St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC "A" Grade

Course structure and syllabus of

B.Sc.

ZOOLOGY

CHOICE BASED CREDIT SYSTEM

(2021 – 22 ONWARDS)

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(ಸ್ವಾಯತ್ತ)

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Re-accredited by NAAC with 'A' Grade - CGPA 3.62
Recognised by UGC as "College with Potential for Excellence"
College with 'STAR STATUS' conferred by DBT, Government of India
3rd Rank in "Swacch Campus" Scheme, by MHRD, Govt. of India

Date: 16-02-2021

NOTIFICATION

Sub: Syllabus of **B.Sc. Zoology** under Choice Based Credit System.

Ref: 1. Decision of the Academic Council meeting held on 12-12-2020 vide Agenda No: 14(2021-22)
2. Office Notification dated 16-02-2021

Pursuant to the above, the Syllabus of **B.Sc. Zoology** under Choice Based Credit System which was approved by the Academic Council at its meeting held on 12-12-2020 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL **REGISTRAR**

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library

BOARD OF STUDIES IN ZOOLOGY

1. Chairperson : Dr. Hemachandra, Associate Professor
2. Members from the department : Mr. Hariprasad Shetty, Assistant Professor.
   Ms.Karen Trescilla D'Souza, Assistant Professor.
   Mr.Kiran Vati K, Lecturer.
   Dr.Rachana B, Assistant Professor.
   Mr. Glavin Thomas Rodrigues, Lecturer.
   Ms. Reena Kishore, Student Representative.
3. External Members:

Subject Experts

Dr Siby Philip
Head of Zoology
Nirmalagiri College
Kuthuparamba, Kannur, Kerala, 670701.

Dr. Shamprasad Varija Raghu
Ramalingaswami Fellow/Associate Professor,
Dept of Applied Zoology, Mangalore University.

Vice-Chancellor Nominee

Dr. Nagarathna K A
Department of Zoology
Mangalore University College, Mangaluru

Representative from Industry / Corporate Sector/ Allied Area

Conrad Charles I P
Atlantis Aquaria, # 16-7-448
Muthu's Compound
Balmatta
Mangaluru-575002

Meritorious Alumnus

Dr Sudeep Ghate
Post Doc fellow, NUCSER, Paneer
Deralkatte.

Preamble

The dimension of biology is fast growing with more and more emphasis being given to cell biology, molecular biology, genetics, biochemistry, biotechnology, modern technique and applied aspects. It is, therefore, important that the students of biological sciences of degree classes need to be fully informed of the contemporary trends in the various fields of biology such as environment, agriculture, medicine, veterinary science and industrial applications. Many Universities in India have already included some relevant applied topics in their undergraduate syllabi. However, the importance of basic Zoology cannot be ignored. Most of the teachers and researchers rightly feel the need for a strong base in general aspects of Zoology as a prerequisite for all the fields of specialization. Therefore, teaching basic science subjects along with modern advance subjects; in pursuit of quality improvement will always remain as one of the main objectives. To achieve this, the Department of Zoology, St Aloysius College has designed the curriculum in Zoology for undergraduate students as per the guidelines of UGC which is on par with the changing educational scenario.

Vision of the Department

Providing a platform for students to imbibe scientific temper and enabling them to acquire global competencies driven by service to society.

Mission of the Department

- To empower students to address the issues and concerns of the society by applying the tools in Zoology.
- To provide opportunities for seriously engaging in academic and research activities like seminars, workshops, conferences and symposia to keep pace with the emerging fields in Zoology.
- To foster a culture of innovation and research among students.
- Motivate students to engage in individual and group projects.

Course Outcome

- Create awareness of various branches in zoology to help the student choose his/ her career in higher education.
- Understand and appreciate the diversity and complexity of all life forms.
- Familiarize with recent advances in various fields of Applied Zoology.
- To get acquainted with the recent trends in research and provide opportunities to develop basic research skills and take up independent research work to develop a scientific temper.
- Emphasize the need for protection of environment by imparting knowledge of environmental degradation and its impact on living organisms.
- Acquire knowledge of the local faunal diversity and understand the importance of its conservation.
- Apply the acquired knowledge and skills to promote self-employment.

PROGRAME OUTCOMES (PO)	
PO.1.	Create awareness of various branches in zoology to help the student choose his/ her career in higher education.
PO.2.	Understand and appreciate the diversity and complexity of all life forms.
PO.3.	Familiarize with recent advances in various fields of Applied Zoology.
PO.4.	To get acquainted with the recent trends in research and provide opportunities to develop basic research skills and take up independent research work to develop a scientific temper.
PO.5.	Emphasize the need for protection of environment by imparting knowledge of environmental degradation and its impact on living organisms.
PO.6.	Acquire knowledge of the local faunal diversity and understand the importance of its conservation.
PO.7.	Apply the acquired knowledge and skills to promote self-employment.
PO.8.	Gain knowledge of communicable and non-communicable diseases to improve personal and public health.
PROGRAME SPECIFIC OUTCOMES (PSO)	
PSO.1·	Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, ecology and applied Zoology
PSO.2·	Analyse the relationships among animals and plants
PSO.3·	Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, Clinical science, tools and techniques of Zoology, Toxicology, Entomology, Biochemistry, Fish biology, Animal biotechnology, Toxicology and Immunology.
PSO.4·	Understand the applications of biological sciences in Apiculture, Aquaculture, Sericulture, Dairy, vermitechnology and Mictotomy
PSO.5·	Gains knowledge about biostatistics and handle the statistical softwares

Scheme of credit based semester system for B.Sc.

Optional subject: Zoology

I Semester

Paper	Instructions hours/ week		Duration of exam hours	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G 508.1 (Theory) Animal Diversity (Non-Chordata)	4	-	3	80	20	100	2
G 508.1P (Practical) Animal Diversity (Non-chordata)	-	3	3	40	10	50	1
G 508.1E (Open Elective) Aquarium Maintenance and Fish Breeding Techniques	**2**	**-**	**2**	**40**	**10**	**50**	**1**

II Semester

Paper	Instructions hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G 508.2 (Theory) Animal Diversity (Chordata)	4	-	3	80	20	100	2
G 508.2P (Practical) Animal Diversity (Chordata)	-	3	3	40	10	50	1
G 508.2E (Open Elective) Apiculture	**2**	**-**	**2**	**40**	**10**	**50**	**1**

III Semester

Paper	Instructions hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G508.3 (Theory): Cell and Molecular Biology, Immunology	4	-	3	80	20	100	2
G 508.3P (Practical) Cell and Molecular Biology, Immunology	-	3	3	40	10	50	1
G 508.3E (Open Elective) Health and Lifestyle Diseases	2	-	2	40	10	50	1

IV Semester

Paper	Instructions Hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G 508.4 (Theory) Biochemistry and Animal physiology	4	-	3	80	20	100	2
G 508.4P (Practical) Biochemistry and Animal physiology	-	3	3	40	10	50	1
G 508.4E (Open Elective) Nature and Wildlife Photography	2	-	2	40	10	50	1

V Semester

Paper	Instructions Hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G 508.5A (Theory) Histology, Reproductive and Developmental Biology	3	-	3	80	20	100	2
G 508.5B (Theory) Ecology, Biostatistics, Ethology and Wildlife Biology.	3	-	3	80	20	100	2
G 508.5P (Practical) Histology, Reproductive and Developmental Biology Ecology, Biostatistics, Ethology and Wildlife Biology	-	4	4	80	20	100	2

VI Semester

Paper	Instructions hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G508.6A (Theory) Genetics, Evolution and Palaeontology	3	-	3	80	20	100	2
G 508.6B (Theory) Applied Zoology, Parasitology, Toxicology and Cancer Biology	3	-	3	80	20	100	2
G 508.6P (Practical) PART A: Genetics, Evolution and Palaeontology Applied Zoology, Parasitology, Toxicology and Cancer Biology PART B: Project OR Additional Experiments	-	4	4	40 40	10 10	50 50	1 1

Broad outline of the syllabus
Subject: Zoology (Three major systems)

Year	Semester	Subject Code No	Paper
I year	1st semester	G 508.1 Theory	Animal diversity (Non- Chordata)
		G 508.1P Practical	Animal diversity (Non-Chordata)
	2nd Semester	G 508.2 Theory	Animal diversity (Chordata)
		G 508.2P Practical	Animal diversity (Chordata)
II year	3rd semester	G 508.3 Theory	Cell and Molecular Biology, Immunology
		G 508.3P Practical	Cell and Molecular Biology, Immunology
	4th semester	G 508.4 Theory	Biochemistry and Animal Physiology
		G 508.4P Practical	Biochemistry and Animal Physiology
IIIyear	5th Semester	G 508.5A Theory	Histology, Reproductive and Developmental Biology
		G 508.5B Theory	Ecology, Biostatistics, Ethology and Wildlife Biology
		G 508.5P Practical	Histology, Reproductive and Developmental Biology Ecology, Biostatistics, Ethology and Wildlife Biology
	6th semester	G 508.6A Theory	Genetics, Evolution and Palaeontology
		G 508.6B Theory	Applied Zoology, Parasitology, Toxicology and Cancer Biology
		G 508.6P Practical	Part A: Genetics, Evolution and Palaeontology Applied Zoology, Parasitology, Toxicology and Cancer Biology Part B: Project OR Additional Experiments

Broad outline of the CBCS syllabus

Year	Semester	Subject Code No	Paper
Iyear	1st semester	G 508.1E (Open Elective)	Aquarium maintenance and fish breeding techniques
Iyear	2nd semester	G 508.2E (Open Elective)	Apiculture
IIyear	3rd semester	G 508.3E (Open Elective)	Health and lifestyle diseases
IIyear	4th semester	G 508.4E (Open Elective)	Nature and Wildlife photography

B.Sc. I SEMESTER

G 508.1

ANIMAL DIVERSITY (NON - CHORDATA)

COURSE OUTCOMES (CO)	
CO1.	Understand animal systematics.
CO2.	Identify and classify invertebrate organisms to their respective phyla.
CO3.	Describe the general characters and classes of the organisms belonging to the invertebrate phyla.
CO4.	Familiarize with evolutionary relationships and basis of life processes in non-chordates.
CO 5.	Analyze the economic importance of invertebrate fauna.

Total hours 48

Learning outcomes

On successful completion of the course, the Student will be able to

1. Understand animal systematics.
2. Identify and classify invertebrate organisms to their respective phyla.
3. Describe the general characters and classes of the organisms belonging to the invertebrate phyla.
4. Familiarize with evolutionary relationships and basis of life processes in non-chordates.
5. Analyze the economic importance of invertebrate fauna.

Unit 1: Animal diversity, Protozoa and Porifera

1.1 Animal diversity **4hrs**

Principles of classification- Binomial nomenclature, ICZN, hierarchy, Fundamentals of animal classification - Grades of organization, animal body plans, symmetry, germ layers, metamerism, coelom. Biodiversity- Levels of Biodiversity- genetic, species and ecosystem level.

1.2 Protozoa **4hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology and life history of *Elphidium*. Economic importance of Protozoa.

1.3 Porifera **4hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology of *Sycon.* Histology of sponges, spicules, canal system in sponges. Economic importance of sponges.

Unit 2: Cnidaria, Ctenophora and Platyhelminthes

2.1 Cnidaria **4hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology of *Hydra*. Structure of cnidoblast. Polymorphism in *Physalia, Halistemma* and *Porpita.* Coral formation and types of coral reefs. Economic importance of coelenterates.

2.2 Ctenophora **1hr**

General characters and affinities of the phylum. External morphology *Pleurobranchia.*

2.3 Platyhelminthes **4hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology of *Taenia solium*, *Fasciola hepatica*, *Planaria* and parasitic adaptations of Platyhelminthes.

2.4 Nematoda **3hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology and parasitic adaptation of *Ascaris, Wuchereria, Enterobius, Ancyclostoma, Dracuncules.*

Unit 3: Annelida, Arthropoda and Onychophora

3.1 Annelida **4hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology and economic importance of *Hirudinaria* and *Pheretima*.

3.2 Arthropoda **6hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology of *Penaeus*(marine prawn). Beneficial and harmful insects. Mouthparts of insects (biting-chewing, piercing-sucking, siphoning and sponging).

3.3 Onychophora **2hrs**

General characters of the phylum, External morphology of Peripatus-affinities.

Phylogenetic significance.

Unit 4: Mollusca, Echinodermata and Hemichordata

4.1 Mollusca **4hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes giving suitable examples. External morphology of *Pila globosa*. Economic importance of molluscs.

4.2 Echinodermata **5hrs**

General characters of the phylum and classification up to classes, distinctive characters of classes with suitable examples. External morphology and water vascular system in *Asterias*. Larval forms of Echinodermata.

4.3 Hemichordata **3hrs**

General characters of the subphylum. External morphology of *Balanoglossus* and tornaria larva. Affinities of Hemichordata.

B. Sc. I SEMESTER

G 508.1P (Practical)

ANIMAL DIVERSITY (NON-CHORDATA)

3hrs/week

I. List of museum specimens and slides: Commonly available specimens cited in the list of examples are to be selected for practicals.

1. **Protozoa:** *Elphidium, Euglena, Plasmodium, Paramecium* and *Vorticella.*
2. **Porifera :** *Leucosolenia, Euplectella ,Euspongia* and Spicules,
3. **Cnidaria:** *Obelia, Physalia, Porpita, Aurelia, Adamsia* and *Fungia,*
4. **Platyhelminthes:** *Planaria, Fasciola hepatica* and *Taenia solium*
5. **Nematoda:** *Ascaris* (Male & female) and *Wuchereria bancrofti*
6. **Annelida:** *Neries, Aphrodite, Arenicola, Cheatopterus, Sabella, Pheretima* and *Hirudinaria.*
7. **Arthropoda:** *Penaeus, Carcinus, Lepas, Scolopendra, Limulus* and *Palamnaeus.* Permanent Slides of mouthparts of insects.
8. **Onychophora:** *Peripatus*
9. **Mollusca:** *Chiton, Dentalium, Cypraea, Xancus, Aplysia, Pila, Mytilus, Oyster, Nautilus, Sepia, Octopus.*
10. **Echinodermata:** *Asterias*, *Ophiothrix*, *Echinus*, *Antedon*, Bipinnaria larva and Pluteus larva.
11. **Hemichordata:** *Balanoglossus* and Tornaria larva

II. Temporary Mounting

1. **Earthworm:** Body setae
2. **Leech:** Jaw and salivary gland cells
3. **Prawn**: Appendages.
4. **Cockroach:** Mouthparts and leg

III. DISSECTIONS

(Demonstration, anatomical observation and comment – as per UGC guidelines)

1. **Leech:** Digestive and Reproductive system
2. **Cockroach:** Digestive and Nervous System

B.Sc. I SEMESTER
G 508.1P (Practical)
ANIMAL DIVERSITY (NON -CHORDATA)
SCHEME OF EXAMINATION

Time: 3hrs **Marks: 40**

1. Identify and comment on the dissection displayed with a neat labeled diagram. **08**
2. One temporary mounting **05**
3. Identify, classify and comment on specimens/slides A, B, C & D and draw labelled diagram. **4X4=16**
4. Identify and comment on insect mouthparts E and F **3x2=06**
5. Class record **05**

SCHEME OF VALUATION

1. Identification of different parts-03
   Labelled diagram-03
   Procedure-02
2. Preparation of mount-04
   Neatness-01
3. Identification and classification - 01
   Labelled diagram with description - 03
4. Identification-01
   Labelled diagram with description-02

References:

1. Adam Sedgwick - A Students Text book of Zoology, Low Price Publications, Delhi, Vol. I , II &Vol.III, 1990.
2. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. I(Invertebrata), Parts I & II. S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 991p.
3. Jordan, E.K. and P.S. Verma, 1993. Invertebrate Zoology, 12th Edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1050 pp.
4. Kotpal, R.L., 1988-1992. (All Series) Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, Aves - Rastogi Publications, Meerut - 250 002.
5. Parker and Haswell, 1964. Text Book of Zoology, Vol I (Invertebrata), A.Z.T, B.S. Publishers and Distributors, New Delhi - 110 051, 874 pp
6. Ismail, S.A., 1997. Vermicology: The Biology of Earthworm, Orient Longrnan, India, 92 pp.
7. Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. l065pp.
8. Hyman, L. H. – The Invertebrates – Vols.I to IV
9. M. Prakash& C. K. Arora – Laboratory Animals, AnmolPublicating, Ansari Road, NewDelhi, 1998.
10. L. A. Borradile and F.A. Potts - The Invertebrate - Cambridge University Press.
11. P.S. Dhami and J.K. Dhami - Invertebrate Zoology - R.Chand and Co.
12. T.C. Majupuria - Invertebrate Zoology
13. T. Jeffery Parker, William A. Haswell – A text book of Zoology, Low Price Publications, Delhi, Vol. I & II, 1990.

B.Sc. II SEMESTER

G 508.2

ANIMAL DIVERSITY (CHORDATA)

COURSE OUTCOMES (CO)	
CO1.	Understand animal systematics.
CO2.	Identify and classify vertebrate organisms to their respective phyla.
CO3.	Describe the characters, classification of vertebrates under different classes of phyla Protochordata up to Mammalia.
CO4.	Analyze his/her role in nature to protect, preserve and promote understanding of their surroundings by learning, observing various life forms.

Unit 1: Protochordata and Agnatha.

1.1 Protochordata 4hrs

General characters of chordates and classification up to subphylum Urochordata, Cephalochordata with distinctive characters giving suitable examples. External morphology of *Herdmania* and *Branchiostoma.* Retrogressive metamorphosis in Ascidians.

1.2 Vertebrata 3hrs

General characters of Vertebrata, classification up to classes with distinctive characters giving suitable examples.

1.3 Cyclostomata 5hrs

General characters. External morphology of *Petromyzon* **(**Lamprey) and *Myxine* (Hagfish). Differences between *Petromyzon* and *Myxine*. Structure of Ammocoetus larva and its metamorphosis.

Unit 2: Pisces and Amphibia

2.1 Pisces 6hrs

General characters of Pisces, Chondrichthyes and Osteichthyes- with examples. Differences between Chondrichthyes and Osteichthyes.External morphology of *Scoliodon* and *Mackeral.* Accessory respiratory organs of *Clarias*, *Anabas*, and *Sacchobranchus*.

2.2 Amphibia 6hrs

General Characters, classification up to orders with distinctive characters giving suitable examples. List of common local amphibians. External morphology and skeletal system of the frog.

Unit 3: Reptilia and Aves

3.1 Reptilia **7hrs**

General characters and classification up to orders (living orders only) with suitable examples. List of common local reptiles. External morphology of *Hemidactylus*. Indian snakes – venomous and non-venomous, dentition, venom apparatus in cobra and its mechanism. Venomous snake bite: Symptoms (cobra, krait and viper). Antivenom and first aid for snake bites.

3.2 Aves **5hrs**

General characters and classification. Distinctive features of Archaeornithes and Neornithes. Salient features of Palaeognathae, Impennae and Neognathae giving suitable examples. List of common local birds. External morphology of pigeon. Flight adaptations in birds.

Unit-4 Mammalia and Comparative anatomy **9hrs**

4.1 General characters and classification up to subclasses. Distinctive features of Prototheria and Metatheria with examples. Affinities of Prototheria.Distinctive features of Primata, Chiroptera, cetacea, Perissodactyla, Artiodactyla, carnivore and Rodentia with examples.

4.2 Comparative account on the evolution of heart and aortic arches in vertebrates **3hrs**

B.Sc. II SEMESTER

G 508.2P (Practical)

ANIMAL DIVERSITY (CHORDATA)

3hrs/week

I. LIST OF MUSEUM SPECIMENS AND SLIDES: Commonly available specimens cited in the list of examples are to be selected for practicals.

1. **Protochordata:** *Herdmania* and *Amphioxus*
2. **Cyclostomata:** *Petromyzon, Myxine* and Ammocoetus larva
3. **Chondrichthyes:** *Scoliodon, Narcine, Pristis* and *Trygon*
4. **Osteichthyes**(**Marine**): *Anguilla, Exocoetus, Hippocampus* and *Syngnathus*
5. **Osteichthyes**(**Freshwater**): *Anabas, Catla, Clarius* and *Labeo*
6. **Amphibia:** *Ichthyophis, Bufo, Rana, Rhacophorous, Ambystoma, Necturus* and Axolotl larva.
7. **Reptilia:** *Hemidactylus, Calotes, Varanus, Draco, Chameleon, Naja, Bungarus, Pit Viper, Eryxconicus* and *Viper russelli.*
8. **Aves:** Bulbul, Parakeet, Crow- pheasant, Grey heron, Common crow, House sparrow, Indian golden oriole, Indian pond Heron, Indian purple sunbird, Indian Robin.
9. **Mammals:** Hedgehog, Anteater, Slender Loris, Flying fox, Striped palm squirrel, House rat.

II. TEMPORARY MOUNTINGS:

1. **Shark:** Placoid scales and Ampullae of Lorenzini
2. **Freshwater fish:** Cycloid scales and Ctenoid scales

III. DISSECTIONS (demonstration, anatomical observation and comment – as per UGC guidelines)

1. **Shark:** Cranial nerves V, VII, IX and X
2. **Shark:** Afferent branchial system.
3. **Shark:** Brain.
4. **Mouse/Rat:** Digestive system and urinogenital systems

OSTEOLOGY (Frog skeleton): (Museum specimens only)

1. Atlas and Typical vertebrae.

2. VIII Vertebra, IX Vertebra and Urostyle

3. Pelvic and Pectoral girdle

B.Sc. II SEMESTER

G 508.2P (Practical)

ANIMAL DIVERSITY (CHORDATA)

SCHEME OF EXAMINATION

Time: 3hrs Max Marks: 40

1. Identify and comment on the dissection displayed with a neat labelled diagram **08**
2. One temporary mounting **05**
3. Identify, classify and comment on the following specimens A, B, C and D and draw labelled diagrams **4X4=16**
4. Identify with reasons and draw labeled diagrams of the items E and F (Frog vertebra + girdle) **3x2= 06**
5. Class record **05**

SCHEME OF VALUATION

1.	Identification of different parts	-	03
	Labelled diagram	-	03
	Procedure	-	02
2.	Preparation of mount	-	04
	Neatness	-	01
3.	Identification and classification	-	01
	Labelled diagram with description	-	03
4.	Identification	-	01
	Labelled diagram with description	-	02

References:

1. Adam Sedgwick - A Students Textbook of Zoology, Low Price Publications, Delhi, Vol. I , II &Vol.III, 1990.
2. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
3. Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.
4. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
5. K. PrabhakarAchar& K. GeethaNayak – Birds of Dakshina Kannada, Bhuvanendra Nature Club – India, 2000.
6. M. Prakash& C. K. Arora – Laboratory Animals, AnmolPublicating, Ansari Road, NewDelhi, 1998.
7. Nair &Achar – A manual of practical Zoology Vol.II (Chordata)
8. Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, jalandhar - 144 008, 942.
9. Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra - 282 003, 477 pp.
10. Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp
11. S. A. Hussain& K.P. Achar – Biodiversity of the Western Ghats. Complex of Karnataka, Biodiversity Initiative Trust, Mangalore, 1999.
12. T. Jeffery Parker, William A. Haswell – A textbook of Zoology, Low Price Publications, Delhi, Vol. I & II, 1990.
13. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan& Co., New York, 587 pp.

B.Sc. III SEMESTER
G 508.3
CELL AND MOLECULAR BIOLOGY, IMMUNOLOGY

Total hrs 48

COURSE OUTCOMES (CO)	
CO1.	Understand the concepts of cell and its components, cell organelles, chromosomes, gene mutation and cell division.
CO2.	Understand the structures of nucleic acids and genes.
CO3.	Analyze the structure and purpose of basic components of prokaryotic and eukaryotic cells, especially the macromolecules, membranes and cell organelles.
CO4.	Identify the components of the immune system at the organ, cellular and molecular levels.
CO 5.	Describe the functioning and regulation of the immune system at different levels..
CO6.	Apply the understanding of the role of immune system in protection against diseases

Unit 1 Cell Biology

1.1 Overview of Cells **2hrs**

Cell and its components: Basic types of cells- prokaryotic and eukaryotic, nature and comparison, Cell theory.

1.2 Cell organelles **4hrs**

Structure and Functions- Plasma Membrane, Endoplasmic Reticulum, Golgi Apparatus, Lysosomes; Peroxisomes, Mitochondria, Cytoskeleton, Nucleus. Microbodies –(peroxisomes and glyoxisomes). Ribosomes. Proteosomes. Centrioles and basal bodies. Cytoskeleton- microtubules, microfilaments and intermediate filaments.

1.3 Chromosome **3hrs**

Chromatin - euchromatin and heterochromatin, nucleosomes, unit fibre, solenoid fibre, and higher order of organization, condensation and coiling. Chromosome - the structure of a typical metaphase chromosome; giant chromosomes- polytene chromosomes, lampbrush chromosomes; endomitosis.

1.4 Cell Division **3hrs**

Cell cycle- G1, S, G2, and M phases (mention G0, and D0 stages and their significances); amitosis Mitosis, Meiosis, Cell cycle and it's regulation

Unit 2 Cell & Molecular Biology

2.1 Introduction **2hrs**

Introduction - Identification of genetic material - Griffith's experiment, Avery, Mcarty and Mcleoad experiment.

2.2 Nucleic acid **4hrs**

Structure of DNA & RNA – Forms of DNA, Types of RNA. Watson and Crick model of DNA-Replication of DNA, Transcription and Translation.

2.2 Gene-Structure and function **2hrs**

Concept of gene, definition. Fine structure of gene - cistron, muton, recon, split genes and redundant DNA.

2.3 Genetic code and gene mutation **4hrs**

Genetic code - properties of genetic code - Wobble hypothesis. Operon concept - Lac Operon. Mutation-Types of mutation, Molecular basis of mutations.

Unit 3 Immunology

3.1 Immune system **3hrs**

Introduction to basic concepts in immunology, innate and acquired, passive and active.

3.2 Organs of immune system **3hrs**

Primary lymphoid organs (thymus, bone marrow, Bursa of Fabricius,). Secondary lymphoid organs (spleen, lymph nodes, Peyer's patches).

3.3 Cells of immune system **2hrs**

B cells, T cells, natural killer cells, neutrophils/ microphages, monocytes/ macrophages.

3.4 Specific body defense **4hrs**

Antigens- Basic properties of antigens, B and T cell epitopes, haptens and adjuvants.

Antibodies- Structure, classes and function of antibodies: monoclonal antibodies, antigen-antibody reactions.

Unit 4 Immunology

4.1 Immunodeficiency disorders **3hrs**

Introduction- types- Multiple Myeloma, Di-George syndrome, AIDS - Causative agent, mode of transmission, effects and preventive measures.

4.2 Autoimmunity **3hrs**

Introduction- Rheumatoid arthritis- **Systemic lupus erythematosus** (lupus)- Myastheniagravis.

4.3 Infections and Vaccines **4hrs**

Introduction - Types- bacterial- viral- toxoid- III generation vaccines (with special reference to Hepatitis, SARS, Ebola).

4.4 Tools and techniques **2hrs**

Electrophoresis, ELISA and RTPCR.

B.Sc. III SEMESTER

G 508.3P

CELL AND MOLECULAR BIOLOGY, IMMUNOLOGY

1. Principle of Light microscope, Phase Contrast Microscope and Electron microscope and principle of cell fixation, staining and fractionation.
2. Staining of prokaryotic and eukaryotic cells.
3. Micrometry: Measurement of cell dimension using micrometry.
4. Preparation of temporarily stained squash of onion root tip to study various stages of Mitosis.
5. Preparation of temporarily stained squash of grasshopper testes to study various stages of Meiosis.
6. Study the effect of Colchicine on Mitosis at 24 hrs and 48 hrs.
7. Preparation of temporary stained mount to show the presence of Barr body in human female blood cells/ cheek cells.
8. Study of Polytene chromosomes from *Drosophila* larvae.
9. Isolation of DNA/RNA from tissues/ yeast.
10. Study of Primary and secondary lymphoid organs.
11. Study of Immune cells.
12. Principle of electrophoresis, RTPCR, RIA and ELISA.

B.Sc. III SEMESTER

G 508.4P (Practical)

CELL AND MOLECULAR BIOLOGY, IMMUNOLOGY

SCHEME OF EXAMINATION

Time: 3hrs **Marks: 40**

1. Write the principle of Light microscope/ Phase Contrast Microscope/ Electron microscope/ Cell fixation/ Cell staining. **05**
2. Squash preparation of onion root tip/ Grasshopper testis / salivary gland chromosomes. **10**
3. Measurement of cell dimensions using micrometry/ temporary slide preparation of buccal mucosal cells/ Isolation of DNA **05**
4. Identification with reasons and labelled diagram A and B (stages of mitosis/ meiosis and immune cell/ immunological organ) **5x2=10**
5. Write the principle of electrophoresis /RTPCR /RIA / ELISA **05**
6. Class record. **05**

SCHEME OF VALUATION

1. Working principle – 05 marks
2. Squash preparation- 05 marks + Chromosomes-05 marks
3. Calculation- 04 marks + Result- 01 mark
   Preparation-04 marks + Neatness/ Result-01 mark
4. Identification with reasons-03 marks + Labelled diagram-02 marks
5. Working principle – 05 marks

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B.Sc. IV SEMESTER

G 508.4

BIOCHEMISTRY AND ANIMAL PHYSIOLOGY

Total hrs 48

COURSE OUTCOMES (CO)	
BIOCHEMISTRY AND ANIMAL PHYSIOLOGY G508.4	
CO1.	Understand the functions of important physiological systems including the digestive, circulatory, respiratory, excretory, reproductive and other metabolic systems.
CO2.	Correlate interactions between different organ systems.
CO3.	Analyze the consequences of malfunctioning of various metabolic systems.
CO4.	Understand the importance of various biomolecules.
CO 5.	Apply the knowledge attained in biochemistry and physiology to lead a healthy life.

UNIT-1 Biochemistry

1.1 Carbohydrates 3 hrs

Classification of carbohydrates-monosaccharides, Oligosaccharides and polysaccharides with suitable examples. Chain and ring structure of carbohydrates- Monosaccharides-glucose, fructose and galactose, Disaccharides- maltose, sucrose, lactose, Polysaccharides- starch, glycogen, cellulose, pectin and chitin. The biological significance of carbohydrates.

1.2 Proteins and Enzymes 6hrs

Amino acids and peptide bonds. Structure of protein: Primary, secondary, tertiary and quaternary structure of proteins. Classification of proteins- simple proteins, conjugated proteins and derived proteins with suitable examples. Biological importance of proteins.

Classification of enzymes (International Union of Biochemistry system). Mechanism of enzyme-catalyzed reaction, enzyme-substrate complex - specificity of enzymes. Factors affecting enzyme action. Mechanism of enzyme inhibition. A brief account of co-enzymes, co-factors and ions. Clinical importance of enzymes.

1.3 Lipids and Vitamins 3hrs

Classification of lipids- simple lipids-compound lipids-steroids with suitable examples. Triglycerides (TGs), Cholesterol, High-Density Lipid (HDL), Low-density Lipid (LDL), Very Low-Density Lipid (VLDL) and Total Lipid (TL). Biological importance of lipids. Fat-soluble vitamins (A, D, E, and K)-water soluble vitamins(B complex and vitamin C) - Functions and deficiency symptoms.

Unit 2: Animal physiology

2.1 Homeostasis 3hrs

Introduction, factors to maintain homeostasis, examples to illustrate homeostasis-blood glucose level. Water-glucose and salt balance

2.2 Digestion 4hrs

Mechanical digestion - chemical digestion.Digestion and absorption of proteins, carbohydrates and lipids. Hormonal control of digestion and absorption. Metabolic disorders - obesity, Kwashiorkor, Marasmus.

2.3 Respiration **5hrs**

External and internal respiration. Respiratory pigments- haemoglobin, haemocyanin and haemoerythrin. Physiology of respiration-exchange of gases-transport of oxygen -oxygen dissociation curves- Bohr's effect - transport of carbon dioxide – chloride shift, respiratory quotient. Respiratory disorders- asthma, pneumonia, occupation related lung diseases

Unit 3: Animal physiology (cont...)

3.1 Circulation **4hrs**

Types of circulation –types of heart in animals- Neurogenic and myogenic heart structure, function and regulation of the human heart. Origin and conduction of heartbeat- Cardiac cycle and ECG- Blood pressure. Composition of human blood-erythrocytes, leucocytes and blood platelets. Circulatory disorders-Anaemia, atherosclerosis, myocardial infarction.

3.2 Excretion **4hrs**

Excretion in aquatic and terrestrial animals - Ammonotelism with examples Ureotelism with examples -Uricotelism with examples.Physiology of urine formation in humans. Countercurrent multiplier system. Role of skin and liver. Excretory disorders- Renal calculi, uremia, gout, nephritis, renal failure-acute and chronic.

3.3 Muscle Contraction **4hrs**

Principle types of muscles – ultrastructure of striated muscles - contractile proteins -myosin, actin, tropomyosin, troponin and actinin. Mechanism of muscle contraction and relaxation - the sliding filament theory. Chemical changes during muscle contraction. Structure of neuromuscular junction. Muscular disorders-Muscle fatigue, muscle twitch, muscle tetanus, rigor mortis.

Unit 4 Animal Physiology (cont...)

4.1 Nervous Coordination **3hrs**

Types of nervous system, Types of neurons and their structure. Nature and conduction of nerve impulses, types of synapses and synaptic transmission, chemical transmitters in vertebrates, Neuro disorders- Parkinson's and Alzheimer's diseases.

4.2 Sense organs **4hrs**

Classification – Structure and functions- Statocysts- Acoustico-lateralis system. Ampullae of Lorenzini - Statoacousticorgans – Human ear. - Thermoreceptors - Organ of Jacobson - Photo and Chemoreceptors - Human eye.

4.3 Endocrine system **5hrs**

Human endocrine organs- Hormones of pituitary, thyroid, parathyroid, pancreas, adrenals and pineal glands -Hypothalamus and its stimulating and inhibitory effects. Hypo and hypersecretion of hormones and its effects

B.Sc. IV SEMESTER

G 508.4P

BIOCHEMISTRY AND ANIMAL PHYSIOLOGY

PRACTICALS

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions and effect of pH, temperature and inhibitors on the action of salivary amylase.
4. Estimation of total protein in given solutions by Lowry's method (To be performed in groups).
5. Qualitative tests for the detection of nitrogenous excretory wastes in the given samples.
6. Detection of abnormal excretory products.
7. Osmotic haemolysis in human blood cells.
8. Determination of ABO Blood group.
9. DC of WBCs of human blood using the human blood smear slides.
10. TC of WBCs of human blood.
11. TC of RBCs of human blood.
12. Estimation of haemoglobin using Sahli's haemoglobinometer
13. Preparation of haematin crystals
14. Recording of blood pressure using a sphygmomanometer
15. Determination of bleeding and clotting time of human blood.

B.Sc. IV SEMESTER

G 508.3P (Practical)

BIOCHEMISTRY AND ANIMAL PHYSIOLOGY

SCHEME OF EXAMINATION

Time: 3hrs **Marks: 40**

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids (By lots) **10**
   Qualitative estimation of nitrogenous waste/ abnormal constituents in urine sample (By lots) **08**
2. One major physiology experiment (Osmotic haemolysis, ABO Blood group, Total count- RBC, WBC, Differential count and Haemoglobin) -By lots **12**
3. One minor physiology experiment (Haematin crystals, Rh factor, Bleeding time, clotting time and measurement of blood pressure) -By lots **05**
4. Class records **05**

Total 40 marks

SCHEME OF VALUATION

1. Principle and Procedure-04, Experiment-04, Result-02
2. Principle and Procedure-02, Experiment-04, Result-02
3. Principle and Procedure-04, Experiment-06, Result-02
4. Principle and procedure - 02, Experiment-02, Result-01

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B.Sc. V SEMESTER
G 508.5A
Histology, Reproductive and Developmental Biology

Total hrs 40

COURSE OUTCOMES (CO)	
FIFTH SEMESTER **Histology, Reproductive and Developmental Biology** **G508.5A**	
CO1.	Identify the histological structures of various organs in relation with their functions.
CO2.	Understand the basic principles of microtomy and differential staining technique, before focusing on the structure and function of mammalian tissues, and the relationships between them;
CO3.	.Describe the structure, functions and biological principles of reproductive system
CO4.	Identify the developmental stages of chick , frog and human foetus.
CO 5.	Describe the key events in early and systematic embryological development.
CO6.	Apply the understanding of concepts in reproductive biology to life.

Unit 1: Histology

1.1. Microtomy

Histology- Histochemistry and Histopathology- Scope and applications **3 hrs**
Tissues and types - Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue.
Processing of tissue for histological sectioning. Paraffin box preparation and section cutting.

1.2. Differential staining techniques **2hrs**
Haematoxylin-eosin Stains of carbohydrates and proteins. Localization of proteins and carbohydrates (Ninhydrin -PAS reaction)

1.3. Study of histological structure of mammalian organs **4hrs**
Tongue, stomach, intestine, liver, kidney, ovary and testis.

1.4. Study of histological structure of endocrine organs **1hr**
Pancreas, thyroid and adrenal.

Unit 2: Reproductive Biology

2.1 Gametogenesis **4hrs**
Spermatogenesis - stages – Structure of human sperm. Oogenesis- Previtellogenesis, vitellogenesis.
Comparison of spermatogenesis and oogenesis. Sexual cycles: Estrous cycle in rodents and menstrual
cycle in humans

2.2 Variations in reproduction **3hrs**

Metagenesis- example Obelia. Parthenogenesis – Types of parthenogenesis – Natural (arrhenotoky,
thelytoky, cyclical) and artificial parthenogenesis. Significance of Parthenogenesis. Hermaphroditism.

2.3 Fertilization **2hrs**

Kinds of fertilization, Mechanism of fertilization. Monospermy and polyspermy-significance of fertilization.

2.4 Human reproductive system and Fertility control **5hrs**

Male and female reproductive systems, accessory sex organs, secondary sexual characters in humans. Gonadal hormones. Fertility control-need for fertility control- family planning method- temporary –permanent barriers-Intra Uterine Devices (IUDs)-hormonal and biological and terminal method tubectomy and vasectomy)

Unit 3 Developmental Biology

3.1 Introduction **1hr**

Historical review, Theories of development, Branches of embryology, Scope of embryology.

3.2 Early development of frog **3hrs**

Structure of ovum- cleavage-blastula-fate map - Gastrulation-mesogenesis- notogenesis and neurulation.

3.3 Early development of chick **4hrs**

Development of chick- Structure of hens egg- cleavage- blastula-fate map- gastrula- origin and structure of primitive streak- 18, 24, 48 hrs chick embryos.

3.4 Extra embryonic membranes **2hrs**

Development, structure and functions of the yolk sac, amnion, chorion and allantois.

Unit 4: Developmental Biology

4.1 Early development of human foetus **2hrs**

Structure of Graafian follicle-ovulation-fertilization- morula- blastocyst-implantation-gastrulation. Twins and multiple births.

4.2 Placenta **2hrs**

Yolk sac placenta- allantoic placenta- structure and functions of placenta.
Morphological and histological classification of placenta with examples.placental hormones.

4.3 Modern trends in reproduction **3hrs**

Cryopreservation- Gene bank, sperm bank. Manipulation of reproduction: artificial insemination, superovulation, *In vitro* fertilization-embryo splitting, animal cloning, and surrogate mother.

4. 4 Organizer phenomenon **3hrs**

Definition-Brachet's experiment, Experiment of Spemann and Mangold. Potencies of the dorsal lip of the blastopore. Induction of organizer, chemical nature, parts of the organizer. Theories of organizer phenomenon.

B.Sc. V SEMESTER
G 508.5P (Practicals)

HISTOLOGY, REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

2hrs/week

1. Study of the histological structure of following mammalian organs: Tongue, Stomach, Intestine, Ovary, Testis, Liver, Kidney, Pancreas, Thyroid and Adrenal.
2. Permanent histology slide preparation of T.S. of stomach, T.S. of Intestine, T.S. of liver, T.S. of testis, T.S. of ovary, T.S. of thyroid, and T.S. of adrenal of Mice.
3. Study of different types of eggs-Graafian follicle,frog's egg, hen's egg and insect egg. Study of Grashopper's , Frog's and mammalian sperms.
4. Stages of development of frog: The study of cleavage stages, blastula, gastrula and neurula (sections).
5. Various stages of tadpole.
6. Study of permanent slides of chick embryo: 18 hr, 24hrs, 36hrs and 48hrs (WM).
7. Study of permanent slides of chick embryos: T.S. of 18 hrs and 24 hrs.
8. Demonstration of development of chick embryo by window technique.
9. Study of permanent slides of any two types of placenta.
10. Study of estrous cycle in Mice.
11. Study of various stages of human foetus.
12. Identification of various family planning devices and their principles.
13. Awareness regarding population explosion

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B.Sc. V SEMESTER

G 508.5B

ECOLOGY, BIOSTATISTICS, ETHOLOGY AND WILDLIFE BIOLOGY

Total hrs 40

COURSE OUTCOMES (CO)	
ECOLOGY, BIOSTATISTICS, ETHOLOGY AND WILDLIFE BIOLOGY G508.5B	
CO1.	Understand the general principles of ecology as to how they related to terrestrial and aquatic (plant and animal) conservation and management.
CO2.	Identify species, characteristics, habitat requirements and behaviour of birds, fish, mammals etc.
CO3.	Apply knowledge to solve problems related to wildlife conservation and management.
CO4.	Acquire knowledge of how wildlife conservation and management relates to the economy and environment, both currently and in the future.
CO 5.	Use contemporary biostatistical tools and techniques for studying animal populations.
CO6.	Familiarize with a variety of laws and regulations that influence how natural resources are used and protected.

Unit 1: Ecology

1.1 Habitats **4hrs**

Aquatic habitats: Marine habitat - Zonation of the sea and ecological classification of marine biota, coastal ecology, estuarine ecology and mangroves. Freshwater habitat - lentic and lotic systems. Ecological classification of freshwater animals.

Terrestrial habitats - A brief account of biomes and terrestrial habitats

1.2 Ecosystem **3hrs**

Types of ecosystems with examples- natural ecosystem-man engineered ecosystem and micro-ecosystem. Biosphere and ecotone. Abiotic and Biotic factors, Food chains and energy flow

1.3 Population Ecology **3hrs**

Population density - natality and mortality - age distribution - population growth rate – population growth curves. Biotic potential - Allee's principle and Gause's principle. Population interactions- mutualism, parasitism, commensalism, predation and competition with relevant examples.

1.4 Community Ecology **3hrs**

Community structure - ecological determinants - ecological stratification- Ecological niches - ecological succession - climax community.

Unit 2 Biostatistics and Ethology

2.1 Biostatistics **2hrs**

Introduction- basic concepts-presentation of data- tabular and graphical representation -Graph-Bar diagram- Histogram-Frequency distribution.

2.2 Statistical methods **3hrs**

mean- median and mode. Standard deviation and standard error-Chi-square test with problems. Correlation, regression and ANOVA.

2.3. Statistical packages. **2hrs**

EXCEL, PAST, R and SPSS.

2.4 Animal behaviour **3hrs**

Definition and types of animal behaviour: Innate behaviour- taxes, reflexes, instincts and motivation; Learnt behaviour - habituation, imprinting, conditioned reflexes and insight learning. Biological clock-circadian rhythm.

Unit 3 Ethology

3.1 Communication in animals **2hrs**

Significance of communication-Components of communication- types with examples-tactile-visual-acoustic- chemical.

3.2 Social organization in animal **2hrs**

Social behaviour, society /colony – ants, monkey troops, elephants and lions.

3.3 Animal Migration **3hrs**

Migration in birds -causes, types of migration, origin of migration, preparation for migration, orientation and navigation. Advantages of migration - methods of studying bird migration (suitable examples are to be cited).

3.4 Nesting behavior and Parental Care **3hrs**

Nesting and parental care in birds (suitable examples are to be cited). Nesting behaviour in wasps. Parental care in fishes (*Hippocampus, Ophiocephalus, Tilapia*) and amphibians (*Rhachophorus, Salamander* and *Ichthyophis*).

Unit 4: Wildlife Biology

4.1 Zoogeography **2hrs**

Zoogeographical realms (with subdivision) of world, with climatic conditions and examples of characteristic fauna - a brief account of Wallace's line.

4.2 Distribution of Wildlife in India **3hrs**

The Himalayan ranges - The Peninsular Indian sub region - Deccan Plateau – the Western Ghats - Eastern hill chain - Aravali ranges - the Indian desert - tropical rain forests –wildlife in Andaman and Nicobar Islands. Biodiversity hotspot concept.

4.3 Wildlife conservation **3hrs**

Threats to wildlife- need for wildlife conservation- agencies engaged in wildlife conservation, Government and Non-Government organizations (NGOs).

4.4 Legal aspects of wildlife conservation **2hrs**

Wildlife (Protection) Act 1972. CITES, endangered species of India. Red data book. Biosphere reserves- Important National parks and Wildlife sanctuaries of India- projects for endangered species, project tiger- project elephant - project rhino.

B.Sc. V SEMESTER

G 508.5P (Practical)

ECOLOGY, BIOSTATISTICS, ETHOLOGY AND WILDLIFE BIOLOGY

2hrs/week

1. Study of tropical pond as an ecosystem - study of fauna and flora and interaction between the various constituents (notes and Figure).
2. Study of the aquarium as an ecosystem - Study of fauna and flora and interaction between the various constituents (notes and figures).
3. Biostatistics problems: Tabulation of data- Bar diagram-Histogram-Frequency distribution-mean, median and mode. Standard deviation-standard error-Chi-square test.
4. Parental care in fishes (Hippocampus) amphibians (*Rhacophorus, salamander, Hyla, Ichthyophis)*
5. Nesting in birds, different types of birds and wasp nests.
6. Feeding behaviour in ant.
7. Sexual behaviour in *Drosophila.*
8. Location of species of zoological interest on the Indian map and world map. Flightless birds, Tigers, Lions, Gorilla, Hippopotamus, Rhinoceros, Dipnoi and *Peripatus.*
9. Location of Tiger reserves, national parks, Biosphere reserves, Wildlife sanctuaries of India on map.
10. Study of threatened animals of India (by Pictures/charts) Tiger, Lion, One-horned Rhinoceros, Gaur, the Golden Languor, Lion Tailed Monkey, Musk Deer, Mouse Deer, Hangul (Kashmir stag), the Great Indian hornbill and Indian rock python.
11. Indian population data: based on census record and plotting a graph to show growth rate.
12. Study of community: By quadrate method to determine frequency, density and abundance of different species present in the community. Alpha diversity.
13. Study of biomass of consumers of a particular area by quadrate method - by determining the dry weight of living organisms - both animals and plants per unit area.
14. Preparation of a small inventory of important local invertebrate and vertebrate species, their common name, zoological name, vernacular name, salient features, classification etc.
15. Estimation of dissolved oxygen, carbon dioxide and hardness of water.
16. Study of ecological adaptations and morphological peculiarities - Hermit crab, Leaf insect, Stick-insect, Glowworm, Stink bug, Pufferfish, Angler fish, *Exocoetes*, *Phrynosoma*, *Draco, Chaemeleon* and Bat.
17. Study of biotic relationships - Leguminous plants, Termites, Liver fluke, Tapeworm, flying fish, Suckerfish, Insectivorous plants.

B.Sc. V SEMESTER

G 508.5P

HISTOLOGY, REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

ECOLOGY, ETHOLOGY, BIOSTATISTICS AND WILDLIFE BIOLOGY

SCHEME OF PRACTICAL EXAMINATION

Time: 4hrs **Marks: 80**

1. Stain, mount and identify with reasons the paraffin section provided. **10**
2. Identify and comment on A, B, C and D (From reproductive biology and developmental biology) **5x4= 20**
3. Biostatistics problem. **05**
4. Estimate the dissolved oxygen /CO_2 / hardness of water. **10**
5. Comment on aquarium/pond ecosystem. **08**
6. Comment on E and F (Ecological adaptation and Biotic relationship) **4x2= 08**
7. Comment on G (Nesting and Parental care) **04**
8. Mark any five locations on Indian map (National parks/ Wildlife sanctuaries/ Biosphere reserves/ Tiger reserves) **05**
9. Class Record. **10**

SCHEME OF VALUATION

1. Staining-03

   Mounting -03

   Identification with reasons -04
2. Identification-01

   Comment with labeled diagram-04 marks
3. Biostatistics problem-05 marks
4. Procedure+ principle- 04 , Calculation-04, Result-02
5. Comments with labelled diagram- 08 marks
6. Identification-01, Comment-03
7. Identification-01, Comment-03
8. Each location -01

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B.Sc. VI SEMESTER
G 508.6A
GENETICS, EVOLUTION AND PALEONTOLOGY

Total hrs 40

COURSE OUTCOMES (CO)	
SIX SEMESTER GENETICS, EVOLUTION AND PALEONTOLOGY G508.6A	
CO1.	Understand the fundamental concepts in Genetics.
CO2.	Explain Mendelian segregation, independent assortment and linkage
CO3.	Apply the principles of Mendelian inheritance and their extensions (one- and two-locus traits with two or more alleles, gene interactions, sex linkage and linkage) by analyzing inheritance patterns from crosses
CO4.	Describe the origin and genetic consequences of mutations and chromosomal abnormalities
CO 5.	Analyze the allele and genotypic frequencies within populations based on the Hardy-Weinberg law
CO6.	Familiarize with the basic processes in population genetics such as mutation, migration, natural selection, sexual selection and genetic drift.
CO7.	Understand the processes of speciation and extinction and the theories of origin if life.

Unit 1: Genetics

1.1 Introduction **3 hrs**

An overview on heredity, Pre-Mendelian experiments, Mendelism- Principles of inheritance-monohybrid and dihybrid crosses with examples. Genotype- phenotype concept, phenocopies, norm of reaction. Scope and significance of Genetics. *Drosophila* as a genetic model.

1.2 Interaction of Genes (Modified genetic ratios) **3 hrs**

Supplementary factors - Comb pattern in fowls (9:3:3:1), Complementary factors (9:7), Dominant epistasis – Plumage colour in Leghorn and Wyandotte (12:3:1), Recessive epistasis- coat colour in mice (9:3:4), Duplicate genes-15:1, Lethal genes- mice coat colour (2:1) (Yellow mice), Lethal alleles in human beings.

1.3 Multiple Alleles, Polygenic inheritance & Pleotropism **4 hrs**

Genetics of ABO blood groups in humans- Rh factor- erythroblastosisfoetalis, application of blood typing in medical and legal fields. Inheritance of coat color in rabbit - Polygenic inheritance in man- Skin color and eye color. Pleotropism in Drosophila-Eye colour pigments.

Unit 2: Linkage and Mapping of chromosomes **2 hrs**

2.1. Linkage and crossing over-

Complete and partial linkage. Construction of linkage maps in *Drosophila*- two point cross, three point crosses. Chromosomal mapping in humans, somatic cell hybridization.

2.2 Sex determination and Sex-linked inheritance **4 hrs**

Types of sex chromosome -Chromosomal mechanism of sex determination. Genic balance theory, Gynandromorphs and intersexes. Sex determination in *Bonilia*. Sex-linked inheritance in *Drosophila.* Haemophilia and colour blindness in man. Y-linked genes, sex-limited and sex-influenced traits.

2.3 Human Genetics **4hrs**

Human karyotype, Idiogram, Chromosomal syndromes – Klinefelter's, Turner's, Down's, Edward's, and Cri-du-chat. Inborn errors of metabolism - Albinism –Phenylketonuria, Alkaptonuria, Sickle cell anemia, Thalassemia, Huntington's chorea. Genetic counseling, Pedigree analysis, Prenatal diagnosis-Amniocentesis, chorionic villus sampling.

Unit 3: Evolution

3.1 Origin of life **4hrs**

Theories of origin of life- (special creation- cosmozoic – abiogenesis –biogenesis- theory of Chemical evolution) - evidence from metabolism-biochemical pathways-Precambrian rocks.

3.2 Theories of Organic Evolution **3hrs**

Lamarckism and Neo-Lamarckism, Darwin-Wallace theory, Synthetic theory of Evolution- Neo-Darwinism- Hardy-Weinberg Equilibrium. Gene mutation, gene flow, genetic drift, natural selection and isolation.

3.3 Evidence of Organic Evolution **3 hrs**

Direct and Indirect evidence: Comparative morphology- adaptive radiation taking as Darwin finches, anatomy (homologous, analogous and vestigial organs), physiology and biochemistry-enzymes, hormones and excretory products, embryology.

Unit 4: Evolution and Palaeontology

4.1 Speciation **2hrs**

Concept of species and speciation- sympatric and allopatric speciation, Factors involved in the speciation-

Gradualism and punctuated equilibrium- Balanced, disruptive and directional selection.

4.2 Extinction **3hrs**

Extinction of species—types and causative factors- habitat destruction, predation, disease and competition- intra and interspecific competition- catastrophic events. Geologic time scale and mass extinction.

4.3 Paleontological evidence for evolutionary theories and Fossils **5 hrs**

Brief account of Dinosaurs and Archaeopteryx. Origin and evolution of man – Fossils : Definition-classification-body fossils-trace fossils-chemical fossils- types-fossilization- methods of preservation of fossils. The incompleteness of fossil record and dating of fossils.

B.Sc. VI SEMESTER

G 508.6P(Practical)

GENETICS, EVOLUTION AND PALEONTOLOGY

2hrs/week

1. Preparation of *Drosophila* culture media.
2. Phenotypic characters of Drosophila.
3. Life cycle of *Drosophila.*
4. Mutants of *Drosophila* (minimum 4 mutants).
5. Mounting of sex comb.
6. Karyotyping of human chromosomes.
7. Dermatoglyphics.
8. Study of homologous organs - fore limbs of frog and bird; mouth parts of cockroach, mosquito and butterfly. Serial homology in Crustacea (appendages).
9. Study of analogous organs - vertebrate and cephalopod eye, wing of bird andinsect.
10. Study of vestigial organs - appendix, coccyx and molar teethin man.
11. Study of models of Dinosaurs (*Tyrannosaurus, Brontosaurus, Stegosaurus* and Triceratops) and Study of Archaeopteryx.
12. Study of models of fossil man. (Any four available models).

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B.Sc. VI SEMESTER

G 508.6B

APPLIED ZOOLOGY, PARASITOLOGY, TOXICOLOGY AND CANCER BIOLOGY

Total hrs 40

COURSE OUTCOMES (CO)	
APPLIED ZOOLOGY, PARASITOLOGY, TOXICOLOGY AND CANCER BIOLOGY G508.6B	
CO1.	Identify and classify different species and breeds of cattle, poultry, silk moths, earthworms, honey bees, prawns, fishes and shellfishes.
CO2.	Understand the morphology, life cycle of different parasites.
CO3.	Explain the epidemiology, diagnosis and treatment of vector-borne diseases.
CO4.	Apply the knowledge in parasitology to prevent diseases.
CO 5.	Understand the concepts of Toxicology and cancer biology.
CO6.	Analyze the effect of carcinogens and toxins on living organisms.

Unit 1 Applied Zoology

1.1 Sericulture 3hrs

Introduction to sericulture. Morphology and life cycle of *Bombyx mori.* Silkworm rearing. Modern rearing technology, spinning. Non-mulberry silkworm. Pests of Silkworm, diseases and control measures.

1.2 Aquaculture 4hrs

Techniques of culturing fishes. Construction of aquaculture tanks, farm management and economics. Induced breeding and seed fish production. Transport of seed fish and brooding fish. Fish diseases and their control. Techniques of culturing shrimps and pearls.

1.3 Apiculture 3hrs

Introduction of apiculture; classification of honey bees, morphology and life history of honey bees. Social life in honey bees. Beekeeping and management.

Economic importance of honey and wax. Pests of honey bees, diseases and control measures.

Unit 2: Applied Zoology (cont……)

2.1 Poultry 3hrs

Economic importance of poultry. Housing management, Poultry for egg production and poultry for meat production, poultry manure. Poultry diseases prevention and control.

2.2 Dairy 3 hrs

Introduction to breeds of dairy animals (cattle, buffaloes and goats), Feeding and raising of different classes of dairy animals. Milk and its products. Biogas and manure. Dairy management.

2.3 Vermitechnology **4hrs**

Introduction to Vermitechnology, Morphology and life cycle of earthworms, Economic importance of earthworms. Ecological classification of earthworms (Epigeic, anisic, endogeic), Preparation of vermicompost from any organic waste material vermiwash, Packing, storage and marketing of vermicompost.

Unit 3: Parasitology

3.1 Introduction to Parasitology and common parasitic diseases **5hrs**

- Protozoan : Malaria, amoebiases, diarrhrea, giardiasis.
- Helminthic : Ascariasis, taeniasis and elephantiasis
- Bacterial : Typhoid and cholera
- Viral: Small pox, measles, chikunguniya, dengue and H1N1.
- Vectors of parasitic diseases.

3.2 Brief account of life history, mode of infection, transmission pathogenicity and control measures. **5hrs**

a. Protozoan- *Entamoeba, Giardia, Trichmonas, Plasmodium*-all species

b. Helminthes- *Ascaris, Taenia, Ancylostoma, Wuchereria.*

Unit 4: Toxicology and Cancer Biology

4.1 Toxicology **5hrs**

Introduction, Definition, subdivisions, Toxicological parameters- Acute and Chronic, toxicity, LD_{50}, LC_{50}. Factors- Route of administration, Host factors-Species, Age, Sex, Pesticides, Bioaccumulation, Biomagnifications, Animal toxins, Food additives. Impact of pesticide pollution on the human population.

4.2 Introduction to Cancer **5hrs**

Introduction, Types of cancer. Characteristics of the cancer cell. Carcinogens (physical, chemical and biological). Classification of human cancers. Characteristics of cancer cells, tumor angiogenesis. chromosomal aberration. Causes of cancers-chemical carcinogenesis, Radiation carcinogenesis-ionizing radiation, UV radiation. Oncogenes and Tumour suppressor genes, Strategies of cancer treatment.

B.Sc. VI SEMESTER

G 508.6P (Practical)

APPLIED ZOOLOGY, TOXICOLOGY, PARASITOLOGY AND CANCER BIOLOGY

2 hrs

1. Different casts of honey bees.
2. Commercially important inland and marine fishes (at least 10).
3. Edible prawns(at least 04)
4. Edible shellfishes (at least 05)
5. Fins in fishes.
6. External morphology and life cycle of *Bombyx mori.*
7. Animal products and secretions : Honey and bees wax, Pearl, molluscan shells, Feathers of birds, Milk and milk products, Egg and Fish products.
8. Slide of *Giardia, Trichomonas, Plasmodium*
9. Parasites: *Microfilaria, Ascaris, Taenia.*
10. Collection/ identification/ observation of at least one species of *Culex*, *Anopheles* and *Aedes*
11. Parasites of live stocks.
12. Determination of LC_{50} value for the selected pesticide using mosquitoes larvae.
13. Qualitative identification of pesticide by paper chromatography.
14. Study of characteristic features of cancerous cells.
15. Visit to Forensic Science laboratory and preparation of report.

References:

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2. Shukla G S and V B Upadhyay (2014) Applied And Economic Zoology, Rastogi Publications, Meerut, India.
3. A.S. Atwal (2001) World of the honey bee, Kalyani Publishers, Ludhiana
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5. Jagadish Prasad (2000) Poultry Production & Management, Kalyani Publishers, Ludiana.
6. Jagdish Prasad (2001) Animal Husbandary & Dairy Science, Kalyani Publishers, Ludiana.
7. D. P. Mathur & V. K. Gupta (1979) Management in small polutry farms; Abhinav Publications, New Delhi.
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B.Sc. VI SEMESTER

G 508.6P (Practical)

PART A :

GENETICS, EVOLUTION AND PALEONTOLOGY

APPLIED ZOOLOGY, TOXICOLOGY, PARASITOLOGY AND CANCER BIOLOGY

PART B: PROJECT/ ADDITIONAL PRACTICAL EXPERIMENTS

SCHEME OF PRACTICAL EXAM

NOTE:

- All Students will have regular practicals (Part A).
- Every student shall have 1 project in any one of the discipline for 50 Marks.
- Project topics can be given to the students in the beginning of V semester.
- Students who do not opt for a project (Part B) in a particular subject, along with regular practicals (Part A) will have additional experiments (Part B) for 50 marks.

PART A: Compulsory set of experiments: 50 marks

1.	Mount the sex comb of *Drosophila melanogaster* on a clean slide	**05**
2.	Comment on A and B (Drosophila mutant and Human Karyotype)	**2x3= 06**
3.	Comment on C , D and E (Homologous organs / Analogous organs/ vestigial organs/ Models of Dinosaurs/ Archaeopteryx model/ Models of Human fossil)	**3x3=09**
4.	Identify and comment on the pathogen F	**05**
5.	Write the economic importance of G (Animal products/ secretions)	**05**
6.	Class record	**10**

Total marks: 40 Marks
Internal Assessment: 10 Marks

SCHEME OF VALUATION

1. Preparation- 04, Neatness- 01 mark
2. Identification-01 mark, Comment-02 marks
3. Identification-01 mark, Diagram- 01mark, Comment-01 mark
4. Identification-01 mark, Labelled diagram-01 mark, Comment-03 marks
5. Economic importance-05 marks

PART B: Compulsory set of experiments for students without Zoology projects: 50 marks

1. Identify the given Fish species H using Taxonomic key (Freshwater/Marine) **10**
2. Identify and comment on the given Prawn species I (Freshwater/ Marine) **05**
3. Identify and comment on the given specimen J (Shellfish/ Castes of Honey bees) **05**
4. Identify and comment on the given Earthworm species K**.** **05**
5. Identify and comment on the given specimen L (Adult Mosquito/ Larva) **05**
6. Class record **05**
7. Viva Voce **05**

SCHEME OF VALUATION

1. Identification using key- key points carry 08 marks and the final result with the family or generic name 02 mark
2. Identification-02 mark, Comment-03 marks (No diagram is required)
3. Identification-02 mark, Comment-03 marks (No diagram is required)
4. Identification-02 mark, Comment-03 marks (No diagram is required)
5. Identification-02 mark, Comment-03 marks (No diagram is required)

PART B: Project OR Additional Experiments 50 Marks

Project (40+10=50 Marks)

Continuous Assessment=10 Marks

Report=30 Marks

Viva= 10 Marks

TOTAL=50 Marks

OR

Additional experiments (40+10=50 Marks)

Experimentation=20 Marks

Internal Assessment = 10 Marks

Record=10 marks

Viva=10 marks

CBCS G 508.1E (Open Elective)

Aquarium Maintenance and Fish Breeding Techniques

Total: 30hrs

COURSE OUTCOMES (CO)	
CO1.	Identify freshwater and marine ornamental fishes both indigenous and exotic.
CO2.	Identify invertebrates and aquatic plants that are popular in the aquarium industry.
CO3.	Design and set up an aquarium.
CO4.	Understand the process of management and maintenance of freshwater aquarium.
CO 5.	Follow biosecurity protocols and ensure safety and hygiene while handling freshwater fishes.
CO6.	Execute breeding of common live-bearing and egg-laying ornamental fishes.

Aquarium maintenance

1. History of aquarium keeping, global overview of aquarium/tropical fish industry. **3hrs**
2. Fish morphology and anatomy. Sexual reproduction: sexual dimorphism, oviparous and ovoviviparous fish, popular aquarium egg laying and live bearing fish with suitable examples. Behavioral patterns. **9hrs**
3. Aquatic plants: Introduction, plant varieties. **3hrs**
4. Aquarium: Fabrication and setting up of an aquarium, Filtration, introduction to freshwater ornamental fish, Aquarium care, common fish diseases with special reference to bacterial and viral pathogens**.** **6 hrs**
5. Marine aquaria: an overview, types of marine ornamental fish, marine invertebrates in aquaria. **6 hrs**

Breeding techniques

6. Introduction to breeding techniques: inbreeding, outbreeding, crossbreeding, hybrids. Hybrid vigour, heterosis, dominance and over dominance**.** **3 hrs**

References

1. Axelrod H. R. (1987) Complete Introduction to Breeding Aquarium Fishes, Tfh Pubns Inc
2. Greg Jennings (2018) 500 Freshwater Aquarium Fish: A Visual Reference to the Most Popular Species, Firefly Books, Canada.
3. Goodwin D. (2001) The aquarium fish handbook, Silverdale books. England
4. Hiscock P. (2003) Encyclopedia of Aquarium Plants, B.E.S. Publishing, USA.
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CBCS G 508.2E (Open Elective)

Apiculture

Total: 30hrs

COURSE OUTCOMES (CO)	
CO1.	Identify and describe the scientific basis of beekeeping.
CO2.	Understand the basic life cycle of the honeybee.
CO3.	Familiarize with beekeeping tools and equipment.
CO4.	Appreciate the importance of honey bees as beneficial insects involved in food production and in ecosystem sustainability.
CO 5.	Detect bee diseases and pests.
CO6.	Execute management practices involved in keeping honey bees healthy and productive for honey production and pollination.

Introduction to Apiculture:

1. History and scope of apiculture. **2hrs**
2. Classification of honey bees, different species of honey bees (*Apis dorsata*, *A. florae*, *A. cerana, A. mellifera*), morphological variation in four species of honey bees, morphology of *Apis mellifera*, mouthparts adaptation, stinging apparatus, bee venom **9hrs**
3. Colony organization and life cycle of honey bees. **2hrs**
4. Co-evolution of honey bee and floral design. **2hrs**

Bee keeping and management

1. Handling of a honey bee colony and maintenance **2hrs**
2. Equipments for bee keeping. Bee keeping and management. **3hrs**
3. Pests of honey bees, diseases and control measures. **3hrs**
4. Physical and chemical composition of honey, economic importance of honey and wax. **2hrs**
5. Hands on training of bee keeping. **5hrs**

References:

1. Abrol, D. P. (2010) Bee and Beekeeping in India 2nd edition, Kalyani Publishers.
2. Arumugam N, T Murugan, R Ram Prabhu J Johnson Rajeshwar (2015) Applied Zoology, Saras Publication,
3. Jaiswal, V (2014) Economic Zoology, Prentice Hall India Learning Private Limited.
4. Jayashree, K.V. (2014) Bee Keeping, edi 1, Saras Publication.
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6. Morrow, E. (2015) Beekeeping for Beginners: The Beginning Beekeepers Guide on Keeping Bees, Maintaining Hives and Harvesting Honey, Mihails Konoplovs, USA.
7. Rahman, A. (2017) Apiculture in India, ICAR, Govt. of India (Indian Council of Agricultural Research).
8. Sathe, T. V. (2007) Fundamental of Beekeeping, Daya Publishing House.
9. Snodgrass, R E (2016) The Anatomy of the Honey Bee, Home Farm Books.

CBCS G 508.3E (Open Elective)
Health and Lifestyle Diseases

Total: 30hrs

COURSE OUTCOMES (CO)	
CO1.	Understand the consequences of lifestyle on human health.
CO2.	Understand the importance of exercise in daily life.
CO3.	Identify the specific risk factors that are associated with cancer and coronary heart diseases.
CO4.	Analyze the differences between controllable and uncontrollable risk factors of lifestyle diseases.
CO 5.	Apply necessary changes in daily lifestyle to reduce the risk of lifestyle diseases.

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UNIT I : EXERCISE PHYSIOLOGY **10hrs**

Fuels for exercise and optimum nutrition for physical activity – Carbohydrates, lipids, Proteins - High Energy Phosphates Daily Caloric requirements of the body for various types of physical and mental activities.

Homeostasis- regulation of body temperature and- osmotic balance - Nature of the Control Systems – Negative and Positive Feedback systems.

Metabolism –Anabolism and catabolism Concepts of BMR with suitable examples.

Energy expenditure- Aerobic/Anaerobic ATP Production.- Exercise Metabolism - Energy Requirements at Rest and - Rest-to-Exercise Transitions.

UNIT II: NUTRITION AND HEALTH **10hrs**

Nutrition– healthy diets- Cereals, —Pulses, — Fruits and vegetables, —Milk & milk products, — Eggs,— Meat, -poultry and fish.

Health –-Physical and mental well-being, BMI.

Modern food habits and its impacts on health

UNIT III: LIFESTYLE DISEASES **10 hrs**

Modern lifestyle- stress and its management.-

Psychosomatic disorders and Life–style diseases: causes, symptoms, diagnosis, treatment and management of – Cardiovascular diseases (Atherosclerosis and Hypertension, Coronary artery disease, Cardiac arrest, Hemorrhage and stroke),—Diabetes mellitus,- Obesity and—Cancer.

References

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3. Tortora J. Gerard, Derrickson Bryan(2011),Principles of anatomy and physiology, John Wiley and sons,Inc,New Jersey.
4. Suresh R.(2012), Essentials of human physiology,Books and allied (P) Ltd,Kolkata.
5. Ratan Vidya(2004),Handbook of human physiology,7th edition,Jaypee brothers medical publishers (P) Ltd ,New Delhi.
6. Verma P.S.,Tyagi B.S., Agarwal V.K.(2015), Animal physiology,S.Chand and Company Pvt. Ltd.,New Delhi.

CBCS Paper IV

G 508.4E (Open Elective)

Nature and Wildlife Photography

Total: 30hrs

COURSE OUTCOMES (CO)	
CO1.	Recall the history and evolution of photography.
CO2.	Understand the basic concepts of photography.
CO3.	Identify the various parts of camera, DSLR or SLR
CO4.	Understand the concepts of ISO, shutter speed, aperture and their interconnection.
CO 5.	Apply the techniques of photography to capture nature and wildlife.
CO6.	Execute advanced skills in photography sucas autofocus, exposure, composition, post processing techniques using software.

Basic concepts of photography:

1. Introduction to Photography-History and Evolution of photography. **2hrs**
2. Types of photography **2hrs**
3. Triangle of photography- ISO, shutter speed and aperture **3hrs**
4. Lighting **1hrs**
5. Depth of field **2hrs**
6. Types of Camera- Point and shoot camera, bridge camera, SLR and DSLR **2hrs**
7. Choice of Camera and lenses for nature and wildlife photography **3hrs**

Advanced skills and techniques:

1. Autofocus and Manual focus **1hrs**
2. Exposure- Metering modes and their use **1hrs**
3. Use of flash in Photography **1hrs**
4. Other tools used in Photography **2hrs**
5. Composition- Rules of composition **1hrs**
6. Post processing techniques in Light room and Photoshop **3hrs**
7. Macro photography **1hrs**
8. Landscape photography **1hrs**

9. Bird Photography **2hrs**
10. Mammal Photography **1hrs**
11. Rules and Codes of ethical nature/wildlife Photography **1hrs**

References

1. Brenda Tharp (2010) Creative Nature & Outdoor Photography Revised Edition, Amphoto Books, pp. 160.
2. Bryan Peterson (2016) Understanding Exposure, Fourth edition, Amphoto books, pp. 176
3. Chris Weston, Nature Photography: Insider Secrets from the World's Top Digital Photography Professionals, Routledge, pp. 288.
4. Douglass Owen (2019) Park Ranger's Guide to Nature & Wildlife Photography, Amherst Media, pp.180.
5. Ian Farrell (2014). Complete guide to Digital photography, Quercus publishers, pp. 416.
6. Jack Ballard (2017) Wildlife Photography: Proven Techniques for Capturing Stunning Digital Images, Falcon guides, pp.264.
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Question Paper Pattern

Time : 3hours **Max. Marks :100**

Note:

1. **Answer any ten questions from Part –A -Assorted questions from all four units**
2. **Answer any EIGHT questions from Part- B- Assorted questions from all four units**
3. **Answer any four questions from Part- C -Assorted questions from all four units**

Part-A

I. Answer any 10 out of the following **2x10=20**

a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.

Part B

II. Answer any eight questions out of ten- Assorted questions from all four units

5x8=40

a.
b.
c.
d.
e.
f.
g.
h.
i.
j.

Part- C

III. Answer any four questions out of six -Assorted questions from all four units

4 x 5=20

a.
b.
c.
d.
e.
f.

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