ST. JOSEPH'S COLLEGE (AUTONOMOUS)

BENGALURU-27

DEPARTMENT OF ZOOLOGY

SYLLABUS FOR UNDERGRADUATE COURSE

Re-accredited with 'A++' GRADE and 3.79/4 CGPA by NAAC

Recognised by UGC as College of Excellence

To be implemented from 2018 -19 Batch

DEPARTMENT OF ZOOLOGY

VISION

To provide a basic course in zoology and train students in a wide range of science based skills that provide the learning base for future courses

MISSION

Our mission is to provide students for advanced studies and specialization on recently emerging technological and multi-disciplinary fields such as genetic engineering, biodiversity, biotechnology, bioinformatics, wildlife and conservation. We will strive to equip them with the knowledge and skills for better planning and management of animal resources, environment and health, medicine, agriculture and population

CREDITS UNDER SEMESTER PATTERN FOR STUDENTS ADMITTED (2018-19 ONWARDS)

Code No	Title	Total Hours	Theory/ Practical	Credits	No. of hours Per Week
SEMESTER I					
ZO118	Animal Diversity of Non Chordates	60	T	4	4
Z01P1	Animal Diversity of Non Chordates **Practical I**	33	P	1	3
SEMESTER II					
ZO218	Animal Diversity of Chordates	60	T	4	4
Z02P1	Animal Diversity of Chordates	33	P	1	3
SEMESTER III					
ZO318	Human Anatomy and Physiology Part-I	60	T	4	4
Z03P1	Human Anatomy and Physiology Part-I **Practical III**	33	P	1	3
SEMESTER IV					
ZO418	Human Anatomy, Physiology Part-II and Comparative Anatomy	30	T	2	2
Z04P1	Human Anatomy, Physiology Part-II and Comparative Anatomy **Practical IV**	33	P	1	3
SEMESTER V					
ZO5118	Cell biology, Molecular biology & Immunology	45	T	3	3
Z05P1	Cell biology, Molecular biology & Immunology		P	1	

	Practical V				
Z05218	Ecology, Wildlife and Animal behavior	45	T	3	3
ZO5P2	Ecology, Wildlife and Animal behavior **Practical VI**		P	1	3
SEMESTER VI					
ZO6118	Histology, Genetics Biotechnology	45	T	3	3
Z05P1	Histology, Genetics Biotechnology **Practical VII**	33	P	1	
Z06218	Developmental Biology, Evolution & Zoogeography	45	T	3	3
ZO6P2	Developmental Biology, Evolution & Zoogeography **Practical VIII**	33	P	1	3

Mark distribution for Theory

- 70 % marks are allotted for End Semester Theory examination with duration of 2hours 30 minutes.
- Out of 30% marks for CIA, 15% marks are allotted for mid semester examination, 10% for CIA (assignments, seminars, MCQ's/tests) and 5% marks for attendance.

Mark distribution for Practicals

- 50 marks are allotted for End Semester Practical Examination with duration of 3 hours.
- Out of 50 marks, 35 marks are allotted for practical examination, and 15 marks are allotted for PIA.

SYLLABUS

SEMESTER	I
TITLE OF THE PAPER	Animal Diversity of Non-Chordates
PAPER CODE	ZO 118
NUMBER OF TEACHING HOURS PER WEEK	4
TOTAL NUMBER OF TEACHING HOURS PER SEMESTER	60 hours [52 hrs (theory) + 8 hrs (Self study)]
NUMBER OF CREDITS	4

Aims and Objectives:

- **To provide students with an in-depth knowledge of diversity in form, structure and habit of non-chordates**
- **To learn the basics of systematic Zoology and understand the hierarchy of different phyla, and its identifying characters with examples**

UNIT-I: INTRODUCTION **4hrs**

1.1 Systematics, Binomial and Trinomial nomenclature, International rules of Zoological nomenclature (IUCN). 1hr

1.2 Modern taxonomic methods. A brief account of the criteria employed in classification: Organization, symmetry, Germ layers, Types of coelomic cavities - Eucoelom and Pseudocoelom, Metamerism and Cephalization. 3hrs

UNIT-II: PROTOZOA **7hrs**

2.1 Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples. 1hr

2.2 Nutrition in Protozoa- Holozoic, Holophytic, Mixotrophic, Saprophytic and Saprozoic. 1hr

2.3 Parasitic protozoans in man -Occurrence, disease caused, mode of transmission, symptoms and preventive measures of 2 hrs

a) *Entamoeba histolytica* b) *Trypanosoma gambiense*
c) *Leishmania donovoni* d) *Cryptosporidium parvum*

Life cycle of Plasmodium.

2.4 Reproduction in Protozoa: 2 hrs
Sexual reproduction – Conjugation in *Paramecium caudatum*

2.5 Asexual reproduction – Binary fission, Multiple fission, Plasmotomy, budding **(Self study)** 1hr

UNIT-III PORIFERA **7hrs**

3.1 Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples. 1hr

3.2	Histology of sponges with reference to Sycon.	1hr
3.3	Canal system - Types, canal system in Sycon and functions	2hrs
3.4	Reproduction - Gemmule, reduction bodies, formation of Amphiblastula larva, Parenchymula larva.	2hrs
3.5	Skeleton in Sponges - Spicules and spongin fibres. **(Self study)**	1hr

UNIT-IV: COELENTERATA **5hrs**

4.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
4.2	External features and life history of Aurelia	1hrs
4.3	Corals – Types of corals and theories of coral reef formation.	2hrs
4.4	Polymorphism with reference to Siphonophora **(Self study)**	1hr

UNIT-V: PLATYHELMINTHES **3hrs**

5.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
5.2	Regeneration in Planaria (Dugesia) - Child's axial gradient theory.	1hr
5.3	Parasitic adaptations in tapeworm **(Self study)**	1hr

UNIT-VI: NEMATODA **3hrs**

6.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
6.2	Parasitic nematodes – Occurrence, mode of infection, disease caused and control measures of the following: *a) Ancylostoma duodenale* *b) Enterobius vermicularis* *c) Wuchereria bancrofti* *d) Ascaris lumbricoides*	2hrs

UNIT-VII: ANNELIDA **7hrs**

7.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
7.2	Nereis a) Externals, structure of head and parapodium. b) Heteronereis, Trochophore larva and its phylogenetic significance	3hrs
7.3	Earthworm morphology, digestive and nervous system	2hrs
7.4	Vermiculture and Vermitechnology **(Self study)**	1hr

UNIT-VIII: ARTHROPODA **9hrs**

8.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
8.2	Unique features and systematic position of Peripatus	1hr
8.3	Penaeus - externals and appendages, nervous system and reproductive system.	3hrs

8.4	Brief account of the externals and life history of *Bombyx mori*	1hr
8.5	Integrated pest management – meaning and steps involved	1hr
8.6	Larval forms in crustaceans-Nauplius, Metanauplius, Protozoea, Zoea, Mysis **(Self study)**	2hrs

UNIT-IX: MOLLUSCA **8hrs**

9.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
9.2	Freshwater mussel- externals, C.S. of shell, respiratory, digestive system and circulatory systems.	4hrs
9.3	Structure and function of foot in – Neopilina, Chaetoderma, Chiton, Mytilus, Pila, Aplysia, Dentalium and Octopus	2hrs
9.4	Brief account of Pearl culture, Chank and Lime industries **(Self study)**	1hr

UNIT-X: ECHINODERMATA **5 hrs**

10.1	Distinguishing features and classification, up to classes, with special emphasis on class characteristics with suitable examples.	1hr
10.2	Star fish - Externals and water vascular system.	2hrs
10.3	Bipinnaria larva and its phylogenetic significance	1hr
10.4	Brief account of Ophiopluteus, Echinopluteus and Auricularia larva	1 hr

UNIT-XI: MINOR PHYLA **2hrs**

11.1	List of minor phyla with examples, Salient features and affinities of Rotifera	2hrs

Paper Code – ZO1P1

SEMESTER - I

ZOOLOGY PRACTICAL - I

ANIMAL DIVERSITY OF NON-CHORDATES

Total number of Practicals: **10 units**

PROTOZOA

Observation of the following permanent slides: 1 unit
Entamoeba, Vorticella, Foraminiferan ooze, Paramecium – w.m.,/conjugation, Euglena and Noctiluca

PORIFERA

Sycon, Hyalonema, Euplectella 1 unit
Slides: Spicules and Gemmule

COELENTERATA

Hydra, Physalia, Porpita, Aurelia, Ephyra larva,Sea anemone and T.S of sea anemone, Fungia, Astrea, Meandrina, *Corallum rubrum*, Gorgonia 1 unit

PLATYHELMINTHES

Planaria, Tape worm – w.m., scolex, Liver fluke – w.m., T.S. of liver fluke 1 unit

NEMATODA

Male roundworm, T.S. of male roundworm, Female roundworm, T.S. of female roundworm 1 unit

ANNELIDA

Nereis, Parapodium, Heteronereis, Aphrodite, Arenicola, Sabella, Chaetopterus, Trochophore larva, Earthworm (T.S. passing through the Typhlosolar region). Mount setae 1 unit

ARTHROPODA

Peripatus, Nauplius larva, Mysis larva, Centipede, Millipede, Praying Mantis, Silk Moth, Limulus 1 unit

MOLLUSCA

Chiton, Nautilus, Octopus, Sepia, Cuttle bone, Pearl Oyster, Dentalium, Patella, Cyprea, Haliotes 1 unit

ECHINODERMATA

Star fish, Brittle star, Sea lily, Sea cucumber, Sea urchin, Cake urchin, Pedicellaria, Bipinnaria larva. 1 unit

CULTURE: 1 unit

Observation of live cultures of protozoans

DISSECTION:

Mounting of the appendages of prawn (*Penaeus*)

Demonstration of Nervous system of *Penaeus*

SCHEME FOR PRACTICAL EXAMINATION

PRACTICAL - I

ANIMAL DIVERSITY OF NON-CHORDATES

Duration: 3 Hours **Max. Marks: 35**

1	Mounting of prawn appendages	3 x 2	6
2	Identify and Classify giving reasons A-F	4 x 6	24
3	Records		5

REFERENCE BOOKS

1. A GENERAL ZOOLOGY OF THE INVERTEBRATES **Carter GS**.
2. A MANUAL OF ZOOLOGY. **Ekambarnath Ayyar and Anantha Krishnan**
3. A STUDENT TEXTBOOK OF ZOOLOGY. **Sedgewick**.
4. AN INTRODUCTION TO THE INVERTEBRATES. **Janet Moore**, revised Cambridge University Press, 2006 ISBN 1139458477, 9781139458474
5. ATLAS OF INVERTEBRATE ANATOMY. **Donald Thomas Anderson**. UNSW Press, 1996.ISBN 0868402079, 9780868402079
6. BIOLOGY OF ANIMALS. Vol 1. **Adhikari, Sinha and Ganguli**. New central book agency, Calcutta.
7. BIOLOGY OF INVERTEBRATES. **Hickman CP**.
8. BIOLOGY OF NON CHORDATES. **Nigam H.C. Naginchand S L** and Co. Jallander.
9. BIOLOGY OF THE INVERTEBRATES. **Cleveland Pendleton Hickman** C. V. Mos Co., 1967
10. ECONOMIC ZOOLOGY**. G.S. Hubhla & V.B. Upadhyoya**
11. INTEGRATED PRINCIPLES OF ZOOLOGY. **Hickman CP**,
12. INVERTEBRATE ZOOLOGY Vol I - Vol VI. **L H Hyman** McGraw Hill Book Company
13. INVERTEBRATE ZOOLOGY. **Meclisten**. Oxford Publishing house.
14. INVERTEBRATE ZOOLOGY. **Barnes**, Hault Saunders, 4th Edition.
15. INVERTEBRATE ZOOLOGY. **Dhami & Dhami.**
16. INVERTEBRATE ZOOLOGY. **Jordan and Verma**. S Chand & Co.,
17. INVERTEBRATE ZOOLOGY: A LABORATORY MANUAL. **Robert L. Wallace, D. Elden Beck, Lee F. Braithwaite**. Prentice Hall, 1997. ISBN 0132700263, 9780132700269.
18. INVERTEBRATES STRUCTURE AND FUNCTION. **Barrington**. ELBS
19. INVERTEBRATES. **Brown, Frank A** ed, Daya Books, 2002. ISBN8176220744, 9788176220743
20. INVERTEBRATES. **Majpuria**.
21. INVERTEBRATES. **Encyclopedia Britannica**, Inc., Encyclopedia Britannica, Inc., 2012 ISBN 1615358250, 9781615358250
22. INVERTEBRATES. **Eugene N. Kozloff**. Saunders College Pub., 1990. ISBN 0030462045, 9780030462047
23. INVERTEBRATES. **Richard C. Brusca**. Sinauer, 2016. ISBN 1605353752, 9781605353753
24. INVERTEBRATES. Vol.1. **Kotpal**. Rastogi publications.
25. INVERTEBRATES: PROTOZOA TO ECHINODERMATA. **Ashok Verma**. Alpha Science International, 2005 ISBN 1842652001, 9781842652008

26. PARASITIC PROTOZOA. Baker JR,
27. TEXTBOOK OF ZOOLOGY. Vol 1. Parker and Haswell. CBS Publishers and distributors.
28. THE INVERTEBRATES, PLATYHELMINTHES AND RHYNCOCOELA. **Hyman L H**
29. THE INVERTEBRATES. R. **McNeill Alexander** CUP Archive, 1979 ISBN 0521293618, 9780521293617.
30. BIOLOGY OF NON-CHORDATES. **Fatik Baran Mandal**. PHI Learning Pvt. Ltd., 2017. ISBN 9387472019, 9789387472013

DEPARTMENT OF ZOOLOGY

SEMESTER	II
TITLE OF THE PAPER	Animal diversity of Chordates
PAPER CODE	ZO 218
NUMBER OF TEACHING HOURS PER WEEK	4
TOTAL NUMBER OF TEACHING HOURS PER SEMESTER	60 hours [52 hrs (theory) + 8 hrs (Self study)]
NUMBER OF CREDITS	4

Aims and Objectives:

- **To learn the general characters and classification of Chordates**
- **To understand the chordate evolutionary tree**

UNIT-I: PROTOCHORDATA **9hrs**

1.1 Salient features of Chordates and classification 3hrs
Origin of Chordates – A brief account of Echinoderm theory, Ascidian theory and Lophophorate theory.

1.2 Hemichordata- Salient features of Hemichordates 2hrs
Balanoglossus-external, structure of Tornaria larva and its significance

1.3 Cephalochordata- Salient features of Cephalochordates 2hrs
Amphioxus- external and modes of feeding

1.4 Urochordata- Salient features of Urochordates 2hrs
Ascidian-external, Ascidian tadpole and retrogressive metamorphosis

UNIT-II: AGNATHA **5hrs**

2.1 Theories regarding the origin of vertebrates-Branchiostome ancestry, Balanoglossus ancestry. 1hr

2.2 External features of Petromyzon 1hr

2.3 Ammocoetes larva- structure and its phylogenetic significance 1hr

2.4 Salient features of Agnatha 2hrs
Classification up to classes, with suitable examples **(Self study)**

UNIT – III: PISCES **7hrs**

3.1 General characters – with emphasis on the primary aquatic adaptations, classification up to orders, with suitable examples. 3hrs
Differences between cartilaginous & bony fishes.

3.2 Pisciculture – rearing, breeding and preservation of fishes 2hrs

3.3 Migration of fishes, Potamodromous, Oceanodromous, Catadromous and Anadromous with suitable examples. 1hr

3.4 Interesting features of dipnoi 1hr

UNIT- IV: AMPHIBIA		**15hrs**
4.1	General characters and classification up to living orders with examples, a brief account of the origin of amphibia	2hrs
4.2	Frog (Rana sp.) – A brief account of digestive, respiratory, circulatory, nervous, and urinogenital systems	9hrs
4.3	Frog endoskeleton.	2hrs
4.4	Neuro-endocrine control of metamorphosis in Amphibia	1hr
4.5	Parental care in Amphibia–*Pipa, Gastrothecus, Alytes and Ichthyophis* **(Self study)**	1hr
UNIT- V: REPTILIA		**6hrs**
5.1	General characters with special reference to terrestrial adaptations and classification of living orders with suitable examples.	2hrs
5.2	Brief account of fossae in reptiles	1 hr
5.3	A brief account of the Mesozoic Reptiles – Dinosaurs, Pterosaurs, Ichthyosaurs and Mammal-like reptiles	1hr
5.4	General adaptations in snakes including poison apparatus, venom, types and its effects	1hr
5.5	A brief account of some poisonous snakes of India : pit viper, cobra, krait and sea snake **(Self study)**	1hr
UNIT-VI: AVES		**9hrs**
6.1	General characteristics and classification of Aves. Unique features of extant birds	2hrs
6.2	Adaptations for aerial mode of life-anatomical and physiological	2hrs
6.3	Differences between Ratitae and Carinatae	1hr
6.4	Migration: Types, factors controlling migration. Ringing and collar technique to determine the route of migration	2hrs
6.5	Brief account of Archaeopteryx **(Self study)**	2hrs
UNIT- VII: MAMMALS		**9hrs**
7.1	General characteristics of Mammals, classification up to orders, with suitable examples.	1hr
7.2	Origin of Mammals, Salient features of the following: Prototheria, Metatheria, Insectivora, Carnivora, Chiroptera, Perissodactyla, Artiodactyla, Cetacea and Proboscidea	4hrs
7.3	Adaptive radiation as illustrated by changes in limb structure and types of locomotion.	2hrs
7.4	Salient features of primates. An outline classification of primates with examples **(Self study)**	2hrs

Paper Code – ZO2P1

SEMESTER - II

ZOOLOGY PRACTICAL - II

ANIMAL DIVERSITY OF CHORDATES

Total Number of Practicals 10 units

PROTOCHORDATES 1 unit

Amphioxus – w.m, T.S. through pharynx and T.S. through intestine
Balanoglossus – w.m, T.S. passing through proboscis
Ascidia, Ascidian tadpole

AGNATHA 1 unit

Petromyzon, Myxine and Ammocoetes larva

FISHES 1 unit

Electric Ray, Saw fish
Sucker fish, Globe fish, Eel- Muraena, Hippocampus, Flat fish.
Accessory respiratory organs in Anabas, Clarias and Saccobranchus.

AMPHIBIANS 2 units

Bufo, Hyla, Ambystoma, Axolotl, Ichthyophis, Necturus, Salamander
Frog endoskeleton (Skull, Vertebrae, Girdles and limb bones)

REPTILES 1 unit

Draco, Phrynosoma, Varanus, Turtle and Tortoise.
Poisonous snakes- Viper, Cobra, Krait and Sea snake

AVES 1 unit

Endoskeleton (Skull, heterocoelous vertebrae, Sternum, Synsacrum) Beak and feet modifications of parrot, duck, eagle and crow

MAMMALS 3 units

Ant eater, Loris, Mongoose, Hedgehog, Bat
Lower jaw of rabbit, dog or cat, horse or cow, monkey or man, hair, hoof, horns of cow or goat

SCHEME FOR PRACTICAL EXAMINATION

PRACTICAL - II

ANIMAL DIVERSITY OF CHORDATES

Duration: 3 Hours Max. Marks: 35

1	Identify, classify and comment on A-F	4x6	24
2	Comment on the lower jaw/epidermal derivatives/beak & feet modifications	2x3	6
3	Records		5

References

1. A MANUAL OF PRACTICAL ZOOLOGY: CHORDATES. **P. S. Verma**, S. Chand Publishing, 2000. ISBN 8121908302, 9788121908306.
2. A MANUAL OF PRACTICAL ZOOLOGY-CHORDATES.**Verma, P.S**. (2002). S. chand and Co. Ltd.
3. A MANUAL OF ZOOLOGY. **Ekambaranatha Ayyar**. (2000). Vol. II S. Viswanathan and Co. ·
4. A TEXTBOOK OF ZOOLOGY **Parker, T.J and Haswell, W.A**. 1962., Vol.2, Vertebrates, 7th edition Mac Millan Press, London.
5. A TEXTBOOK OF CHORDATES. **R. McNeill Alexander** 2002 H.S. Bhamrah (Author), Kavita
6. A TEXTBOOK OF VERTEBRATE ZOOLOGY. **S. N. Prasad, Vasantika Kashyap**. New Age International, 1989. ISBN 0852269285, 9780852269282
7. BIOLOGY OF CYCLOSTOMES. **Hardisty M W**.
8. CHORDATE ORIGINS AND EVOLUTION: THE MOLECULAR EVOLUTIONARY ROAD TO VERTEBRATES. **Noriyuki Satoh.** Academic Press, 2016. ISBN 0128030062, 9780128030066.
9. CHORDATE ZOOLOGY. **Bhaskaran, K. K. and Biju Kumar**, A. (2003). Manjusha Publications. Calicut. ·
10. CHORDATE ZOOLOGY. **Jordan E. L. and P. S. Verma**. (2002). S. Chand and Co. New Delhi ·
11. CHORDATE ZOOLOGY. **P. S. Verma.** S. Chand Publishing, 1965. ISBN 8121916399, 9788121916394.
12. CHORDATE ZOOLOGY: A Textbook for B. Sc. Students of Indian Universities. **Dhami P**. S.. R Chand, 1977.
13. COLOUR CHANGES IN ANGUILLA. **Neil RM**
14. EPIGENETICS OF BIRDS. **Waddigton CH**
15. GENERAL ZOOLOGY. **Storer and Usinger**
16. LIFE: AN INTRODUCTION TO BIOLOGY. **William S. Beck, Karel, F., Liem and George Gaylord** Simpson. (2000). Harper Collins Publishers, New York. 9 ·
17. MANUAL OF ZOOLOGY **Ekambaranatha Ayyar, T. N. Ananthakrishnan**. Volume II Part I – Chordata
18. MODERN TEXTBOOK OF ZOOLOGY: VERTEBRATES. **Kotpal, R.L**. (2000).

Rastogi Publications, Meerut.
19. THE CHORDATES. **R. McNeill Alexander.** CUP Archive, 1981 ISBN 0521236584, 9780521236584.
20. THE FISHES OF INDIA BEING A NATURAL HISTORY OF FISHES KNOWN TO INHABIT THE WATERS OF BURMA AND CEYLON. **Day F**.
21. THE LIFE OF VERTEBRATES. **Young J.Z.** (2006). Oxford University Press
22. THE VERTEBRATE BODY, W.B.S. Saunders, Philadelphia
23. VERTEBRATE PALEANTOLOGY. **Romer AS. Chicago**
24. VERTEBRATE ZOOLOGY; AN INTRODUCTION TO THE COMPARATIVE ANATOMY, EMBRYOLOGY, AND EVOLUTION OF CHORDATE ANIMALS **De Beer, Gavin**.
25. VERTEBRATES. F. **Harvey Pough, John B. Heiser, Christine M. Janis Benjamin Cummings**, 2008 - Hyman's Comparative Vertebrate Anatomy Edited By Marvalee H. Wake
26. VERTEBRATES. **Kardong**. Tata McGraw-Hill Education, 2005. ISBN 0070607508, 9780070607507.
27. VERTEBRATES. **Norman K. Wessels, Elizabeth M. Center**. Jones & Bartlett Learning, 1992. ISBN 0867208538, 9780867208535

DEPARTMENT OF ZOOLOGY

SEMESTER	III
TITLE OF THE PAPER	Human Anatomy & Physiology Part- I
PAPER CODE	ZO 318
NUMBER OF TEACHING HOURS PER WEEK	4
TOTAL NUMBER OF TEACHING HOURS PER SEMESTER	60 hours (52 teaching hours + 8 hours self study)
NUMBER OF CREDITS	4

Aims and Objectives:

To bring the students closer to understanding the human body for its anatomical details, physiological functions and disorders of the body systems.

UNIT-I SKELETALSYSTEM **15hrs**

1.1 Unique human skeletal characteristics 1 hr

1.2 Concept of skeletal system and types of bones 1 hr

1.3 A brief account of the Axial skeleton: 6 hrs
Skull and Facial bones
Vertebral column –Vertebral column and its function.
Atlas, Axis, Typical cervical, Seventh cervical, Thoracic, Lumbar Vertebrae, Sacrum, Coccyx.
Inter Vertebral disc – Structure and function, Slip Disc.

1.4 Thoracic cage with reference to the Sternum and ribs. 1 hr

1.5 Appendicular skeleton: 6 hrs
Pectoral girdle – Scapula, Clavicle; Upper limb – Humerus, Radius, Ulna, carpels, Metacarpels and Phalanges.
Pelvic girdle – Innominate Bone; Lower limb- Femur, Patella, Tibia, Fibula, Tarsals, Metatarsals and Phalanges.

UNIT-II THE INTEGUMENTARY SYSTEM

3 hrs

Layers of the skin: Epidermis and Dermis structure and functions.

	Glands- Sabaceous and sweat glands their structural differences and biological activity.	2hrs
	Derivatives of the skin: Nail and hair – structure and function **(self study)**	1hr
UNIT-III	**MUSCULAR SYSTEM**	**2 hrs**
	Muscle - types and characteristics. Composition and ultra structure of the muscle including bandings- sarcomere. Filaments of a muscle fibre and muscular proteins - actin and myosin. Muscle contraction: Physico-chemical changes during muscle contraction, electrical activity and Excitation - contraction theory.	
UNIT-IV	**DIGESTIVE SYSTEM**	**9 hrs**
4.1	A detailed account of the digestive system including oral cavity. Gross structure of the tongue. Structure of tooth and dentition. Alimentary canal: gross structure and outlines of histology with reference to its function.	4 hrs
4.2	Associated glands: Liver and Pancreas – shape, gross structure, location and outlines of its internal structure.	2hrs
4.3	Digestive secretions and control of digestive secretions - Salivary, gastric – Nervous and Hormonal control, bile, Pancreatic and intestinal secretions - enzymes, substrates acted and products.	1 hour
4.4	Role of microorganisms in digestion in ruminants and termites.	1 hour
4.5	Gastrointestinal disorders- Hyperacidity, ulcers, cirrhosis of liver, Jaundice, gall stones and appendicitis. **(Self study)**.	1 hour
UNIT-V	**CARDIO-VASCULARSYSTEM &LYMPHATIC SYSTEM**	**7 hrs**
5.1	Heart – Shape, Location and surrounding organs External and Internal structure – Double circulation	1 hr
5.2	Origin and conduction of heartbeat - Pacemaker natural (SAN) and artificial.	1 hr
5.3	A brief account of the Arterial and Venous system – Haemopoiesis and RBC storage.	2 hrs 1 hrs
5.4	Disorders: Anemia, Hypertension, Leukemia. Ischemic heart diseases, Mitral stenosis, Atherosclerosis, Coronary heart disease, Angina pectoris - Angioplasty and Bypass surgery. **(self**	2 hrs

5.5 **study)**

LYMPHATIC SYSTEM

Anatomy of Lymphatic System.
Gross Structure of Spleen, Thymus and Lymph nodes.
Functions of lymphatic system – Immune response - Phagocytosis.

UNIT-VI RESPIRATORY SYSTEM **10 hrs**

6.1 Definition - external and internal respiration.
Anatomy of respiratory system – Nostrils, bones, lining of the nasal passage, functions, internal nares. 4 hrs

Larynx – A detailed structure with main cartilages, a special mention on vocal cords. Concepts of pitch, volume and resonance.
Trachea- Location with reference to surrounding organs; structure, "C" shaped cartilaginous rings; lining of the trachea – functions and significance.
Branches of the respiratory tree – Bronchi, bronchioles – [Primary, secondary, tertiary (respiratory / alveolar bronchioles)], layers of tissue covering the branches of the respiratory tree.
Structure and function of an Alveolus.

6.2 Breathing and its mechanism – Rib cage, shape and structure of diaphragm, central tendon. 1 hr
External and Internal - Intercostals muscles – arrangement pattern and their movements during expiration and inspiration process.
Concepts of Tidal volume, dead space and alveolar ventilation. Respiratory cycle and its rate.

6.3 Transportation of Respiratory gases
Transportation of oxygen: Concepts of partial pressures of oxygen and carbon dioxide. 3 hrs
Oxygen dissociation curves - Bohr's effect; factors affecting the oxygen dissociation from Oxyhaemoglobin.
Transportation of carbon-dioxide - both in plasma and erythrocytes. Blood buffer mechanism, Chloride Shift and Hamburger's phenomenon.
Concept of Respiratory quotient and its estimation. RQ for herbivores, carnivores and omnivores.

6.4 Respiratory pigments - Properties and types of pigments - haemoglobin, haemocyanin, haemoerythrin and chlorocruorin. (**Self study**) 1 hr

6.5 Respiratory disorders - A brief account of Asthma and Pneumonia – anatomical changes, Etiology and treatment. 1 hr

Effects of smoking **(self study)**

UNIT-VII	**EXCRETORY SYSTEM**	**5 hrs**
7.1	The Kidneys: Renal anatomy, Structure of the nephron and functions. Physiology of urine formation, Urine- composition and factors affecting the composition.	2 hrs
7.2	Types and formation of nitrogenous wastes: Ammonia –deamination, Uric acid and Urea, Ornithine cycle.	1 hr
7.3	Renal failure- Dialysis and brief account of ketosis.	1 hr
7.4	Renal calculi- causes, types, treatment and prevention. **(Self study)**	1 hr
UNIT-VIII	**REPRODUCTIVE SYSTEM**	**3 hrs**
8.1	Introduction to reproduction and reproductive system with reference to humans. Female reproductive system – External genitalia- Vulva, Vagina, cervix, Uterus-shape, size, areas and brief outline of layers of uterine wall. Fallopian tubes – parts and significance and brief histology. Ovary – position, mesovarium and internal structure with a mention on ovarian follicular stages.	2 hrs
8.2	Male reproductive system- Scrotum – testes- seminiferous tubules and outline on cells of the seminiferous tubules, epididymis, spermatic cord, ejaculatory ducts, origin of urethra – 3 parts. Penis: structure- erectile tissues, Glans penis and prepuce. Accessory glands- Prostate, seminal glands and bulbourethral (Cowper's gland) its secretions – nature and functions	1 hr
UNIT-IX	**OSMOREGULATION**	**3 hrs**
9.1	Homeostasis- internal environment and equilibrium - feedback mechanisms with examples of diabetes insipidus, child birth and lactation.	1 hr
9.2	Osmoregulation- variations in marine cartilaginous and bony fishes and fresh water bony fishes.	1 hr
	Salt -water balance in camel and man	1 hr
9.3	Internal environment: Body fluids and types. **(self study)**	
UNIT-X	**THERMOREGULATION**	**3 hrs**
10.1	Influence of temperature on metabolic rate – concept of Q_{10}	1 hr

10.2	Differences between poikilotherms, homeotherms, steno and eurythermal animals. Features of ectotherms, endotherms and heterotherms. Process of thermoregulation in endotherms, role of hypothalamus in thermoregulation	1 hr
10.3	Adaptive thermoregulation: Torpor: hibernation, aestivation, frostbite and heatstroke **(self study)**	1 hr

Paper code ZO 3P1
ZOOLOGY – SEMESTER III
PRACTICAL – III
ZO3P1: Human Anatomy and Physiology Part-I

Total number of Practical classes	**10 units**
HUMAN SKELETAL SYSTEM	**4 units**
• Skull	1unit
• Vertebrae – Atlas, Axis, Typical Cervical, 7th Cervical Vertebrae, Thoracic Vertebrae, Lumbar Vertebrae, Sacrum and Coccyx, Ribs.	2 units
• Scapula and clavicle; Humerus, radius and ulna.	
• Innominate (ox coxae or hip) bone; femur, tibia and fibula.	1 unit
PHYSIOLOGY	**6 units**
• Tests for ammonia, Urea and Uric acid.	1unit
• Estimating the amount of salt lost or gained by the given aquatic animal (fish/crab) in unit time when transferred from one medium to another.	1unit
• Estimating the amount of oxygen consumed by the given animal (aquarium fish) in unit time.	
• Analysis of ascorbic acid in various biological samples.	1unit
• Estimation of creatinine in the urine sample.	
• Effects of temperature on the activity of salivary amylase.	1unit 1unit 1 unit

SCHEME FOR PRACTICAL EXAMINATION
PRACTICAL – III
ZO3P1: Human Anatomy and Physiology Part – I

Duration: 3 Hours **Max. Marks: 35**

S. No	Description / Particulars	Marks allotted	
1	Human Osteology	5 x 4	20
2	Physiology		10
3	Class records		05
		Total Marks	**35**

REFERENCE BOOKS

1. A TEXTBOOK OF PHYSIOLOGY by D. Emslie-Smith, Churchill Livingstone publication, 1988.
2. PHYSIOLOGY by Ganong, Appleton and Lange 1989.
3. CELL PHYSIOLOGY by Giese A.C. Saunder's, Toppan and Co. Japan, 1984.
4. ANIMAL PHYSIOLOGY by Schmidt Nielson *et al,* MacGraw Hill Publ. 5th Ed. 1991.
5. FOUNDATIONS OF ANATOMY, Cambridge Publishers.
6. HUMAN PHYSIOLOGY by Vander
7. PHYSIOLOGY by Ross and Wilson, ELBS and Churchhill Livingstone
8. TEXT BOOK OF ANIMAL PHYSIOLOGY by Nagabhushanam *et al.,* Oxford – IBH Publ. 2nd ed.
9. HUMAN PHYSIOLOGY FROM CELL TO SYSTEM by Lauralee Sherwood 7th ed.
10. HUMAN ANATOMY AND PHYSIOLOGY, 6thedn. By Elaine N. Marieb, 1237 pages, Benjamin –Cummings publication.
11. PRINCIPLES OF HUMAN PHYSIOLOGY, Germann and Stanfield, 4thedn., 2010, Benjamin –Cummings.
12. HUMAN PHYSIOLOGY: VOLUME I &II, C.C. Chaterjee, CBS Publishers and distributors.
13. ANATOMY AND FUNCTIONAL PHYSIOLOGY by Tortora & Derrickson.
14. TEXTBOOK OF ANATOMY AND PHYSIOLOGY FOR NURSES AND ALLIED HEALTH SCIENCES by Indu Khurana &Arushi, CBS publishers and distributors, 2010.
15. TEXTBOOK OF MEDICAL PHYSIOLOGY by Guyton & Hall, Elsevier
16. GRAY'S ANATOMY FOR STUDENTS by Drake, Vogl& Mitchell, Churchhill Livingstone publication.

DEPARTMENT OF ZOOLOGY

SEMESTER	IV
TITLE OF THE PAPER	Human Anatomy, Physiology Part-II and Comparative Anatomy. (FOR ZOOLOGY STUDENTS)
PAPER CODE	ZO 418
NUMBER OF TEACHING HOURS PER WEEK	2
TOTAL NUMBER OF TEACHING HOURS PER SEMESTER	30 hours (26 teaching hours + 4 hours of self study)
NUMBER OF CREDITS	2

Aims and Objective:

In addition to the knowledge of Human body in terms of anatomical details, physiological function and its disorders, students also gain knowledge and synthesize ideas to compare and understand the anatomical details of other vertebrate systems with that of the human system.

UNIT-I	**NERVOUS SYSTEM**	**10 hours**
1.1	Organization of the vertebrate Nervous system – CNS, PNS & ANS.	1hrs
1.2	Divisions of the central nervous system – Brain – meninges, ventricles of the brain, Cerebrospinal fluid and its function, anatomy of the human brain & its lobes and function.	2 hrs
1.3	Nerve impulse, properties, Origin and conduction along the axon.	1hrs
1.4	Synapse- Definition, Types- Chemical and Electrical, Synaptic transmission, Factors affecting synaptic transmission Neurotransmitters.	2 hrs
1.5	Spinal cord – Anatomy and reflex action.	2 hrs
1.4	Types of neuron: Unipolar, Bipolar & Multipolar - Structure and Function**(self-study)**	2hrs

UNIT-II	**ORGANS OF SPECIAL SENSES**	**5 hours**
2.1	**ANATOMY OF THE HUMAN EYE** – Layers of the eye wall, cornea, lens, ciliary body, suspensory ligaments. Retina – types of photosensitive cells – rods and cones – structure and pigments. Yellow spot – Macula and Fovea centralis. Blind spot, optic nerves and chiasma. Physiology of vision: Accommodation of the eye. Binocular vision, physiology of visual pigments. Abnormalities of refraction of the eye: Myopia and Hypermetropia. Causes and corrective measures **(self study)**	2 hrs 1 hr
2.2	**ANATOMY OF THE EAR**: Structure – external, middle and internal. Structure and Physiology of hearing and balance – static and dynamic equilibrium.	2 hrs

UNIT-III	ENDOCRINOLOGY	10 hours
3.1	Differences between Endocrine and Exocrine glands.	1 hr
3.2	**PITUITARY GLAND** – Gross structure – Embryonic origin, position, parts of the pituitary – Adenohypophysis, intermediate lobe and neurohypophysis. Anterior lobe / Adenohypophysis: histology. Hormones of the Anterior lobe- TSH, FSH, ACTH, LH, LTH and GH. Hormones of the intermediate lobe of pituitary (MSH). Posterior lobe of Pituitary gland/ Neurohypophysis: Structure of a neurosecretory cell and neurohormones - oxytocin and ADH. Diabetes insipidus. Growth hormone disorders- acromegaly, gigantism and Dwarfism. **(self study)**	2 hrs 1 hr
3.3	**THYROID GLAND**: Position, shape and its lobes, histology. Hormones: Thyroxine – Biochemistry of synthesis and functions. Hypothyroidism (Myxoedema and Goitre, Cretinism) and Hyperthyroidism (Grave's disease). Calcitonin: Functions with reference to calcium homeostasis.	3 hrs
3.4	**PARATHYROID GLANDS**: Position, shape and number; histology. Parathormone: Functions - antagonistic to calcitonin in calcium homeostasis. Hypo and Hyperparathyroidism.	1 hr
3.5	**ISLETS OF LANGERHANS**: Location and structural organization. Hormones- Glucagon, Insulin, Somatostatin and Functions. Diabetes Type I and Type II. Differences, Symptoms and management. **(Self study)**	1 hr
3.6	**ADRENAL GLAND/SUPRARENAL GLANDS**: Location, structural organization – Cortex and medulla. Hormones- Cortex: Glucocorticoids, Minerelocorticoids and sex hormones. Medulla–Adrenaline and Nor Adrenaline – Physiological role.	1 hr

UNIT-IV	**COMPARATIVE ANATOMY**	**5hours**
4.1	Evolution in aortic arches: Shark, frog, lizard, pigeon and rabbit.	2hrs
4.2	Evolution in excretory system: archinephros, pronephros, mesonephros and metanephros.	1hr
4.3	Evolution in the structure of brain of shark, frog, lizard, pigeon and rabbit.	2hrs

Paper Code - ZO4P1

ZOOLOGY: SEMESTER – IV

PRACTICAL – IV

HUMAN ANATOMY, PHYSIOLOGY – Part II & COMPARATIVE ANATOMY

Total number of Practical classes **10 units**

PHYSIOLOGY **5 units**

- Organic constituents of Protoplasm – tests for glucose, sucrose, starch and proteins. 1unit
- Effect of temperature on the rate of opercular movement in an aquarium fish. 1unit
- Analysis of urine for the presence of reducing sugars and albumin (protein). 1unit
- Estimating the amount of total glycogen in the muscle by anthrone method 1 unit
- Analysis of urine for the presence of ketone bodies. 1 unit

COMPARATIVE ANATOMY **3units**

- Comparative study of the brain of shark, frog, reptile, bird and rat or any mammal 1unit
- Comparative study of the heart of shark, frog, reptile, bird and rat or any mammal 1unit
- Comparative study of the skin of fish, frog and mammal 1unit

MICROTECHNIQUE **2 units**

- Preparation of paraffin blocks of organs (block making), section cutting and staining technique. 1 unit
- Mounting and staining of paraffin section 1 unit

SCHEME FOR PRACTICAL EXAMINATION
PRACTICAL – IV
ZO4P1: HUMAN ANATOMY, PHYSIOLOGY – Part II & COMPARATIVE ANATOMY

Duration: 3 Hours **Max. Marks: 35**

		Marks allotted
1	Physiology experiment	15
2	Comparative Anatomy	8
3	Staining of Paraffin section and a question on micro technique	7
4	Class Records	5
	Total Marks	**35**

REFERENCE BOOKS

1. A TEXT BOOK OF PHYSIOLOGY by D. Emslie-Smith, *et al.*, ELBS low priced edition 1988.
2. PHYSIOLOGY by Ganong, Appleton and Lange 1989.
3. CELL PHYSIOLOGY by Giese A.C. Saunder's, Toppan and Co. Japan, 1984.
4. ANIMAL PHYSIOLOGY by Schmidt Nielson *et al.,* MacGraw Hill Publ. 5th Ed. 1991.
5. FOUNDATIONS OF ANATOMY, Cambridge Publishers.
6. HUMAN PHYSIOLOGY by Vander
7. PHYSIOLOGY by Ross and Wilson, ELBS and Churchhill Livingstone
8. TEXT BOOK OF ANIMAL PHYSIOLOGY by Nagabhushanam *et al.,* Oxford – IBH Publ. 2nd edition.
9. HUMAN PHYSIOLOGY FROM CELL TO SYSTEM by Lauralee Sherwood 7th ed.
10. HUMAN ANATOMY AND PHYSIOLOGY, 6thedn. By Elaine N. Marieb, 1237 pages, Benjamin –Cummings publication.
11. PRINCIPLES OF HUMAN PHYSIOLOGY, Germann and Stanfield, 4thedn., 2010, Benjamin –Cummings.
12. HUMAN PHYSIOLOGY: VOLUME I &II, C.C. Chaterjee, CBS Publishers and distributors.
13. ANATOMY AND FUNCTIONAL PHYSIOLOGY by Tortora & Derrickson.
14. VERTEBRATE ZOOLOGY; AN INTRODUCTION TO THE COMPARATIVE ANATOMY, EMBRYOLOGY, AND EVOLUTION OF CHORDATE ANIMALS De Beer, Gavin.
15. ELEMENTS OF COMPARATIVE ANATOMY by Carl Gegenbaur, 2007. Read books publications, UK.
16. COMPARATIVE ANATOMY OF THE VERTEBRATES by Robert R. Carr & George C. Kent, McGraw Hill Science publication.

DEPARTMENT OF ZOOLOGY
SYLLABUS FOR CHOICE BASED CREDIT SYSTEM (CBCS)
(FOR NON ZOOLOGY STUDENTS)
ZOOE 4118: A JOURNEY INTO ANIMAL WORLD AND HUMAN LIFE
Minimum intake of students = 20
Maximum intake of students = 60
Total number of credits = 02
Total number of teaching hours = 30 hrs

UNIT–I	**INTRODUCTION TO ANIMAL WORLD**	**10 hours**
1.1	Brief Introduction to the Animal diversity, Outline classification, general characters with suitable examples, eco-economic importance and comparison between phyla	4 hrs
1.2	Contributions of Linnaeus, Darwin and Mendel. Taxonomic Hierarchy, Connecting links, and human genetic traits with examples	1 hr 1 hr
1.3	Parasitology: lifecycle pattern of tapeworm and round worm	1 hr
1.4	Identification of poisonous and non-poisonous snakes, anti-venom Reproduction patterns in animals with suitable examples, courtship	1 hr 1 hr
1.5	Parental care in scorpion, octopus, crocodile, tilapia, Surinam toad, kangaroo	1 hr
1.6	Migration of fishes and birds, techniques to track migration	

UNIT–II	**HUMAN BODY (ANATOMY AND PHYSIOLOGY)**	**6 hours**
	A brief description of the structure and functions of the following systems:	
2.1	Digestive system	1 hr
2.2	Respiratory system	1 hr
2.3	Circulatory system	1 hr
2.4	Excretory system and Reproductive system	2 hrs
2.5	Nervous system and Endocrine system	1 hr

UNIT–III	**HEALTH AND DISEASES**	**9 hours**
3.1	Communicable diseases: TB, Leprosy, Disease outbreak (Epi and pandemic) and vector borne diseases	2 hrs
3.2	Lifestyle related non-communicable diseases: hypertension, coronary heart disease (CHD), Diabetes mellitus, obesity and	1 hr
3.3	mental ill Health	1 hr
3.4	Social health problems: Smoking, alcoholism, AIDS. Causes, treatment and prevention	1 hr
3.5	Cancer: types, causes, and treatment	
3.6	Genetic diseases: Genetic disorders, positive and negative eugenics. Blood grouping and transfusion	2 hrs
	Environmental and occupational health hazards: Allergy, Bronchitis, Radiation sickness, health care professionals, silicosis, noise induced hearing loss, first Aid	2 hrs

UNIT – IV	**ECONOMIC ZOOLOGY AND WILDLIFE CONSERVATION**	**5 hours**
4.1	Brief account of vermiculture, aquaculture, sericulture and apiculture	2 hrs
4.2	Conservation biology: In-situ and Ex-situ, megadiverse countries, Biodiversity hotspots, Citizen Science, env. movements	1 hr
4.3	Threats to wildlife: IUCN Red and green books, conflict and Mitigation	1 hr
4.4	Animal behaviour and Anthropomorphism	1 hr

REFERENCE BOOKS

1. INVERTEBRATES. Vol-1. By Kotpal, rastogi publications.
2. INVERTEBRATES – Structure and function. By Barrington. ELBS.
3. INVERTEBRATE ZOOLOGY. By Meclisten. Oxford Publishing House.
4. HUMAN ANATOMY AND PHYSIOLOGY, 6th edition. By Elaine N. MArieb, Benjamin – Cummings publication.
5. A TEXT BOOK OF PHYSIOLOGY. By D. Emslie-Smith, Churchill Livingstone publication, 1988.
6. THE SCIENCE OF ENTOMOLOGY. By William S. Romoser and John G. Stoffolano Jr.
7. FUNDAMENTALS OF ENTOMOLOGY. By Richard J. Elzinga.
8. WILDLIFE ECOLOGY, CONSERVATION AND MANAGEMENT. Second edition, By Anthony R E Sinclair, John M. Fryxell and Graeme Caughley.
9. TEXT BOOK OF ANATOMY AND PHYSIOLOGY FOR NURSES AND ALLIED HEALTH SCIENCES. By Indu Khurana & Arushi, CBS Publishers and distributors, 2010.
10. DISEASES AND DISORDERS, Vol-2. By Marshall Cavendish, 2007.

DEPARTMENT OF ZOOLOGY

SEMESTER	V
TITLE OF THE PAPER	Cell Biology, Molecular Biology and Immunology
PAPER CODE	ZO 5118
NUMBER OF TEACHING HOURS PER WEEK	03
TOTAL NUMBER OF TEACHING HOURS PER SEMESTER	45 hours (39 hours of teaching + 6 hours of self study)
NUMBER OF CREDITS	03

Program outcome:

- To create a learning framework of enhanced knowledge in understanding the skills in cell biology, molecular biology and the overall organization of the immune system.
- To develop observational and analytical skills
- Motivate the students to pursue research in the field of cell, molecular biology and immunology.

Course outcome: Provide broad and deep understanding of the concepts, principles, techniques and applications of cell biology, molecular biology and immunology.

Units **PART A – Cell Biology** **23 hrs**

1 INTRODUCTION TO CELL BIOLOGY **8hrs**

1.1 Microscopy- Working principle and components – Compound microscope, fluorescent microscope, Phase-contrast microscope and Electron microscope. 2hrs

1.2 Plasma membrane – Robertson model, Fluid mosaic model of Singer and Nicholson. 1hr

1.3 Modifications of Plasma membrane – Microvilli, Desmosomes, Tight junctions and Gap junctions. 1 hr

1.4 Functions of Plasma membrane: Osmosis, Diffusion, Facilitated transport, Carrier molecule concept, Active and passive transport **(Self-study)** 1hr

1.5 Structure and function of cell organelles - 2 hrs

- Mitochondria
- Golgi complex
- Endoplasmic reticulum – smooth ER and rough ER
- Ribosomes and Lysosomes – structure and function**(Self study)** 1 hr

2 CHROMOSOMES: ORGANIZATION AND ANOMALIES **8hrs**

2.1 Gross structure of chromosomes with a brief account of Nucleosome model. Types of chromosomes based on the position of Primary

	constriction; Telomere, Autosomes and Allosomes	3hrs
2.2	Polytene chromosome in *Drosophila melanogaster* – Formation, Structure and significance.	1hr
2.3	Human Karyotype: Normal karyotyping, Idiogram, Outlines of banding techniques: G, Q & R bandings and FISH	1 hr
2.4	Structural aberrations in chromosomes - Deletion, Duplication, Translocation and Inversion	2 hrs
	Numerical aberrations in chromosomes-Polyploidy and Aneuploidy **(Self-study)**	1 hr
3	**CELL CYCLE, APOPTOSIS,STEM CELLS & CANCER BIOLOGY**	**7 hrs**
3.1	Cell cycle - Stages of Cell cycle	1hr
3.2	Apoptosis-Definition, Significance with examples, comparison of apoptosis with necrosis, brief account of apoptosis in *Caenorhabditis elegans* (Molecular pathway) and consequences of deregulated apoptosis.	2hrs
3.3	Stem cells: Origin, types and applications **(Self study)**	1hr
3.4	Cancer biology-Definition, metastasis, types of cancer, general properties of cancer cells, structural and metabolic variations in cancer cells and carcinogens. Types of treatment of cancer.	3hrs
Units	**PART B – Molecular biology and immunology**	**22 hrs**
4	**NUCLEIC ACIDS**	**5hrs**
4.1	Chemical composition, structure, types of DNA-Watson and Crick model and Chargaff's rule.	3hrs
4.2	RNA- Types and structure of RNA-Viral RNA, mRNA, tRNA and rRNA.	2hrs
5	**CENTRAL DOGMA OF MOLECULAR BIOLOGY**	**7hrs**
5.1	DNA replication –Semi conservative type (Meselson and Stahl expt.)-steps involved in activation, unwinding, formation of RNA primers, Okazaki fragments.	2hrs
5.2	Genetic code - Triplet codon, code characteristics-Degeneracy and Wobble hypothesis	1hr
5.3	Protein synthesis in prokaryotes and eukaryotes– Transcription and Translation	3 hrs
5.4	DNA amplification through PCR technique [thermocycler] and its applications **(Self-study)**	1 hr
6	**IMMUNOLOGY**	**10hrs**
6.1	Immunity-Innate and acquired with suitable examples.	1hr
6.2	Components of Immune system–B, T–lymphocytes, Monocytes and Macrophages.	1hr

6.3	Antigens and antibodies–Types of antigens. Structure of Antibody, different types of antibodies-IgG, IgA, IgM, IgE and IgD. Antigen–Antibody reactions – Agglutination, precipitation, flocculation, complement fixation and opsonization.	2 hrs
6.4	Production of monoclonal antibodies by Hybridoma technique and its applications.	1hr
6.5	Hypersensitivity- Anaphylactic, cytotoxic, immune complex mediated and delayed.	1hr
6.6	Autoimmune diseases- Definition and causes. Example- Multiple Sclerosis, Arthritis, Lupus erythematosus **(Self-study)**	1hr
6.7	AIDS– Structure of HIV, causes, preventive measures, ELISA Test	1hr
6.8	Transplantation– Autograft, Syngraft, Allograft, and Xenograft. Organ transplantation, graft rejection, immune suppressors, plastic surgery and cornea grafting.	2hrs

Paper code ZO5P1
ZOOLOGY-SEMESTER V
PRACTICAL–V
CELL BIOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY

Total number of Units **10**

Units

1	Squash preparation • Onion root tips for mitosis. • Grass hopper testes for meiosis.	3units
2	Mounting of salivary gland chromosome in *Drosophila* larvae	1unit
3	Extraction of DNA from liver tissue and buccal cells.	1unit
4	Estimation of DNA by Diphenylamine method.	1unit
5	Estimation of RNA by Orcinol method.	1unit
6	Paper Chromatography for the separation of eye pigments in *Drosophila*	1unit
7	Blood grouping: Antigen and antibody reaction and Study of Blood smear for different types of blood cells. Differential counting of blood cells by Haemocytometer.	1unit
8	PCR technique–demonstration only	1unit

SCHEME FOR PRACTICAL EXAMINATION
PRACTICAL V
ZO5P1: CELL BIOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY

Duration: 3 hours **Max. Marks-35**

1	Preparation of a temporary squash of onion root tips/grass hopper, testes and identification of any two stages with neat labelled diagrams.	**10**
2	A) Extraction of DNA	**5**
	B) Estimation of DNA/RNA.	**10**
3	Identification of Blood groups. Comment on Antigen and antibody reaction/ Blood smear.	**5**
4	Records	**5**

REFERENCE BOOKS

1. CELL BIOLOGY. Gerard Karp, 7th edition.
2. MOLECULAR BIOLOGY OF THE GENE. Watson et.al., 2004, Pearson publication
3. MOLECULAR BIOLOGY OF THE CELL by Bruce Alberts, 5th edition.
4. CELL BIOLOGY – Winchester
5. CHROMOSOMES by MJD White
6. IMMUNOLOGY by Fahim Khan. Pearson education
7. PRINCIPLES OF IMMUNOLOGY by George Pinchuk
8. CELL BIOLOGY by DeRobertis
9. IMMUNOLOGY by Janis Kuby.
10. BIOLOGY OF MICROORGANISMS, 13th edition by M. Madigan *et al*., Pearson 2012.
11. PRINCIPLES OF BIOCHEMISTRY by Lehninger
12. CELL BIOLOGY, GENETICS, MOLECULAR BIOLOGY EVOLUTION & ECOLOGY, Agarwal V. K. and Verma P.S , S. Chand & Company Pvt Ltd.

MODEL BLUE PRINT

Paper code ZO5118

Title - CELL BIOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY

Unit no.	Title	No. of teaching hours	Max marks allotted to each unit
1.	INTRODUTION TO CELL BIOLOGY	8	16
2.	CHROMOSOMES: ORGANIZATION AND ANOMALIES	8	16
3.	CELL CYCLE, APOPTOSIS, STEM CELLS AND CANCER BIOLOGY	7	14
4.	NUCLEIC ACIDS	5	10
5.	CENTRAL DOGMA OF MOLECULAR BIOLOGY	7	14
6.	IMMUNOLOGY	10	20
		45	
		Total marks	70
		Total marks including bonus	90

MODEL QUESTION PAPER –V SEMESTER Paper V (3 CREDITS-45 TEACHING HOURS)

MAX MARKS : 70 (90 WITH CHOICE)

PART A: 1 mark questions – 7 nos. (Fill in the blanks)	7 x 1 = 0**7**
PART B: 2 marks questions – 4 nos. – Short answers.	4 x 2 = 0**8**
PART C: 5 marks questions – 5 nos. (+2 choice questions)	5 x 5 = **25**
PART D: 10 marks questions – 3 nos. (+1 choice question)	3 x 10 = **30**
MAXIMUM MARKS	**70**

DEPARTMENT OF ZOOLOGY

SEMESTER	V
TITLE OF THE PAPER	Ecology, Wildlife and Animal Behaviour
PAPER CODE	ZO 5218
NO. OF TEACHING HOURS PER WEEK	03
TOTAL NO. OF TEACHING HOURS PER SEMESTER	45 (39 hours of teaching + 6 hours of self study)
NO. OF CREDITS	03

Program outcome:

- To understand the organisation and function of the ecosystem and animal societies.
- To create awareness about current trends in conservation biology and climate change.
- To appreciate the ecological significance of biodiversity in India.

Course Outcome:

- To find career opportunities in the field of ecology and wildlife.
- To be instruments of change by involving, educating and creating awareness among general public about the need to conserve biodiversity and our environment.

UNITS	PART A - ECOLOGY	32 hrs
1	**ECOSYSTEMS AND HABITAT ECOLOGY**	**8hrs**
1.1	**Introduction**: The scope and branches of ecology, components of ecosystem (abiotic and biotic), ecotone and edge effect, weather and climate	2hrs
1.2	**Habitat and Niche:** Concept (types with examples, Aquatic and terrestrial, micro and macro; exobiology). Niche: types, competitive exclusion (*Paramecium aurelia* and *P. caudatum*) and resource partitioning with examples.	2hrs
1.3	**Ecosystems**: Aquatic ecosystems: Freshwater – lentic & lotic systems. Type study: Pond ecosystem. Marine ecosystem – zonation of the sea and ecological classification of marine biota. Estuary and wetlands. Terrestrial ecosystems: Types and general features of terrestrial biomes, soil profile and soil organisms.	4hrs
2	**ECOLOGICAL ENERGETICS**	**5 hrs**
2.1	**Energy flow in ecosystem:** Laws of thermodynamics and energy flow models.	1 hr
	A) Food chain and food web B) Ecological pyramids types with examples **(Self study)**	1 hr
2.2	**Productivity**: Primary & secondary productivity. Methods of measuring primary productivity – Harvest, Dark and light bottle, Carbon dioxide method, Chlorophyll and Bomb calorimetry.	2hrs
2.3	**Bio-geo chemical cycles**: Definition and types, Nitrogen cycle, Nutrient Enrichment and Eutrophication.	1hr

3	**ECOLOGICAL FACTORS**	**5 hrs**
3.1	**Limiting factors**: Liebig's law of minimum and Shelford's law of tolerance and Allen's effect on minimum group size.	2 hrs
3.2	**Effects of abiotic factors**:	
	• Light (Development, photo-periodism, bioluminescence, celestial orientation, pigmentation and Light Pollution (Artificial light pollution at night - ALAN	2 hrs
	• Temperature on animals (Development, Cyclomorphosis, Metabolism). Poikilotherms and Homeotherms **(self study)**.	1 hr
4	**POPULATION AND COMMUNITY ECOLOGY**	**6 hrs**
4.1	**Population Characteristics**: Concept of Density, Natality, Mortality, Dispersion and Age structure.	1 hr
4.2	**Population growth**: Linear and Exponential. Concept of biotic potential and environmental resistance. Density dependent and independent growth, r and k selected species.	2hrs
4.3	**Community ecology**: Animal associations–Positive (Mutualism, commensalism, proto-cooperation), Negative (Parasitism, Antibiosis, Predation and Competition) with relevant examples. Lotka-Volterra model.	1hr
4.4	**Ecological succession**: Meaning, types (primary and secondary), stages with reference to Hydrosere.	2hrs
5	**GLOBAL ENVIRONMENTAL ISSUES**	**4hrs**
5.1	**Pollution**: Water and Air pollution**(self study)**	1 hr
	• Greenhouse effect and global warming, climate change, IPCC	1 hr
5.2	**Eco-toxicology**: Meaning, dose, response, bio-magnification, bioaccumulation, biotransformation, endocrine disruptors, toxicity measures-LC 50 and LD 50, EIA and bioremediation -Types, advantages and disadvantages with examples.	2hrs
6	**WILDLIFE AND CONSERVATION BIOLOGY**	**4 hrs**
6.1	**Basic concepts**: Mega-diverse nations, Biodiversity Hotspots in India. Endemic species in India. Keystone, Umbrella and Flagship species.	1 hr
6.2	**Wildlife protection**:	
	• Protected areas in India, IUCN categories and criteria with Indian examples. Red and Green data book (**Self-Study**)	1 hr
	• Threats and measures to preserve Biodiversity. Conflict and mitigation, captive breeding programs, population reintroductions and translocations, wildlife Protection Act (1972) , CITES	1 hr

6.3	**Environmental movements**: Chipko and Appiko movements, Citizen science (**Self-Study**)	1 hr

PART – B ANIMAL BEHAVIOUR

7	**ANIMAL BEHAVIOUR**	**13hrs**
7.1	**Introduction**: Aims and objectives, contributions of Konrad Lorenz, Karl Von Frisch and Niko Tinbergen	1 hr
7.2	**Stereotyped Behaviour**: Characteristics, taxis, kinesis, reflexes & instincts with suitable examples	1hr
7.3	**Learning Behaviour**: Approaches (Mechanistic, vitalistic, and ethological). Imprinting, habituation, associative learning (Classical and instrumental conditioning) and insight learning	3 hrs
7.4	**Animal Communication:** Chemical, auditory, visual, tactile (Features with examples)	2hrs
7.5	**Sociobiology**: Hamilton's rule and Altruism; advantages and disadvantages of social grouping. • Bird Sociobiology: Cooperative breeding in birds and Brood Parasitism • Primate Sociality: Social systems in primates with examples	3hrs
7.6	**Foraging Behaviour**: Optimal foraging theory, Group foraging with special reference to birds.	1 hr
7.7	**Chronobiology**: Types of Biorthythms, Phase response curve, biological clock, Entrainment, Zeitgebers and Dyschronism	1 hr
7.8	**Field ethology**: Techniques involved in study of Animal Behaviour (**Self-Study**)	1 hr

Paper code- ZO 5P2

ZOOLOGY SEMESTER–V

Practical VI

ZO5P2: ECOLOGY, WILDLIFE AND ANIMAL BEHAVIOUR

I. ECOLOGY EXPERIMENTS 5units

1. Estimation of salinity.
2. Estimation of dissolved oxygen.
3. Estimation of organic matter.
4. Determination of total hardness in water and pH by pH meter.
5. Estimation of calcium carbonate content in soil

II. ECOLOGICALADAPTATIONS 3 units

1. Fossorial forms- Amphioxus, Dentalium and Balanoglossus
2. Sedentary forms- Barnacle, sea anemone and Ascidia
3. Colonial forms–honey bees and termites
4. Parasitism-tapeworm, sacculina on crab,
5. Mutualism: Facultative (hermit crab with sea-anemone) and obligatory (Fig-Fig wasp)
6. Mimicry and camouflage-stick insect, leaf insect and chameleon.
7. Volant Adaptations- Draco, Exocoetus and Bat

III. COMPONENTS OF FIELD ECOLOGY 1 unit

1. Camera traps, Binoculars, GPS, sound recorders
2. Identification of indirect evidences: pugmark (tiger, leopard and wild dog) and excrement (scat, pellet, dung, droppings)
3. Problems to solve using Simpson's index

IV. ANIMALBEHAVIOUR 1 unit

1. Demonstration of Geotaxis and observation of courtship behaviour in *Drosophila*

**** A field report must be submitted***

SCHEME FOR PRACTICAL EXAMINATION

PRACTICAL - VI

ZO 5P2: Ecology, Wildlife and Animal Behaviour

Duration: 3hours Max Marks: 35

1. A. Major experiment	10
B. Minor experiment	5
2. Spotters /Problem to solve	5 X 3 = 15
3. Record	5

Reference books

1. Collin R, Townsend, Harper J L, and Michael Begon. 2000 Essentials of ecology. (Blackwell Sci. Comp.) pp 552
2. Manning. An introduction to animal behaviour-5th ed. Cambridge Press
3. Odum E P 1971 Fundamentals of ecology (WB Saunders Co.) Pp 574.
4. Pandey B. N. Ecology and Animal Behavioural-.4:.; Tata McGraw-Hill Education.
5. Attenborough, D. Trials Of Life: A Natural History Of Animal Behaviour:.; Little Brown & Co
6. Evolution adaptation and ecology; Sanjiv Chattopadhyay. 2014 books and allied private limited
7. Animal behaviour; Dr VK Agarwal 2009; S Chand and company.
8. Animal behaviour psychobiology and ecology and evolution; David Mcfarland 1987, ELBS publications
9. Hazardous waste management; La Grega and Evans 2015 scientific international distributors and publishers
10. Ecology and environmental sciences; J.P Singh S.P Singh S.R Gupta 2014 S. Chand publications
11. Animal behaviour ecology and evolution; Bernard CJ London CroomHelme 1983
12. Dustin R Rubenstum and John Alcock: Animal behaviour. Sinauer assosiate publishers. 2019

Model blue print

Paper code - Z0 5218
Title: Ecology Wildlife and Animal Behaviour

UNITS	Title	No. of hours allotted	Max. Marks allotted to each units
7.	Ecosystems and habitat ecology	8hrs	16
8.	Ecological energetics	5 hrs	10
9.	Ecological factors	5hrs	10
10.	Population and community ecology	6hrs	12
11.	Global environmental issues	4hrs	8
12.	Wildlife and conservation biology	4 hrs	8
13.	Animal Behaviour	13hrs	26
		45	
		Total marks	70
		Total marks including bonus	90

MODEL QUESTION PAPER –V SEMESTER PAPER VI (3 CREDITS-45 TEACHING HOURS)

MAX MARKS: 70 (90 WITH CHOICE)

PART A: 1 mark questions – 7 nos. (Fill in the blanks)	7 x 1 = **7**
PART B: 2 mark questions – 4 nos. – Short answers.	4 x 2 = **8**
PART C: 5 mark questions – 5 nos. (+2 choice questions)	5 x 5 = **25**
PART D: 10 mark questions – 3 nos. (+1 choice question)	3 X 10 = **30**
MAXIMUM MARKS	**70**

DEPARTMENT OF ZOOLOGY

SEMESTER	VI
TITLE OF THE PAPER	HISTOLOGY,GENETICS AND BIOTECHNOLOGY
PAPER CODE	ZO 6118
NUMBER OF TEACHING HOURS PER WEEK	03
TOTAL NUMBER OF TEACHING HOURS PER SEMESTER	45 hours (39 hours of teaching + 6 hrs of self study)
NUMBER OF CREDITS	03

Program outcome: To understand the tissue architecture in mammalian organs, to be informed and appreciate the science behind inheritance. Learning molecular techniques for human welfare.

Course outcome: Enabling students to pursue career in R&D sector as well as in the advanced fields of Zoology for the welfare of mankind.

PART A - HISTOLOGY

UNITS

1	**HISTOLOGICAL STRUCTURES OF MAMMALIAN ORGANS-**	**12 hrs**
1.1	Tongue, stomach, small intestine, liver, pancreas, kidney, pituitary, adrenals, testes, ovary	11 hrs
	(thyroid and spleen) **(Self-study)**	1hr
	PART B – GENETICS	**27 hrs**
2.	**MENDELIAN GENETICS**	**3hrs**
2.1	Introduction	1hr
2.2	Principles of Mendelian genetics–law of dominance, law of segregation, law of independent assortment, test cross, back cross and problems.	2 hrs
3	**EXTENSIONS OF MENDELISM**	**6hrs**
3.1	Incomplete dominance, Co-dominance and Multiple alleles-ABO blood groups in man, Rh factor.	2hrs
	Problems– **(Self study)**	1hr
3.2	Interaction of genes- comb patterns in fowl; problems.	1hr
3.3	Epistasis- plumage in white leghorn and white Plymouth breed of fowls.	1hr
3.4	Polygenic inheritance- skin colour in man, Pleiotropy.	1hr

4	**LINKAGE, CROSSING OVER AND MAPPING**	**5 hrs**
4.1	Linkage in Drosophila- grey body and vestigial wings, Mapping- recombination frequency and map units.	2hrs
4.2	Crossing over-mechanism and theories.	1hr
4.3	Sex linkage–Hemophilia, colour blindness and eye colour in Drosophila.	1hr
	Problems – **(Self study)**	1 hr
5	**SEX DETERMINATION**	**4hrs**
5.1	Chromosomal Sex Determination : XX-XY, XX-XO, ZZ-ZW and ZZ-ZO types.	1hr
5.2	Dosage Compensation- Barr body, Lyon's hypothesis, Genic balance theory of Bridges, gynandromorphs and free martins.	2hrs
5.3	Non-disjunction of Sex chromosomes- Turner's syndrome, Klinefelter's syndrome.Autosomal anomalies - Down syndrome and Cri-du-chat syndrome.	1hr
6	**MUTATIONS**	**2hrs**
6.1	Gene mutations- Base substitution, Insertions and deletions, ClB method of detecting sex linked lethal mutations.	1hr
6.2	Spontaneous and induced mutations, Physical and Chemical Mutagens: Radiations, Base analogs and Alkylating agents.	1hr
7	**REGULATION OF GENE EXPRESSION**	**2hrs**
7.1	Prokaryotes - Inducible lac operon	1hr
	repressible trp operon (**Self-study**)	1hr
8	**HUMAN GENETICS**	**5hrs**
8.1	Patterns of Inheritance - Autosomal dominant, Autosomal recessive, X-linked recessive, X- linked dominant and Y-linked.	2hrs
8.2	Inborn errors of metabolism- Phenylketonuria, Alkaptonuria, Galactosemia and Sickle cell anaemia.	1hr
	Albinism, Thalasemmia and Haemophila (**Self-study)**	1hr
8.3	Eugenics – positive and negative eugenics. Genetic testing- Pre-natal and post-natal genetic testing **(Self-study)**.	1hr
	PART C – BIOTECHNOLOGY	**6hrs**
9	**TOOLS IN GENETIC ENGINEERING**	
9.1	Restriction Endonucleases (Type I, II and III), Ligases, DNA Polymerases, Reverse transcriptase, Vectors and Cloning host.	2hrs
9.2	Application of recombinant DNA technology: Production of human insulin and Transgenic animal.	1hr
9.3	Molecular Genetic analysis– Polymerase Chain Reaction, DNA sequencing- Sanger method, DNA markers and Fingerprinting.	2hrs
9.4	Bioinformatics- Introduction to Databases, Search tool: BLAST and FASTA, Local and Global sequence alignment.	1hr

Paper code ZO6P1
ZOOLOGY SEMESTER-VI
Practical VII
ZO 6P1: HISTOLOGY, GENETICSAND BIOTECHNOLOGY

Total number of Units **10 units**

1	Histology of mammalian organs- Tongue, stomach, small intestine, liver, pancreas, spleen, kidney, thyroid, adrenals, pituitary, testis and ovary	4 units
2	Statistical assessment of visible phenotypic traits (classroom exercise) and preparation of buccal smear for barr body.	1unit
3	Genetic problems with emphasis in pedigree analysis	1unit
4	Drosophila culture, Life history, male and female identification, sex count and mutants (white eye, yellow body, bar eye, vestigial wings and ebony body).	1 unit
5	Mounting of sex comb and Genital plate in Drosophila.	1 unit
6	Restriction digestion of plasmid DNA.	1unit
7	Online Databases- NCBI, EMBL and DDBJ, Search tool- BLAST and FASTA	1unit

SCHEME FOR PRACTICAL EXAMINATION

PRACTICAL -VII
ZO6P1: HISTOLOGY, GENETICS AND BIOTECHNOLOGY

Duration: 3 Hours **Max Marks 35**

1	Identification of histology slides (A to D)	4X4 = 16
2	Preparation of Barr body/ Mounting sex comb/ Mounting genital plate	5
3	Identification of any 2 mutants.	2 X 2 = 4
4	Genetic problems	5
5	Record	5

REFERENCE BOOKS

1. GENETICS-A CONCEPTUAL APPROACH by Benjamin A. Pearce, 2012.
2. GENES X. Benjamin Lewin, 2004, Pearson Prentice Hall publication.
3. GENETICS 3rd edition, Strickberger
4. PRINCIPLES OF GENETICS. Gardner
5. TEXT BOOK OF GENETICS. Winchester
6. CELL BIOLOGY, GENETICS, MOLECULAR BIOLOGY, EVOLUTION AND ECOLOGY, Verma and Agarwal
7. TEXTBOOK OF HISTOLOGY, Bevelander
8. HUMAN HISTOLOGY, Inderbir Singh
9. PRACTICAL MANUAL OF HISTOLOGY FOR MEDICAL STUDENTS, Neelkanth Kote
10. TEXTBOOK OF HISTOLOGY by Krishna Garg and *et al*.
11. MOLECULAR BIOLOGY OF THE GENE, Watson *et al.*, 2004, 5th edition, Pearson publications.
12. GENETICS-A MOLECULAR APPROACH, Peter J. Russel, 3rd edition, Benjamin Cummings.
13. CELL AND MOLECULARBIOLOGY, Concepts and Experiments.5th edition Karp, Wiley Publications.
14. PRINCIPLES OF GENETICS by Sinnott, Dunn & Dobzhansky, 5th edition, 1958, McGraw Hill publications.
15. *INTRODUCTION TO BIOINFORMATICS*,T. Attwood and P. Smith. USA: Pearson Education, 2007.
16. BIOTECHNOLOGY by U. Satyanarayana.
17. PRINCIPLES OF GENE MANIPULATION AND GENOMICS by S. B. Primrose and R.M. Twyman, Blackwell publications.
18. ESSENTIAL BIOINFORMATICS by Jin Xiong.

MODEL BLUEPRINT
PAPER CODE - Z0 6118
TITLE: HISTOLOGY, GENETICS AND BIOTECHNOLOGY

UNITS	Title	No. of hours allotted	Max. marks allotted to each unit
1.	Histology	12	24
2.	Mendelian Genetics	3	6
3.	Extensions of Mendelism	6	12
4.	Linkage, Crossing over and Mapping	5	10
5.	Sex Determination	4	8
6.	Mutations	2	4
7.	Regulation of Gene expression	2	4
8.	Human Genetics	5	10
9.	Biotechnology	6	12
		Total marks	70
		Total marks including choice	90

MODEL QUESTION PAPER–SEMESTER VI, PAPER VII (3 CREDITS–45 TEACHING HOURS)

MAX MARKS: 70 (90 WITH CHOICE)

PART A: 1 mark questions – 7 nos. (Fill in the blank) 7 x 1 = **7**

PART B: 2 marks questions – 4 nos. – Short answers. 4 x 2 = **8**

PART C: 5 marks questions – 5 nos. (+2 choice questions) 5 x 5 = **25**

PART D: 10 marks questions – 3 nos. (+1 choice question) 3 x 10 = **30**

TOTAL MARKS **70**

DEPARTMENT OF ZOOLOGY

SEMESTER	VI
TITLE OF PAPER	Developmental Biology, Evolution and Zoogeography
PAPER CODE	ZO 6218
NO. OF TEACHING HOURS PER WEEK	3 hrs
TOTAL NO. OF TEACHING HOUR PER WEEK	45 hrs (39 hours of teaching+ 6 hours of Self- study
NO. OF CREDITS	3

Program outcome:

- To understand development and evolutionary patterns including human evolution .
- To understand the principles of population genetics and factors leading to speciation.

Course outcome: Prepare students to pursue careers on research in developmental and evolutionary biology

PART A - DEVELOPMENTAL BIOLOGY — 27 hrs

UNITS

1 INTRODUCTION TO DEVELOPMENT — 3 hrs

1.1 Theories of development–Preformation theory, Epigenetic theory and Von Baers theory. — 1 hr

1.2 Reproductive patterns: — 1 hr

Parthenogenesis (haploid, diploid and artificial) — 1 hr

Asexual (Budding, fission, regeneration), Sexual (conjugation, oviparity, viviparity and ovoviviparity) **(Self-study)**

2	**CLEAVAGE**	**5 hrs**
2.1	Types of eggs-based on distribution and quantity of yolk with suitable examples.	1 hr
2.2	Cleavage–Types of cleavage planes, patterns of cleavage, types of cleavages, influence of yolk on the process of cleavage, types based on the amount of yolk with examples.	2 hrs
2.3	Structure and evolutionary significance of a Cleidoic egg with chick's egg as an example.	1 hr
2.4	Cleavage patterns in Amphioxus, frog and chick embryos	1 hr
3	**BLASTULA AND BLASTULATION**	**3 hrs**
3.1	Blastulation in Amphioxus, Frog and Chick	2 hrs
3.2	Comparative account of the blastula of Amphioxus, Frog and Chick.	1 hr
4	**GASTRULATION**: Gastrulation in Amphioxus, Frog and chick.	**3hrs**
5	**DEVELOPMENTAL GENETICS**: Egg polarity, Segmentation and Homeotic genes in *Drosophila* development	**1 hr**
6	**ORGANOGENESIS**	**5 hrs**
6.1	Organizer phenomena–Definition of organizer, Spemann experiments (potencies of gray crescent, the dorsal lip of the blastopore of amphibian gastrula), Spemann and Mangold transplantation experiment. Chemical nature and structure of organizer	2 hrs
6.2	Induction–Components, Chain and Reciprocal induction, Competence with reference to development of amphibian eye.	1 hr
6.3	Fate maps of Frog, Neurulation, Notogenesis and Mesogenesis with reference to Frog	2 hrs
7	**EXTRA-EMBRYONIC MEMBRANES**	**3hrs**
7.1	Extraembryonic membranes of chick: Formation,structure and functions of Yolksac, Amnion, Chorion and Allantois.	1 hr

7.2	Placenta:Types based on foetal membranes involved (Yolksac, Allantoic and chorionic placenta) **(Self – study)**	1 hr
7.3	Morphological (deciduous and non-deciduous) and Histological classification with examples. Placental hormones and their functions.	1 hr
8	**HUMAN DEVELOPMENTAL BIOLOGY**	**4hrs**
8.1	Role of Gonadotropins, hormones secreted by testes and ovaries **(Self-study)**	1 hr
8.2	Menstrual Cycle and its hormonal control.	1hr
8.3	Process of fertilization, blastocyst formation and implantation.	2 hrs
UNITS	**PARTB–EVOLUTION AND ZOOGEOGRAPHY**	**18hrs**
9	**GEOLOGICAL TIME SCALE**	**2hrs**
9.1	Eras, periods and epochs with major fauna of each period.	1 hr
9.2	Origin of life: Protobiont, ribozymes, endosymbionts, Cambrian explosion, Mass extinctions **(Self-study)**	1 hr
10	**THEORIES OF ORGANIC EVOLUTION**	**3hrs**
10.1	Lamarckism and Neo-Lamarckism **(Self-study)**	1 hr
10.2	Darwin-Wallace theory of Natural Selection, Critical account of Darwinism. Modern synthetic theory	1 hr
10.3	Hardy-Weinberg law of genetic equilibrium and Elementary forces of evolution: Derivation, gene mutation, gene flow, genetic drift (founder and bottleneck effects), Natural selection (Directional, stabilizing and disruptive) and Isolation	1 hr
11	**EVIDENCES IN SUPPORT OF ORGANIC EVOLUTION**	**3hrs**
11.1	Anatomical, Serological and Embryological.	1 hr
11.2	Paleontological evidences: Fossils : definition, importance, formation and types of fossils. Dating of fossils: Uranium-lead method, potassium–argon method, radio carbon method.	1 hr
11.3		1 hr

12	**MECHANISMS OF SPECIATION**	**5hrs**
12.1	Biological species concept, Isolating mechanisms and speciation: reproductive isolation (pre and post –zygotic barriers) and geographic isolation (allopatry, sympatry and parapatry)	1 hr
	Adaptive radiation (Mammals and reptiles) **(Self –study)**	1 hr
12.2	Micro and macro evolution, Molecular clocks and Co-evolution (Bees and angiosperms)	1 hr
12.3		2 hrs
12.4	Basics of Phylogenetics, Cladogram with an example	
13	**ORTHOGENESIS OF HORSE:** Causes and fossil forms**:** Hyracotherium/Eohippus, Mesohippus, Merychippus and *Equus*.	**1 hr**
14	**PALAEOANTHROPOLOGY:** Ramapithecus, Homonins: *Australopithecus afarensis*, genus *Homo*(*H. habilis, H.eragaster, H.erectus* -peking and java man),*H. heidelbergensis- H. neanderthalensis), H.sapiens* (Cro-magnon man and *H.sapiens sapiens*)	**1 hr**
15	**ZOOGEOGRAPHY**	**3hrs**
	Plate tectonics : A brief account of continental drift, evidences in favour of continental drift	1 hr
	Causes for discontinuous distribution. Zoological realms with major fauna	2 hrs

PAPER CODE ZO6P2
ZOOLOGY SEMESTER–VI
PRACTICAL–VIII
DEVELOPMENTAL BIOLOGY, EVOLUTION AND ZOOGEOGRAPHY

Sl.no	Total number of practicals	10 units
1	**Frog embryology:** Study of cleavage, blastula, gastrula and neurula	1 unit
2	**Chick embryology**: Study of 18, 24, 36 and 48hours chick embryo	1 unit
3	**Human embryology**: T.S. of fallopian tube and Uterus (Proliferative and Secretory phase).	1 unit
4	**Placenta:** • Morphological types: Cotyledonarytype (sheep), Monodiscoidal type (human) • Histological types: Haemochorial (Human)	1 unit
5	• Model organisms: *Caenorabditis elegans*, Zebrafish, Mouse • Mounting of fish scale	1 unit
6	**Studyof anatomical evidences** • *Homologous organs*(Forelimbs of Frog and Bird, Mouth parts of Cockroach and Mosquito) • *Analogous organ s*(Bird and Insect wing) • *Vestigial organs*:Appendix,Coccyx, molar tooth, ear pinna • *Phylogenetic homology*: Mounting of mouthparts of Honeybee/ Mosquito and *Drosophila* • *Serial Homology*: Mounting of Prawn appendages.	3 units
7	**Palaentology** • Moulds and Casts(Ammonites, bivalve), Connecting links: Platypus and Peripatus, Living fossil: Nautilus • Phylogenetic analysis.	2 units

SCHEME FOR PRACTICALEXAMINATION

Practical VIII

Papercode ZO6P2: DEVELOPMENTAL BIOLOGY, EVOLUTION AND ZOOGEOGRAPHY

Duration:3Hrs **Max.Marks:35**

1	Embryology:Identify and comment on slides and spotters (A – D)	**4X 4=16**
2	Evolution: dentify and comment on the evolutionary significanceofthe spotters (E – G)	**3 X 3 = 09**
3	Whole mount preparation/Mounting of insect mouth parts/ Mounting of prawn appendages.	**05**
4	Class Records	**05**

REFERENCE BOOKS

1. Balinsky.B.L. 1971 Introduction to Embryology (Saunders College pub.)
2. Beril N.J. and Karpotata.G. 1972 Development (Mc Graw Hill Publications)
3. Carlson.B.M. 1998 Pattern's foundations of Embryology (Mc Graw Hill publications: New York), Delhi
4. Dobzhansky, Th., F. J. Ayala, G. L. Stebbins & J. M. Balentine, 1976. Evolution. Surjeet Publication,
5. Freeman, S and J. C. Herron 1998. Evolutionary Analysis. Prentice Hall, New Jersey.
6. Futuyma D. J. 1986. Evolutionary Biology. Sinauer Associates, INC. Sunderland.
7. Gilbert S.F. 1997 Developmental Biology Fifth edn. (Sinquer Associates Publications, Sunderland)
8. Gilbert. S.F. and Raunio. A.M. 1977 Embryology – Constructing the Embryo (Sinauer Associates Inc. Pub: Sunderlands USA)
9. Grunz. H. 2004 Vertebrate Organizer – pp 429 (Springer)
10. Guilbert S.F. and Mussach. S. 1999 Developmental Biology (Sinquer Associates Publication,
11. Smith, J. M. 1998. Evolutionary Genetics. Oxford University Press. Oxford.
12. Stearns, S. C. and R. F. Hoekstra 2000. Evolution: An Introduction. Oxford University Press, Oxford.
13. Strickberger, M. W. 1990. Evolution. Jones and Bartlett Publishers. Boston
14. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
15. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

MODEL BLUE PRINT
PAPER CODE: ZO 6218

TITLE: DEVELOPMENTAL BIOLOGY, EVOLUTION AND ZOOGEOGRAPHY

Unit no.	Title	No. of hours alloted	Max. Marks allotted to each unit
1.	**INTRODUCTION TO DEVELOPMENT**	3	6
2.	**CLEAVAGE**	5	10
3.	**BLASTULA AND BLASTULATION**	3	6
4.	**GASTRULATION**	3	6
5.	**DEVELOPMENTAL GENETICS**	1	2
6.	**ORGANOGENESIS**	5	10
7.	**EXTRA-EMBRYONIC MEMBRANES**	3	6
8.	**HUMAN DEVELOPMENTAL BIOLOGY**	4	8
9.	**GEOLOGICAL TIME SCALE**	2	4
10.	**THEORIES OF ORGANIC EVOLUTION**	3	6
11.	**EVIDENCES IN SUPPORT OF ORGANIC EVOLUTION**	3	6
12.	**MECHANISMS OF SPECIATION**	5	10
13.	**ORTHOGENESIS OF HORSE**	1	2
14.	**PALAEOANTHROPOLOGY**	1	2
15.	**ZOOGEOGRAPHY**	3	6
	Total marks excluding bonus marks		**70**
	Total marks including bonus marks		**90**

MODEL QUESTION SEMESTER VI PAPER – VIII (3 CREDITS - 45 TEACHING HOURS)

Max. Marks 70 (90 WITH CHOICE)

PART A: 1 mark questions**–** 7 nos. (Fill in the blanks)	7 x 1 =7
PART B: 2mark questions– 4 nos. – Short answers	4 x 2 =8
PART C: 5 mark questions – 5 nos. – (+ 2 choice questions)	5 x 5 = 25
PART D: 10 mark questions **–** 3 nos**.** – (+ 1 choice question)	3 x 10 = 30
MAXIMUM MARKS **70**	