGOs;
    - UNEP, GEF, WCS, Bird Life International
  - Important NGOs in India & their contributions
    - WWF, ATREE, BNHS, WTI, Kalpavriksha etc.
  - Important NGO movements
    - Chipko movement, Narmada Bachao Andolan
    - Pani Panchayats, Seed Movement etc.
- **UNIT 204: Advanced techniques in field studies (60 lectures)**
  - 204.1: Molecular Techniques (15 lectures)
    - Genomics (General concepts & applications)
    - Extraction of DNA from samples
    - PCR & RTPCR
    - DNA sequencing, Sanger's & Maxam Gilbert methods
    - DNA fingerprinting, DNA bar coding
    - Southern Blotting and its applications
  - 204.2: Molecular Techniques – (15lectures)
    - Proteomics - General concepts & applications in phylogenetic analysis
    - Extraction & evaluation of proteins
    - Protein fingerprinting (e.g. venom proteins, plant proteins)
    - Western Blotting and its applications
    - Protein characterization (X-ray crystallography, Mass spectrometry)
  - 204.3: Analysis of animal tracks & signs (General concepts) (15 Lectures)
    - Tracking large mammals
    - Studying & analyzing animal tracks & signs
    - Scat analysis and evaluation of food, feeding and health
    - Enumeration using tracks & signs, nest census
  - 204.4: Modeling techniques (15 lectures)
    - Various software platforms for modeling; analytical models & simulations
    - Collecting data for modeling



Applications of modeling  
Basic understanding of Remote sensing and GIS techniques and  
their applications  
Case studies: e.g. Minimum Sustainable Population of commercial Fish,  
Keoladeo National Park, Serengeti, Velavadar, etc.

## Semester II – PRACTICALS

Note :

- Field visits will be integral part of the Practical. Visits to nearby sea-shore, lake, pond, river, reserved forest, Buffer area of a reserve, inhabitations / settlements near wild life areas or any other relevant site must be arranged.
- The report of these visits will be submitted as part of the practical work.

### (PSBWCMP201)

1. Using photographs / paintings / coloured drawings identify and study ecological role of characteristic animal species (major representative species only) of various Biomes.
2. Using photographs / paintings / coloured drawings identify and study ecological role of characteristic plant species (predominant trees / shrubs only) of various biomes.
3. Mount and identify zooplankton (preserved samples may be used).
4. Study of animal architecture (photographs / diagram / abandoned specimen) ;  
Hive of honey bee, nest of paper wasp, nest of potter wasp,  
mount of termite, nests of weaver bird and tailor bird.
5. Comparative study of mouth parts (preserved specimen / diagrams only);  
House fly, female mosquito, cockroach, butterfly / moth, bug, beetle.
6. Using photographs / paintings / coloured drawings identify and study distribution and ecological role of common bivalves and gastropods that occur along a sea-shore.

### (PSBWCMP202)

1. Behavioural observations on Siamese fighter fish in different settings; male in front of mirror, male in front of female, male in front of male, male in front of other fish species (aggressive and timid species). (Use specially designed small aquarium tanks and suitable method to record observation).
2. Identification, biology & ecological role of following introduced species;  
*Parthenium*, *Eichhornia*, *Lantana camera*.
3. Identification, biology & ecological role of the following using suitable diagram / picture;  
Pangolin, blind cave fish – as adaptation to extreme  
Pollination of fig flowers by fig wasp,

Pollination of orchids by pseudo-copulation – obligatory Interaction

4. Determination of  $LC_{50}$  of a suitable toxicant (e.g.  $CuSO_4$  / neem leaf extract) using a suitable model e.g. *Daphnia*, *Cyclops*, mosquito larvae, Chironomous larvae, rice weevil). Compare two or more different toxicants and compare their lethality.
5. Extract chlorophyll from leaves of two plant species (garden plants: one shade loving and another sun loving). Spectrophotometrically estimate chlorophyll a and b and find out the chlorophyll a: b ratio and comment on the results.

**(PSBWCMP203)**

1. On a phylogeographic map of India locate & demarcate major sanctuaries / national parks.
2. In different false colour images from a satellite imagery, identify and describe land use patterns; city, reservoir, forest, agricultural land, sea-shore.
3. Separate (serum / milk / pulses, etc.) proteins using PAGE and identify protein sizes using a protein ladder.
4. Extraction of DNA from a suitable mammalian blood / human cheek smear / Tissue or Plant sample (use kits / phenol-chloroform – isoamyl alcohol method / SDS – Ethanol method). Evaluate the purity of the extracted DNA with spectrophotometry. Comment on the results.

**(PSBWCMP204)**

1. Using a suitable camera fitted with a macro lens, take close-up photograph of the following (to record diagnostic features). Record the camera settings and take 5" X 7" prints on three different papers;  
Head of cockroach, eye of prawn
2. Identify and study specifications & applications of various ringing & tagging devices (photographs or models or working models and diagrams).
3. Preparation of herbaria using suitable fresh plant samples (spreading, drying, pressing and labeling); e.g. mint, coriander, curry leaves, *Hibiscus* - twig with flower.
4. Bioinformatics – using BLASTA / FASTA tools, compare / analyse proteins

**Revision of syllabi for Semesters III and IV shall be completed and uploaded later for students pursuing the same from academic year 2020 – 21.**



## QUESTION PAPER PATTERN

### THEORY

**Total Marks – 60**

**Total duration – two and half hours**

**Total question – 04**

**Marks for each question – 15**

**Coverage of each question –** each question will correspond to each unit taught in that semester

**Options –** There will be internal options in each question (within 15 marks)

e.g. Q. 1 – 15 marks OR Q. 1 – a) 8 marks b) 7 marks

**Compulsory questions –** All four questions will be compulsory.

### PRACTICAL

**Total Marks – 50**

**Total duration – Six hours**

**Total questions – 05**

**Distribution of marks –** Question No. 1, 2, and 3 – **12** marks each (performance & results)

Question No. 4 – Reports of field visits – **10** marks

Question No. 5 – Viva voce – **04** marks

### SUGGESTED READINGS

Sr. No.	Title	Author	Publisher	Year
1.	Protected Area Update; Newsletter	-----	Kalpavriksh Environment Action Group, Pune , India	Periodical
2.	Zoos in India; Legislation, Policy, Guidelines and Strategy	-----	Central Zoo Authority, New Delhi	2007
3.	Wildlife ecology	Aaron, N.M.	W.H. Freeman Co. San Francisco, U.S.A.	1973
4.	The Book of Indian Birds	Ali, Salim	Oxford University Press, Mumbai	1997
5.	Wildlife Ecology, Conservation and Management	Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly	Blackwell Publishing, U.S.A.	2006
6.	The Book of Indian Shells.	Apte, Deepak.	Oxford University Press, Mumbai.	
7.	Colorful Atlas on Indian Wildlife Diseases and Disorders	Arora and Bipul Chakraborty B.M.	IBDC, Lucknow.	2008
8.	Indian Wildlife Yearbook	Arora B. M. , Editor	AIZ & WV, Bareilly and Central Zoo Authority, New Delhi	2002
9.	Dietary Husbandry of Wild Mammalia	Arora, B.M.	AIZ & WV, Bareilly and CZA, New Delhi.	2001
10.	Indian Wildlife Diseases and Disorders.	Arora, B.M.		
11.	Rehabilitation in free living wild animals	Arora, B.M.	AIZ & WV, Bareilly	2007
12.	Reproduction in Wild Mammalia & Conservation	Arora, B.M.	AIZ & WV, Bareilly.	2002
13.	A Text Book of Developmental Biology	Banerjee, S.	IBD, Dehradun	2001
14.	Remote Sensing for Hazard Monitoring and Disaster Assessment	Barett, E.C. and Anton Micallef	Taylor and Francis, London	1991
15.	Statistics in Research	Bernard Ostle and R.W.Mensing		
16.	Wild Animals in Central India	Brander, A.A	Natraj Publisher, Dehradun.	
17.	Method of Statistical Analysis	C.H. Goulden	John Wiley & Sons	
18.	Environmental Impact Assessment	Canter, L. W.	Graw, Mc, , Hill Publication, New York.	
19.	A Text Book of Agricultural Statistics	Chandel S.R.S.,	Achal Prakashan Mandir, Kanpur	1999



<b>Sr. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>	<b>Year</b>
20.	Introduction to Geographic Information Systems,	Chang – Kang, Tsung	Tata McGraw -Hill Publishing Company Limited, New Delhi	2002
21.	A guide to Chemical Restraint of Wild Animals.	Chowdhury, Sushant and Malik, Pradeep	Natraj Publishers, Dehradun.	
22.	EIA – A Biography	Clark, B. D., Bissel, B. D. and Watheam, P.	School of Forestry and Environment, SHIATS- Deemed University, Allahabad	
23.	The Temple Tiger.	Corbett, Jim	Oxford University Press, New Delhi	2007
24.	Asian Elephant,	Daniel, J.C.	Natraj Publishers, Dehradun	
25.	The Book of Indian Reptiles and Amphibians	Daniel, J.C.	Oxford University Press, Mumbai.	
26.	Resource and Environmental Economics	Fisher, A.C.	New York: John Wiley & Sons	1979
27.	The conservation of plant biodiversity.	Frankal, Otto H., Anthony, A., Brown, D. and Burdon, Jeremy J.	Cambridge University Press	1995
28.	Statistical Methods	G.W. Snedecor and W.G. Cochran		
29.	The Serengeti Lion	George B. Schaller		
30.	Fundamentals of Wildlife Management	Gopal, Rajesh	Justice Home, Allahabad, India.	1992
31.	Encyclopedia of mammals	Grzimek	McGraw Hill Publishing House, New Delhi.	1988
32.	Wild Animals, Their Minds and Manners	Hornaday, W.T.	IBD, Dehradun.	1989
33.	Concepts in Wildlife Management	Hosetti, B.B.	Daya Publishing House, Delhi.	1997
34.	Collection and preservation of animals	Jairajpuri M. S.	Zoological Survey of India	1990
35.	Statistical Ecology	John A. Ludwig & James F. Reynolds	John Wiley & Sons	1988
36.	Handbook of Environment, Forest and Wildlife Protection Laws in India	Justice Kuldip Singh	Natraj Publishers, Dehradun	1998
37.	Biodiversity conservation in managed and protected areas	Katwal/Banerjee	Agrobios, India	2002

<b>Sr. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>	<b>Year</b>
38.	Advances in Fish and Wildlife Ecology and Biology	Kaul, B.L.		1999
39.	A Vet in Wilderness	Khan Ali M. G.	Central Zoo Authority, New Delhi	
40.	Modern Textbook of Zoology, Vertebrates.	Kotpal, R.L.	Rastogi Publications, Merrut.	
41.	Remote Sensing and Image Interpretation	Lilleand, T.M. and Kieffer, R.W	John Wiley and Sons	
42.	Wild Animals of India, Burma, Malaya and Tibet	Lydekker, R.,	Natraj Publishers, Dehradun.	
43.	Wildlife Crime	Menon, Vivek and Kumar, Ashok	Natraj Publisher, Dehradun.	1999
44.	Wildlife Issues in a Changing World	Moulton, M. P. & J. Sanderson	St. Lucie Press	1997
45.	A handbook of forestry.	Negi, S.S.	International Book Distributor, Dehradun.	2005
46.	Biodiversity and its conservation in India	Negi, S.S.	Indus Publishing Co., New Delhi.	1993
47.	Manual for Wildlife Management in India	Negi, S.S.		
48.	Fundamentals of Ecology	Odum, Eugene P	Natraj Publishers, Dehradun.	
49.	Applied Anatomy of the Domestic Animals.	Ommer, P.A. and Harshan, K.R.	Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.	
50.	Natural Resource Information for Economic Development	Orris C. Herfindahl	Baltimore: The Johns Hopkins University Press	1969
51.	Watching and Conserving	Oxford Anthology of Indian Wildlife	Oxford University Press, New Delhi.	
52.	Aerial Photography and Image Interpretation for Resource Management.	Paine, D.P.	John Wiley and Sons.	
53.	The Ecology of Wildlife Diseases.	Peter J. Hudson, Annapaola Rizzoli, Bryan T. Grenfell, Hans Heestrbeek and Andy P. Dobson	Oxford University Press, Oxford	2002
54.	Book of Indian Animals.	Prater, S.H.	Bombay Natural History Society, Mumbai.	
55.	Essentials of Conservation Biology	Primack, R.B.	Sinauer Associates, Inc. Sunderland, MA	1998



<b>Sr. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>	<b>Year</b>
56.	Principles and Procedures of Statistics (with special reference to Biological Sciences)	R.G. Steel and J.H. Torrie		
57.	A Text Book of Agricultural Statistics	R.Rangaswamy		
58.	Birds of Wetlands and Grasslands	Rahmani, Asad R. & Ugra, Gayatri	Bombay Natural History Society, Mumbai.	
59.	A Handbook of the Management of Animals in Captivity.	Ram Bramha Sanyal		1995
60.	Hunting and Shooting	Rangarajan, Mahesh	The Oxford Anthology of Indian Wildlife.	1999
61.	The ecology and evolution of animal behavior	Robert, A.W	Good Year Pub. Co. California, U.S.A.	1979
62.	Wildlife management.	Robert, G.H.	W.H. Freeman and Co., San Francisco, U.S.A.	1978
63.	The Care and Feeding of Infant Orphaned Wild Birds.	S.M.L. Grose.	IBD, Dehradun	
64.	Remote Sensing: Principles and Applications	Sabbins, F.E., Freeman		
65.	Manual of wildlife techniques for India.	Sale, J.B. and Berkmuller, K.	WII, FAO, Dehra Dun, India	1988
66.	A Handbook of the Management of Animals in Captivity.	Sanyal, Ram Bramha		1995
67.	Indian Wildlife Resources Ecology and Development	Sharma, B.D	Daya Publishing House, Delhi	1999
68.	A New Approach to Linear Programming	Sharma, S.D.	Kedarnath, Ramnath and Co. Meerut	1975
69.	Wildlife Ecology, Conservation and Management	Sinclair, Anthony R.E., Fryxell, John M. and Caughly, Graeme	Blackwell Publishing, U.S.A.	2006
70.	Economics of PA's and its effect on biodiversity.	Singh and Vijaykumar.	APH Publishing Corporation, New Delhi.	2001
71.	Text Book of Wildlife Management.	Singh, S.K.	IBDC, Lucknow.	2005

<b>Sr. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>	<b>Year</b>
72.	Conserving India's Natural Heritage	Singh, Samar	Natraj Publication, Dehra Dun.	1987
73.	Wildlife and Forest Conservation	Sinha, P.C.	Anmol Publishing Pvt. Ltd., New Delhi.	1998
74.	Mammals Skin.	Sokolov, V.E.	IBD, Dehradun.	1982
75.	Wildlife research and management. Asian and American Approaches	Stephen, H.B. and V.B. Saharia	Oxford University Press, Delhi	1995
76.	Zoogeography of India and Asia.	Tiwari, S.K.	CBS Publisher and Distributors, New Delhi.	
77.	Natural Resource and Environmental Economics	Tony Prato,	Iowa State University Press	1998
78.	Environmental and social impact assessment	Vanclay F. and Bronstein, D.A.	John Wiley & Sons, New York.	1995
79.	Guide for Planning Wildlife Management in Protected Areas and Managed Landscapes	Vishwas Sawarkar	Natraj Publisher. Dehradun	
80.	Experimental Designs	W.G. Cochran and G.M.Cox		
81.	Parasitic Diseases of Wild Animals.	W.M. Samuel, M.J. Pybus and A.A. Kocan		2005
82.	Vertebrate Zoology and Evolution.	Yadav, B.N.	IBD, Dehradun.	2000