St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC "A" Grade

Course structure and syllabus of

B.Sc.

ZOOLOGY

CHOICE BASED CREDIT SYSTEM

(2019 – 20 ONWARDS)

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ªÀÄAUÀ¼ÀÆgÀÄ- 575 003

ST ALOYSIUS COLLEGE
(Autonomous)
P.B.No.720
MANGALURU- 575 003, INDIA
Phone:+91-0824 2449700,2449701
Fax: 0824-2449705
Email: principal_sac@yahoo.com
principal@staloysius.edu.in
Website: www.staloysius.edu.in

Re-accredited by NAAC with 'A' Grade - CGPA 3.62
Ranked 94 in College Category by NIRF, MHRD, Government of India
Recognised by UGC as "College with Potential for Excellence"
College with 'STAR STATUS' conferred by DBT, Government of India

No: SAC 40/Syllabus 2019-20 Date: .. – 05 - 2019

NOTIFICATION

Sub: Syllabus of **B.Sc. ZOOLOGY** Under Choice Based Credit System.

Ref: 1. Academic Council decision dated 02-05-2019
2. Office Notification dated ..-05-2019

Pursuant to the Notification cited under reference (2) above, the Syllabus of **B.Sc. ZOOLOGY** is hereby notified for implementation with effect from the academic year 2019-20.

PRINCIPAL **REGISTRAR**

To:

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

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 are 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, 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.

Objectives

- The main aim of present syllabus is to include recent advances in the field of Molecular Biology, Biological Chemistry, Cytology, Wildlife Biology etc. which is the need of the day.
- In the curriculum emphasis is given for the protection of our environment by imparting knowledge of environmental degradation and its harmful effects.
- To acquire knowledge of faunal diversity of the region and importance of its conservation.
- To provide opportunities to take up independent research work, encourage collection of data, analysis, interpretation and report writing. This enables them to develop a scientific temper.
- To provide opportunities to learn skills in basic research techniques and involve stakeholders in extension activities.
- To train the students to apply their knowledge and skills to make them self employable.

Vision of the Department

- To provide ample opportunity the students of Zoology for developing scientific temper.
- To enable them to acquire skills related to various facets of zoological sciences, thereby improving their academic qualities.
- To get trained to tackle the problems and issues of the society with fortitude.

Scheme of CBCS 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		
G 508.3(Theory) Comparative Anatomy and Animal Physiology	4	-	3	80	20	100	2
G 508.3P (Practical) Comparative Anatomy and Animal Physiology	-	3	3	40	10	50	1
G 508.3E(Open Elective) Physiology and yoga	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) Cell &Molecular Biology and Genetics	4	-	3	80	20	100	2
G 508.4P (Practical) Cell &Molecular Biology and Genetics	-	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

Paper	Instructions hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G 508.5B (Theory) Environmental Biology , Biostatistics and Wildlife Biology	3	-	3	80	20	100	2
G 508.5P (Practical) Histology, Reproductive and Developmental Biology Environmental Biology, Biostatistics 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) Immunology , Medical Zoology, Toxicology and Economic Zoology	3	-	3	80	20	100	2

Paper	Instructions hours/ week		Duration of exam hour	Marks		Total Marks	Credits
	Theory	Practical		Exam	IA		
G 508.6B (Theory) Ethology, Evolution and Palaeontology	3	-	3	80	20	100	2
G 508.6P (Practical) PART A: Immunology , Medical Zoology, Toxicology and Economic Zoology Ethology, Evolution and Palaeontology 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)
		G 508.1E Open Elective	Aquarium maintenance and fish breeding techniques
	2nd Semester	G 508.2 Theory	Animal diversity (Chordata)
		G 508.2P Practical	Animal diversity (Chordata)
		G 508.2E Open Elective	Apiculture
II year	3rd semester	G 508.3 Theory	Comparative Anatomy and Animal Physiology
		G 508.3P Practical	Comparative Anatomy and Animal Physiology
		G 508.3E Open Elective	Physiology and yoga
	4th semester	G 508.4 Theory	Cell &Molecular Biology and Genetics
		G 508.4P Practical	Cell &Molecular Biology and Genetics
		G 508.4E Open Elective	Nature and Wildlife photography
III year	5th Semester	G 508.5A Theory	Histology , Reproductive and Developmental Biology
		G 508.5B Theory	Environmental Biology, Biostatistics and Wildlife Biology
		G 508.5P Practical	Histology ,Reproductive and Developmental Biology Environmental Biology , Biostatistics and Wildlife biology
	6th semester	G 508.6A Theory	Immunology , Medical Zoology, Toxicology and Economic Zoology
		G 508.6B Theory	Ethology, Evolution and Palaeontology
		G 508.6P Practical	Part A: Immunology , Medical Zoology, Toxicology And Economic Zoology Ethology, Evolution and Palaeontology Part B: Project OR Additional Experiments

B.Sc. I SEMESTER

G 508.1 ANIMAL DIVERSITY (NON - CHORDATA)

Total hours 48

Unit 1: Animal diversity, Protozoa and Porifera

1.1 Animal diversity **4hrs**

Principles of classification- Binomial nomenclature, hierarchy. 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: Coelenterata, Ctenophora and Platyhelminthes

2.1 Coelenterata **4hrs**

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

2.4 Nemathelminthes **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 upto 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). Economic importance of beneficial and harmful insects. Mouth parts of insects (biting-chewing, piercing-sucking, siphoning and sponging).

3.3 Onychophora **2hrs**

External morphology of *Peripatus*- affinities . Phylogenetic significance.

Unit 4: Mollusca, Echinodermata and Hemichordata

4.1 Mollusca **4hrs**

General characters of the phylum and classification upto 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 upto 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. **Coelenterates :** *Obelia, Physalia, Porpita, Aurelia, Adamsia* and *Fungia,*
4. **Platyhelminthes :** *Planaria, Fasciola hepatica* and *Taenia solium*
5. **Nemathelminthes :** *Ascaris* (Male & female) and *Wuchereria bancrofti*
6. **Annelida :** *Neries, Aphrodite, Arenicola, Cheatopterus, Sabella Pheretima* and *Hirudinaria.*
7. **Arthropoda :** *Penaeus, Carcinus, , Lepas, Scolopendra, Limulus, Palamnaeus* and *Peripatus. Permanent Slides of mouthparts of insects.*
8. **Mollusca :** *Chiton, Dentalium, Cypraea, Xancus, Aplysia, Pila, Mytilus, Oyster, Nautilus, Sepia, Octopus.*
9. **Echinodermata :** *Asterias*, *Ophiothrix*, *Echinus*, *Antedon*, Bipinnaria larva and Pluteus larva.
10. **Hemichordata :** *Balanoglossus* and Tornaria larva

II. Temporary Mounting

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

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, Anmol Publicating, 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. 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 labelled 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

CBCS Paper I

Aquarium maintenance and fish breeding techniques

Total: 30 hrs

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. **6hrs**

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, T.F.H. Publications. United States.
2. Goodwin, D. (2001) The aquarium fish handbook, Silverdale books. England.
3. Hiscock,P. (2003) Encyclopedia of aquarium plants, B.E.S. Publishing, USA.
4. Hargreaves, V. (2007) The complete book of the freshwater aquarium: A comprehensive reference guide to more than 600 freshwater fish and plants, Thunder Bay Press. California.
5. Jennings, G. (2018) 500 Freshwater aquarium fish: A visual reference to the most popular species, Firefly books, Canada.
6. Kumar, S. and Tembhre, M. (2010) Fish and fisheries, New central book agency (P) Ltd. West Bengal.
7. Mukherjee, H. S., Nanware,S. N. and Jagtap, S. S. (2009) Practical manual of pisciculture and aquarium keeping, Daya Publishing House, New Delhi

B.Sc. II SEMESTER
G 508.2 ANIMAL DIVERSITY (CHORDATA)
Total hrs 48

Unit 1: Protochordata and Agnatha.

1.1 Protochordata **4hrs**

General characters of chordates and classification upto 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 upto classes with distinctive characters giving suitable examples.

1.3 Cyclostomata **5hrs**

General characters. External morphology of *Petromyzon* **(**Lamprey) and *Myxine* (Hag fish). 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 upto orders with distinctive characters giving suitable examples. List of common local amphibians. External morphology and skeletal system of frog.

Unit 3: Reptilia and Aves

3.1 Reptilia **7hrs**

General characters and classification upto orders (living orders only) with suitable examples. List of common local reptiles. External morphology of *Hemidactylus*. Indian snakes – poisonous and non poisonous, poison apparatus in cobra and its working mechanism.Snake bite: Symptoms of bites of various venomous snakes like cobra, krait and viper. Antivenoms 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 **9hrs**

4.1 General characters and classification upto subclasses. Distinctive features of prototheria and metatheria with examples. Affinities of prototheria. Distinctive features of primata, chiroptera, cetacea, perissodactyla, artiodactyla, carnivora and rodentia with examples.

4.2 External morphology, digestive and reproductive systems of rat. **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, Eryx conicus* and *Viper russelli.*
8. **Aves :** Bulbul, Parakeet, Crow- pheasant, Grey heron, Common crow, House sparrow, Indian golden oriole, Indian pond Heron, Indian purple sun bird, Indian Robin.
9. **Mammals :** Hedgehog, Ant eater, 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

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. 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. Prabhakar Achar & K. Geetha Nayak – Birds of Dakshina Kannada, Bhuvanendra Nature Club – India, 2000.
6. M. Prakash & C. K. Arora – Laboratory Animals, Anmol Publicating, 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 text book 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. 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 labelled 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

CBCS Paper II
Apiculture

Total: 30hrs

Introduction to Apiculture

1. History and scope of apiculture in India with special reference to Karnataka. **2hrs**
2. Taxonomic classification of honey bees. Morphological variation in *Apisdorsata, A. florae, A. cerana, A. mellifera*. Mouthparts, adaptation, stinging apparatus, bee wax, bee venom. **9hrs**
3. Social structure and colony organization in honey bees. Life cycle of honey bees. **2hrs**
4. Co-evolution of honey bee and floral design. **2hrs**

Bee keeping and management

5. Handling of a honey bee colony and maintenance **2hrs**
6. Equipment and management of bee keeping. **3hrs**
7. Physical properties and chemical composition of honey, economic importance of honey, wax and venom. **3hrs**
8. Pests, parasites and diseases of honey bees and their control **2hrs**
9. Hands on training of bee keeping. **5hrs**

References

1. Abrol, D. P. (2010) Bee and beekeeping in India.2nd Edn, Kalyani Publishers. Kolkata.
2. Arumugam, N., Murugan,T., Ram Prabhu,R., Johnson, J. and Rajeshwar (2015) Applied Zoology, Saras Publication, Tamil Nadu.
3. Jaiswal, V. (2014) Economic Zoology, Prentice Hall India Learning Private Limited. New Delhi.
4. Jayashree, K. V. (2014) Bee Keeping, 1st Edn. Saras Publications.Tamil Nadu.
5. Mishra, R. (2002) Perspectives in Indian Apiculture.Anmol Publisher. New Delhi.
6. Rahman, A. (2017) Apiculture in India, Indian Council of Agricultural Research (Govt. of India). Pusa, New Delhi.
7. Sathe, T. V. (2007) Fundamental of beekeeping, Daya Publishing House. New Delhi.
8. Snodgrass, R. E. (2016) The anatomy of the honey bee, Home Farm Books. United States.

B.Sc. III SEMESTER
G 508.3
COMPARATIVE ANATOMY AND ANIMAL PHYSIOLOGY
Total hrs 48

Unit 1: Comparative anatomy

1.1 Introduction to comparative anatomy-Symmetry and body plan in animals 3hrs

Introduction – Types - Radial-Biradial - Bilateral with examples

1.2 Comparative study of heart and aortic arches in vertebrate groups. 3hrs

Comparative account of heart and aortic arches in fishes, amphibians, reptiles, aves and mammals.

1.3 Comparative study of kidney in vertebrate groups 3hrs

Comparative account of Pro, meso and metanephric kidney.

1.4 Comparative study of brain in vertebrate groups 3hrs

Evolution and comparative account of brain in shark, frog, lizard, pigeon and rat.

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 hearts structure, function and regulation of human heart. Origin and conduction of heart beat- 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. Counter - current 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 – ultra structure 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 neuro muscular 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.

4.2 Sense organs **4hrs**

Classification of sense organs-Statocysts- Acoustico-lateralis system. Ampullae of Lorenzini - Statoacoustic organs – 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. III SEMESTER

G 508.3P (Practical)

COMPARATIVE ANATOMY AND ANIMAL PHYSIOLOGY

3hrs/week

Comparative anatomy :

1. Skin of fish, frog and rat.
2. Heart of shark, pigeon and rat.
3. Brain of shark, pigeon and rat.

Animal Physiology:

4. Qualitative tests for the detection of carbohydrates in the given sample- Molisch's test-Iodine test-Fehling's stest and picric acid test.
5. Qualitative tests for the detection of proteins in the given samples.
   Biuret, Ninhydrin, Millons, Xanthoprotiec test
6. Qualitative tests for the detection of lipids in the given samples.
   Acrolein, Leiberman, Burchard, Salkowasky test
7. Qualitative tests for the detection of nitrogenous excretory wastes in the given samples. For ammonia - Nessler's test, urea - Urease test, uric acid – Folin's test.
8. Detection of abnormal excretory products-detection of glucose, albumin creatinine and ketone bodies in human urine.
   Sugar-Benedict's test, albumin-Heller's ring test, Creatinine- Jaffe's test, ketone bodies-
9. Estimation of total protein (Biuret method) / blood glucose (Nelson-Somogyi) / glycogen / Triglycerides (Demonstration only).
10. Differential count (DC) of white blood corpuscles (WBCs) of human blood using the human blood smear slides.
11. Total count (TC) of white blood corpuscles (WBCs) of human blood.
12. Total count (TC) of red blood corpuscles (RBCs) of human blood.
13. Salivary amylase activity of human saliva.
14. Osmotic haemolysis in human blood cells.
15. Preparation of haematin crystal from human blood.
16. Paper chromatography.
17. Determination of bleeding and clotting time of human blood.
18. Preparation of human blood smear to study types of blood cells.
19. Estimation of Haemoglobin in blood sample.
20. Measurement of blood pressure using sphygmomanometer.

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B.Sc. III SEMESTER

G 508.3P (Practical)

COMPARATIVE ANATOMY AND ANIMAL PHYSIOLOGY

SCHEME OF EXAMINATION

Time: 3hrs **Marks: 40**

1.	Identify and give a comparative account of the given specimen (Heart / Brain / Skin)	**05**
2.	One major experiment (selected from Exp No. 08-16)	**15**
3.	Qualitative estimation of biological compounds (By lots, exp No. 04 - 07)	**10**
4.	One minor experiment (selected from Exp No. 17-20)	**05**
5.	Class records	**05**
Total marks		**40**

SCHEME OF VALUATION

1. Identification – 01 + Comparison =04
2. Principle and procedure-04+02, Experiment-07, Result-02
3. Procedure-04, Experiment-04, Result-02
4. Procedure-02, Experiment-02, Result-01

CBCS Paper III
Human physiology and Yoga
Total: 30hrs

Physiology

1. Digestive system 3 hrs

Anatomy of digestive system, ingestion, role of digestive secretions in digestion of food, absorption and assimilation, egestion.

2. Cardiovascular system 3 hrs

Anatomy of heart and blood vessels, control of cardiac cycle and circulation, cardiac output, blood pressure.

3.Respiratory System 3 hrs

Anatomy of respiratory system, mechanism of breathing, exchange and transport of gases, lung volumes and capacities, control of respiration.

4. Endocrine System 6 hrs

Endocrine glands- Pituitary gland, Pineal gland, thyroid, parathyroid, thymus, pancreas, adrenal, testis, ovary and their secretions and functions.

Basics of yogic science

5. Yoga 4 hrs

Meaning, definitions, concepts, aim, objects, misconcepts, historical development of Yogic science, Yogic texts and famous yogis (10), Ashtanga Yoga.

6. Hathayoga, Mudras, Meditation and Shuddhi 6 hrs

Introduction, destructive and constructives of yoga. Methods of Hathayoga practice, Shatkriyas, Asana, Pranayama. Bandha-Mudra, Meditation techniques, Duration, Time, Gradation, Benefits. Nadishuddhi, Varieties of Kumbhaka, Methods, Benefits, Hathashuddhi.

7. Health , Diet and management 5 hrs

Definitions of Health, Indian concepts, Modern concepts, WHO.Yogic diet – pathya, apathya, balanced diet, quantity, quality, eating time etc., Yogic management of health. Implementation of yoga practice in daily life (preparation, selection of Kriyas, Asanas, Pranayamas etc.,).

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Physiology

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Yoga

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B.Sc. IV SEMESTER

G 508.4 - CELL & MOLECULAR BIOLOGY AND GENETICS

Total hrs 48

Unit 1: Cell and molecular biology

1.1 Structure and function of Cell organelles **4hrs**

Cell theory, types of cells: structure of prokaryotic and eukaryotic cells – plant and animal cells. Structure and functions of mitochondria, golgi complex, endoplasmic reticulum, ribosomes, lysosomes, centrioles, nucleus. Plasma membrane -chemical composition, ultrastructure (fluid mosaic model)

1.2 Structure of chromosome, Mitosis and Meiosis **4hrs**

General and ultra structure of Chromosome-Mitosis- Cell cycle- Stages of mitosis –mechanism of mitotic division -Significance of mitosis - Mitotic inhibitors. Meiosis- Stages of I and II meiosis. Synaptonemal complex and Recombination. Mechanism of crossing over. Significance of meiosis.

1.3 Cancer Biology **4hrs**

Introduction, Types of cancer. Characteristics of cancer cell. Carcinogenic agents (physical, chemical and biological). Oncogenes and Tumour suppressor genes, Cancer immunology, Strategies of cancer treatment.

Unit 2: Cell and Molecular Biology (cont…)

2.1 Nucleic Acids **4hrs**

Introduction - Identification of genetic material - Griffith's experiment, Avery,Mcarty and Mcleoad experiment. Nucleic acids-structure of DNA & RNA – Forms of DNA, Types of RNA. Watson and Crick model of DNA- Replication of DNA.

2.2 Gene-Structure and function **4hrs**

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: Genetics

3.1 Introduction **4hrs**

Heredity and variation. Mendel's theories of inheritance. Mono and dihybrid crosses. Test cross and back cross, *Drosophila* in genetic studies.

3.2 Interaction of Genes (Modified genetic ratios) **4hrs**

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

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

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

Unit 4: Genetics (Cont...)

4.1 Linkage and Mapping of chromosomes **4hrs**

Linkage-definition, complete and partial linkage. Crossing over. Linkage in *Drosophila.*

Construction of linkage maps in *Drosophila* , double cross overs, three point crosses. Chromosomal mapping in humans, somatic cell hybridization.

4.2 Sex determination **2hrs**

Types of sex chromosome -Chromosomal mechanism of sex determination. Genic balance theory, Gynandromorphs and intersexes. Environmental and hormonal effects on the determination of sex in *Bonilia*

4.3 Sex linked inheritance **2hrs**

Sex linked inheritance in *Drosophila.* Haemophilia and colour blindness in man. Y-linked genes, sex limited and sex influenced traits.

4.4 Human Genetics **4hrs**

-Human karyotype, Ideogram, Pedigree analysis. Common human syndromes – Klinefelter's, Turner's, Down's, Edward's, and Cri-du-chat. -Inborn errors of metabolism - Albinism –Phenylketonuria, Alkaptonuria, Sickle cell anaemia, Thalassemia, Huntington's chorea. -Genetic counselling, Prenatal diagnosis-Amniocentesis, chorionic villus sampling. Human genome project.

B.Sc. IV SEMESTER
G 508.4P (Practical)

CELL & MOLECULAR BIOLOGY AND GENETICS
3hrs/week

CELL BIOLOGY AND MOLECULAR BIOLOGY

1. Squash preparation of onion root tip to study stages of mitosis.
2. Squash preparation of grasshopper testis to study stages of meiosis.
3. Display of Barr body from buccal smear of man.
4. Observation of cellular changes in different types of cancer (histology slides)
5. Micrometry- Measurement of cell dimension using micrometry.
6. Isolation of DNA/RNA from tissues/ yeast.
7. Quantitative estimation of DNA using spectrophotometer (Demonstration only).

GENETICS

1. Genetic problems : Monohybrid inheritance (4)
2. Genetic problems : Dihybrid inheritance (4)
3. Genetic problems : Multiple alleles - ABO blood group in humans (4).
4. Genetic problems : Sex-linked inheritance in *Drosophila* (2)
5. Genetic problems : Sex-linked inheritance in humans (2)
6. Calculation of allele frequency - ABO blood group in humans.
7. Preparation of *Drosophila* culture media.
8. Phenotypic characters of Drosophila.
9. Life cycle of *Drosophila.*
10. Mutants of *Drosophila* (minimum 4 mutants).
11. Mounting of sex comb.
12. Preparation of salivary gland chromosomes (Polytene giant chromosomes)
13. Karyotyping of human chromosomes.
14. Dermatoglyphics.

References:

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B.Sc. IV SEMESTER

G 508.4P (Practical)

CELL & MOLECULAR BIOLOGY AND GENETICS

SCHEME OF EXAMINATION

Time: 3hrs **Marks: 40**

1. Squash preparation of onion root tip/ Grasshopper testis / salivary gland chromosomes. **10**

   OR

   Stain, mount and identify the histology slide provided. **10**

2. Measurement of cell dimensions using micrometry/ temporary slide preparation of buccal mucosal cells/ Mounting of sex comb **05**

3. Identification with reasons and labelled diagram A, B, C, D and E (slides of mitosis, meiosis, cancer and mutants) **5x3=15**

4. Genetic problem **05**

5. Class record. **05**

SCHEME OF VALUATION

1. Squash preparation- 05 marks + Chromosomes-05 marks

2. Calculation- 04 marks + result- 01 mark
   Preparation-04 marks + Neatness-01 mark

3. Identification with reasons-02 marks + labelled diagram-01 mark

4. Solution-04 marks + Result-01 mark

CBCS Paper IV

Nature and wildlife photography

Basic concepts of photography

1. Introduction to photography: History and evolution of photography. **2hrs**
2. Types of photography **2hrs**
3. Basics of photography: Focusing, aperture, ISO, shutter speed. **3hrs**
4. Lighting **1hr**
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:

8. Autofocus and manual focus **1hr**
9. Exposure: Metering modes and their use **1hr**
10. Use of flash in photography **1hr**
11. Other tools used in photography **2hrs**
12. Rules of composition **1hr**
13. Post processing techniques in Light room and Photoshop **3hrs**
14. Macro and landscape photography 2**hrs**
15. Bird and mammal photography **3hrs**
16. Rules and codes of ethical nature/wildlife photography **1hr**

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B.Sc. V SEMESTER

G 508.5A

HISTOLOGY, REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

Total hrs 40

Unit 1: Histology

1.1 Microtomy **2hrs**

Processing of tissue for histological sectioning. Paraffin box preparation and section cutting.

1.2 Differential staining technique **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 **2hrs**

Pancreas, thyroid and adrenal.

Unit 2: Reproductive Biology

2.1 Gametogenesis **4hrs**

Spermatogenesis in humans - different stages of formation of sperms – 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 **3hrs**

Kinds of fertilization, approximation of gametes- fertilizin and antifertilizin, acrosome reaction, cortical reaction, amphimixis. Monospermy and polyspermy- significance of fertilization.

2.4 Reproductive system and Fertility control **4hrs**

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 of blastula- Gastrulation-mesogenesis- notogenesis and neurulation.

3.3 Early development of chick **3hrs**

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

3.4 Extra embryonic membranes **3hrs**

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

Unit 4: Developmental Biology

4.1 Early development of human foetus **3hrs**

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

4.2 Placenta **3hrs**

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 **2hrs**

Cryopreservation- Gene bank, sperm bank. Manipulation of reproduction: artificial insemination, super ovulation, Invitro fitlization embryo splitting, animal cloning, and surrogate mother.

4. 4 Organizer phenomenon **2hrs**

Definition-Brachet's experiment, Spemann's experiment. 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.

References:

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B.Sc. V SEMESTER

G 508.5B

ENVIRONMENTAL BIOLOGY, BIOSTATISTICS AND WILDLIFE BIOLOGY

Total hrs 40

Unit 1: Environmental Biology

1.1 Introduction **5hrs**

Abiotic factors: Light-effects of light on plants and animals. Temperature-thermal stratification-extreme temperature-cyclomorphosis.

Biotic factors: Animal relationships-mutualism, parasitism, commensalism, predation and competition with relevant examples.

1.2 Ecosystem **3hrs**

Types of ecosystems with examples- natural ecosystem-man engineered ecosystem and micro ecosystem. Aquarium ecosystem and its maintenance. Biosphere and ecotone.

1.3 Food chains and energy flow **2hrs**

Types of food chains with examples. Food webs with examples. Ecological pyramids with examples - energy flow and laws of thermodynamics.

Unit 2: Environmental Biology (Cont…)

2.1 Habitats **5hrs**

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

Terrestrial habitats - A brief account of biomes and terrestrial habitats.

2.2 Community Ecology **2hrs**

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

2.3 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.

Unit 3 : Environmental Biology (Cont…) and Biostatistics

3.1 Limiting Factors **1hr**

Liebig's and Shelford's laws and combined concept of limiting factors.

3.2 Environmental Pollution **5hrs**

Air pollution- major air pollutants (Carbon dioxide, oxides of sulphur and nitrogen), acid rain, photochemical smog, chlorofluorocarbon, radioactive elements, fly ash. Water pollution - industrial, thermal pollution, sewage and eutrophication. Biochemical oxygen demand (BOD), Biomagnification, bioindicators and geoindicators. Soil pollution, noise pollution: sources, effects and control. *El-nino, La-nino*. Global impacts- Greenhouse effect, tsunami. Case study for air, water, nosie, soil and other factors of global impacts.

3.3 Biostatistics **6hrs**

Introduction- basic concepts-presentation of data- tabular and graphical representation -Graph- Bar diagram- Histogram-Frequency distribution-mean-median and mode. Standard deviation and standard error-Chi-square test with problems. Statistical packages.

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 **4hrs**

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 and legal aspects **4hrs**

Threats to wildlife-Need for wildlife conservation - agencies engaged in wildlife conservation. Government organization and non-government organizations (NGOs), 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. Human wildlife conflicts.

B.Sc. V SEMESTER

G 508.5P (Practical)

ENVIRONMENTAL BIOLOGY, BIOSTATISTICS 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 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. Location of species of zoological interest on the Indian map and world map. Flightless birds, Tigers, Lions, Gorilla, Hippopotamus, Rhinoceros, Dipnoi and *Peripatus.*
5. Location of Tiger reserves, national parks, Biosphere reserves, Wildlife sanctuaries of India on map.
6. Study of threatened animals of India (by Pictures/charts) Tiger, Lion, One-horned Rhinoceros, Gaur, the Golden Langur, Lion Tailed Monkey, Musk Deer, Mouse Deer, Hangul (Kashmir stag), the Great Indian hornbill and Indian rock python.
7. Indian population data: based on census record and plotting a graph to show growth rate.
8. Study of community: By quadrate method to determine frequency, density and abundance of different species present in the community. Alpha diversity.
9. 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.
10. Preparation of a small inventory of important local invertebrate and vertebrate species, their common name, zoological name, vernacular name, salient features, classification etc.
11. Estimation of dissolved oxygen, carbon dioxide and hardness of water.
12. Study of ecological adaptations and morphological peculiarities - Hermit crab, Leaf insect, Stick-insect, Glowworm, Stink bug, Puffer fish, Angler fish, *Exocoetes*, *Phrynosoma*, *Draco*, *Chaemeleon* and Bat.
13. Study of biotic relationships - Leguminous plants, Termites, Liver fluke, Tapeworm, flying fish, Sucker fish, Insectivorous plants.

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B.Sc. V SEMESTER

G 508.5P

HISTOLOGY, REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

ENVIRONMENTAL BIOLOGY, BIOSTATISTICS AND WILDLIFE

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) **20**
3. Estimate the dissolved oxygen /CO_2 / hardness of water. **10**
4. Comment on aquarium/pond ecosystem. **10**
5. Comment on E and F (ecological adaptation and biotic relationship) **10**
6. Biostatistic problem. **10**
7. Class Record. **10**

SCHEME OF VALUATION

1. Staining-03
   Mounting -03
   Identification with reasons -04

2. Identification-01
   Comment with labelled diagram-04 marks

3. Procedure+ principle- 04
   Calculation-04
   Result-02

4. Comments with labelled diagram- 10 marks

5. Identification-01
   Comment-04

6. Biostatistics problem-10 marks

B.Sc. VI SEMESTER

G 508.6A

IMMUNOLOGY, MEDICAL ZOOLOGY, TOXICOLOGY AND ECONOMIC ZOOLOGY

Total hrs 40

Unit 1- Immunology

1.1 Immune system 5hrs

Immunity: innate and acquired, passive and active. Organs of immune system -Primary lymphoid organs (thymus , bone marrow, Bursa of fabricius,). Secondary lymphoid organs (spleen, lymph nodes, peyers patches). Cells of immune system (B cells, Tcells, natural killer cells, macrophages). Antigens and antigenecity . Immunoglobulins, -structure of IgG, functions of immunoglobulins. Immunological memory.Antibody diversity.

1.2 Immunodeficiency diseases 5hrs

Arthritis, Myasthenia Gravis, AIDS - Causative agent, mode of transmission, effects and preventive measures. Vaccines- bacterial- viral- toxoid- III generation vaccines-immunodeffieciency-Autoimmunity.

Unit 2: Medical Zoology

2.1 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.

2.2 Brief account of life history, mode of infection, transmission pathogenecity and control measures. 5hrs

a. Protozoan- *Entamoeba, Giardia, Trichmonas, Plasmodium*-all species
b. Helminthes- *Ascaris, Taenia, Ancylostoma, Wuchereria.*

Unit 3: Toxicology and Economic Zoology

3.1 Toxicology 6hrs

Introduction, Definition, sub divisions, 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 pollustion on human population.

3.2 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.

3.2 Sericulture **3hrs**

Introduction to sericulture. Morphology and life cycle of *Bombyx mori.* Silk worm rearing. Modern rearing technology, spinning. Non mulberry silk worm. Pests of Silk worm, diseases and control measures.

3.3 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.

Unit 4: Applied Zoology (cont……)

4.1 Apiculture **3hrs**

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

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

4.2 Poultry **3hrs**

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

4.3 Vermitechnology **4hrs**

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

B.Sc. VI SEMESTER

G 508.6P(Practical)

IMMUNOLOGY, MEDICAL ZOOLOGY, TOXICOLOGY AND ECONOMIC ZOOLOGY

2hrs/week

IMMUNOLOGY

1. Blood typing- A, B, AB, O and Rh factors in the given human blood samples using antisera.

MEDICAL ZOOLOGY

2. Slide of *Giardia, Trichomonas, Plasmodium*
3. Parasites: *Microfilaria, Ascaris, Taenia.*
4. Collection/ identification/ observation of at least one species of *Culex, Anopheles* and *Aedes*
5. Parasites of live stocks.

TOXICOLOGY

6. Determination of LC_{50} value for the selected pesticide using mosquitoes larvae.
7. Qualitative identification of pesticide by paper chromatography.

APPLIED ZOOLOGY

8. Different casts of honey bees.
9. Commercially important inland and marine fishes (at least 10).
10. Edible prawns(at least 04)
11. Edible shell fishes (at least 05)
12. Fins in fishes.
13. External morphology and life cycle of *Bombyx mori.*
14. Animal product and secretion

a) Honey and bees wax,
b) Pearl, molluscan shells
c) Feathers of birds
d) Milk and milk products.
e) Egg
f) Fish products.

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B.Sc. VI SEMESTER
G 508.6B
ETHOLOGY, EVOLUTION AND PALAEONTOLOGY

Total hrs 40

Unit 1: Ethology

1.1 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.

1.2 Communication in animals **3hrs**

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

1.3 Social organisation in animals **2hrs**

Social behaviour, society /colony - ants, termites and monkey troops.

1.4 Behaviour in solving ecological obstacles **2hrs**

Foraging behaviour-territorial behaviour-antipredatory behaviour-aggressive behaviour-play behaviour**.**

Unit 2: Ethology (Cont….)

2.1 Animal Migration **3hrs**

Migration in fishes. Catadromous and anadromous. 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.)

2.2 Reproductive behaviours **1hr**

Sexual selection-Reproductive strategies- diversity in mating system monogamy - types- polygamy- types- polyandry- types.

2.3 Courtship behaviour **1hr**

Courtship in spiders, frogs and birds.

2.4 Nesting behavior and Parental Care **5hrs**

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

Unit 3: Evolution

3.1 Origin of life **4hrs**

Theories of origin of life- (special creation- cosmozoic – abiogensis –biogensis- theory of Chemical evolution)-evidences from metabolism-biochemical pathways-precambian rocks.

3.2 Theories of Organic Evolution **3hrs**

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

3.3 Evidences of Organic Evolution **3hrs**

Evidences from comparative morphology - Adaptive radiation taking Darwin's finches as example, anatomy, physiology, biochemistry, embryology and paleontology.

Unit 4: Evolution and Palaeontology

4.1 Speciation **2hrs**

Concept of species - sympatric and allopatric speciation, Microevolution and macroevolution.

4.2 Extinction **3hrs**

Extinction of species-natural and mass –causative factors-habitat destruction-predation and disease- interspecific competition- catastrophic events. Extinction linked to species characteristics.

4.3 Palaeontological evidences for evolutionary theories **3hrs**

Brief account of Dinosaurs and Archaeopteryx. Origin and evolution of horse and man.

4.4 Fossils **2hrs**

Definition-classification-body fossils-trace fossils-chemical fossils- types-fossilization- methods of preservation of fossils.

B.Sc. VI SEMESTER

G 508.6P (Practical)

ETHOLOGY, EVOLUTION AND PALAENTOLOGY

2 hrs/week

ETHOLOGY

1. Parental care in fishes (Hippocampus) amphibians (*Racophorus, salamander, Hyla, Ichthyophis)*
2. Nesting in birds, different types of bird and wasp nests.
3. Feeding behaviour in ant.
4. Sexual behaviour in *Drosophila.*

EVOLUTION

5. Study of homologous organs - fore limbs of frog and bird; mouth parts of cockroach, mosquito and butterfly.
6. Serial homology in Crustacea (appendages).
7. Study of analogous organs - vertebrate and cephalopod eye, wing of bird and insect.
8. Study of vestigial organs - appendix, coccyx and molar teeth in man.
9. Darwins Finches : Beak adaptation in birds.

PALAEONTOLOGY

10. Study of models of Dinosaurs. (*Tyranosaurus, Brontosaurus, Stigosaurus* and Triceratops).
11. Study of Archaeopteryx.
12. Study of models of fossil man. (Any four available models).

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B.Sc. VI SEMESTER

G 508.6P (Practical)

PART A : IMMUNOLOGY, MEDICAL ZOOLOGY AND ECONOMIC ZOOLOGY ETHOLOGY, EVOLUTION AND PALAENTOLOGY

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 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. Identify and comment on the given immunological organ A
   05
2. Comment on pathogens B
   05
3. Write the economic importance of C
   05
4. Identify and comment on evolutionary/paleontological models D and E
   10
5. Comment on the behavior of F
   05
6. Class record
   10

Total marks: 40 Marks

Internal Assessment: 10 Mark

SCHEME OF VALUATION

1. Identifciation- 01 mark
   Labelled diagram-02 marks
   Comment- 02 marks
2. Identification-01 mark
   Labelled diagram-02 marks
   Comment-02 marks
3. Economic importance-04 marks
   Labelled digarm- 01mark
4. Identification-01 mark
   Labelled diagram-02 marks
   Comment-02 marks
5. Animal behaviour-04 marks
   Labelled diagram- 01mark

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

Syllabus of the open elective papers are included as per CBCS

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