

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

**New Arts, Commerce and Science College, Ahmednagar
(Autonomous)**

(Affiliated to Savitribai Phule Pune University, Pune)



Choice Based Credit System (CBCS)

Bachelor of Science (B. Sc.)

Syllabus of

T. Y. B. Sc. Zoology

Implemented from

Academic Year 2022 - 23

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)**

Board of Studies in Zoology

Sr. No.	Name	Designation
1.	Hon. Prof. S. N. Pokale	Chairman
2.	Hon. Dr. A. D. Harkal	Member
3.	Hon. Prof. R. J. Chavan	Academic Council Nominee
4.	Hon. Prof. S. S. Nanware	Academic Council Nominee
5.	Hon. Dr. S. S. Teradalkar	Vice-Chancellor Nominee
6.	Hon. Prof. B. A. Pawar	Alumni
7.	Hon. Ms. Manjushree Tadvalkar	Industry Expert
8.	Hon. Shri. M. S. Kasture	Member (co-opt)
9.	Hon. Ms. S. P. Salve	Member (co-opt)
10.	Hon. Shri. G. G. Wakchoure	Member (co-opt)
11.	Hon. Ms. G. R. Devdhe	Member (co-opt)
12.	Hon. Ms. S. S. Mote	Member (co-opt)
13.	Hon. Ms. P. N. Dongare	Member (co-opt)
14.	Hon. Ms. S. J. Wagh	Member (co-opt)

Programme Structure and Course Titles

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	F. Y. B.Sc.	I	BSC-ZO 101 T	Animal Systematics & Diversity-I	02
2.	F. Y. B.Sc.	I	BSC-ZO 102 T	Animal Ecology	02
3.	F. Y. B.Sc.	I	BSC-ZO 103 P	Zoology Practical Paper-I	1.5
4.	F. Y. B.Sc.	II	BSC-ZO 201 T	Animal Systematics & Diversity-II	02
5.	F. Y. B.Sc.	II	BSC-ZO 202 T	Cell Biology	02
6.	F. Y. B.Sc.	II	BSC-ZO 203 P	Zoology Practical Paper-II	1.5
7.	S. Y. B.Sc.	III	BSC-ZO 301 T	Animal Systematics & Diversity-III	02
8.	S. Y. B.Sc.	III	BSC-ZO 302 T	Genetics	02
9.	S. Y. B.Sc.	III	BSC-ZO 303 P	Zoology Practical Paper- III	02
10.	S. Y. B.Sc.	IV	BSC-ZO 401 T	Animal Systematics & Diversity-IV	02
11.	S. Y. B.Sc.	IV	BSC-ZO 402 T	Biological Techniques	02
12.	S. Y. B.Sc.	IV	BSC-ZO 403 P	Zoology Practical Paper- IV	02
13.	T. Y. B.Sc.	V	BSC-ZO 501 T	Animal Biology- I	02
14.	T. Y. B.Sc.	V	BSC-ZO 502 T	Mammalian Histology	02
15.	T. Y. B.Sc.	V	BSC-ZO 503 T	Applied Zoology- I	02
16.	T. Y. B.Sc.	V	BSC-ZO 504 T	Biochemistry	02
17.	T. Y. B.Sc.	V	BSC-ZO 505 T	Developmental Biology	02
18.	T. Y. B.Sc.	V	BSC-ZO 506 T	Parasitology	02
19.	T. Y. B.Sc.	V	BSC-ZO 507 P	Zoology Practical Paper- V	02
20.	T. Y. B.Sc.	V	BSC-ZO 508 P	Zoology Practical Paper- VI	02
21.	T. Y. B.Sc.	V	BSC-ZO 509 P	Zoology Practical Paper- VII	02
22.	T. Y. B.Sc.	V	BSC-ZO 510 T	Computer Applications in Biology	02
23.	T. Y. B.Sc.	V	BSC-ZO 511 P	Zoology Practical Paper- VIII	02
24.	T. Y. B.Sc.	VI	BSC-ZO 601 T	Animal Biology- II	02
24.	T. Y. B.Sc.	VI	BSC-ZO 602 T	Animal Physiology	02
25.	T. Y. B.Sc.	VI	BSC-ZO 603 T	Applied Zoology- II	02

26.	T. Y. B.Sc.	VI	BSC-ZO 604 T	Molecular Biology	02
27.	T. Y. B.Sc.	VI	BSC-ZO 605 T	Evolutionary Biology	02
28.	T. Y. B.Sc.	VI	BSC-ZO 606 T	Entomology	02
29.	T. Y. B.Sc.	VI	BSC-ZO 607 P	Zoology Practical Paper- IX	02
30.	T. Y. B.Sc.	VI	BSC-ZO 608 P	Zoology Practical Paper- X	02
31.	T. Y. B.Sc.	VI	BSC-ZO 609 P	Zoology Practical Paper- XI	02
32.	T. Y. B.Sc.	VI	BSC-ZO 610T	Recombinant DNA Technology	02
33.	T. Y. B.Sc.	VI	BSC-ZO611 Pr	Project	02
	Total	06	33		67



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Syllabus of T.Y. B. Sc. Zoology (Semester-V)
under
Faculty of Science and Technology

Semester – V	Paper – I
Course Code: BSC-ZO 501 T	Title of the Course: Animal Biology- I
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the systematic position, habit habitat and external morphology of type study.
2. Understand the general physiological mechanism in the type study.
3. Understand the mechanism of reproduction in the type study.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	<i>Paramecium caudatum</i> : Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestion and Cyclosis, Excretion and Osmoregulation, Reproduction	(06)
2.	<i>Aurelia</i> Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestion, Respiration, Excretion and Osmoregulation, Reproduction	(06)
3.	<i>Fasciola hepatica</i> : Systematic Position with reasons, External Morphology, Digestion, Excretion, Life Cycle and Reproduction, Pathogenicity and Treatment.	(06)
4.	<i>Palaemon</i>	(06)

Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestive System, Circulatory system, Excretory System, Nervous System, Sense Organs, and Reproductive System

5. *Asterias* (06)
Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestive System, Circulatory system, Excretory System, Nervous System, Sense Organs, and Reproductive System

Suggested Reading:

1. **Modern Text-Book of Zoology, vertebrates.** By Kotpal, RL., Rastogi and Co.,
2. **Nigam H.C., Zoology of Chordates,** Vishal Publication, Jalandhar
3. **Jordan, E.L. and P.S.Verma Chordate Zoology,** S. Chand and Co., Ltd. Ram Nagar, New Delhi.
4. **Fundamentals of Zoology** Ghosh, Manna NCBA
5. **Biology of Vertebrate H.C.** Nigam Vishal Publishers
6. **Biology of Chordate H.C.** Nigam Vishal Publishers



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Semester – V	Paper – II
Course Code: BSC-ZO 502 T	Title of the Course: Mammalian Histology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the scope of Histology.
2. Understand, classify and identify the different types of tissues.
3. Understand the different structures and functions of tissues and organs.
4. Understand the histology and roles of endocrine glands in mammals.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Introduction: Definition and scope of Histology	(01)
2.	Definitions and Review of Types of Tissues: Epithelial tissue. Connective tissue. Nervous tissue. Muscular tissue.	(03)
3.	Histological study of following mammalian organs: Skin (V. S.). Tooth (V. S.). Tongue (C. S.) with reference to mucosa papillae and taste buds.	(03)
4.	Histological study of Alimentary canal and associated glands: Oesophagus (T. S.). Stomach (T. S.). Duodenum (T. S.). Ileum (T.S.)	(09)

Rectum (T. S.).
Salivary glands – parotid (C.S.), submandibular (C.S.) sublingual (C.S.),
Liver (C.S.)
Pancreas (C.S.) including both exocrine and endocrine components.

5. **Histological study of Respiratory organs:** (02)
Trachea (T. S.).
Lung (C. S.).
6. **Histological study of Excretory organs:** (03)
Kidney (L. S.).
Juxtglomerular complex.
7. **Histological study of Reproductive organs:** (04)
Testis (T. S.) with reference to Seminiferous Tubules and Cells of Leydig.
Ovary (C. S.). primary, secondary and matured (Graffian) follicle corpus luteum and corpus albicans.
8. **Histology of Endocrine glands:** (05)
Pituitary gland.
Thyroid gland.
Adrenal gland.

Suggested Reading:

1. **A Text Book of Histology**, 2014, 5th Edn. Krishna Garg, Indira Bahl & Mohini Kaul CBS Publication & Distributors, Delhi.
2. **Histology**, 1987, 9th Edn., Arthur W. Ham, David H. Cormack, J. B. Lippincott Co. Philadelphia.
3. **Histology**, 1977, 4th Edn., R. O. Greep and L. Weiss, McGraw Hill Int. Book Co., New York.
4. **Hand Book of Histo-pathological & Histo-chemical Techniques**, 1983, 3rd Edn. reprint, Butterworth & Co. (Publishers) Ltd, UK.

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Semester – V	Paper – III
Course Code: BSC-ZO 503 T	Title of the Course: Applied Zoology- I
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the biology, varieties of silkworms and the basic techniques of Sericulture.
2. Understand various aspects of goat farming.
3. Understand different techniques in vermiculture.
4. Understand the techniques in pearl culture

Detailed Syllabus:

Unit	Name of Topic	Hours Allotted
1.	Sericulture Introduction Types of silkworms – Mulberry, Tassar, Eri and Muga silkworm. Morphology and life cycle of <i>Bombyx mori</i> . Rearing of silkworms – Selection of Mulberry variety and cultivation of Mulberry (Rain fed and irrigated mulberry cultivation – Fertilizer schedule, pruning methods and leaf yield), Harvesting of Mulberry (leaf plucking, Branch cutting, whole shoot cutting); Rearing house and rearing appliances, Types of Mountages Harvesting and storage of cocoons, Stiffling, Sorting, Storage, Deflossing and riddling. Cocoon cooking, reeling and rereeling equipments, washing and polishing. Economic importance of silk.	(13)
2.	Goat farming Introduction	(04)

Breeds of Goat
Rearing of Goat
Facilities and Equipment
Maintenance and health care
Economic importance of Goat farming

3. Vermiculture : (10)

Introduction of Vermiculture and Vermicomposting.
Exotic and Indigenous species (Any two).
Rearing of Earthworms, Equipments, devices used in Vermiculture, Vermicompost technology.
Bedding, Essential parameters for Vermiculture and Management.
Methods of Harvesting (Manual and Mechanical).
Economic importance of Vermiculture.

4. Pearl culture: (03)

Species of Oyster
Process of Pearl formation: Natural and Artificial
Maintenance of Oysters
Harvesting
Importance of Pearl.

Suggested Readings:

1. **Handbook of Silkworm Rearing:** Agriculture an Technical Manual-1, Fuzi Pub. Co.
2. **Narasimhanna, M. N. Manual of Silkworm Egg Production,** CSB, Banglore 1998.
3. **Wupang-Chun and Chen Da-Chung,** Silkworm Rearing;, pub: By FAO Rome 1998.
4. **Sengupta, K. A Guide for Bivoltine Sericulture;** Director, CSR & TI, Mysore 1989.
5. **Krishnaswamy, S. Improved Method of Rearing Young age silkworm;** CSB, Banglore, 1986.
6. **Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture:** CSB, Banglore.
7. **Jolly. M.S. appropriate Sericultural Techniques;**, Ed., Director, CSR & TI, Mysore.
8. Lee, Earthworm Ecology
9. **Ranganathan L.S., Vermicomposting technology-** soil health to human health.

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Semester – V	Paper - IV
Course Code: BSC-ZO 504 T	Title of the Course: Biochemistry
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand basic concepts and significance of biochemistry
2. Understand the concepts of pH and buffers.
3. Understand the chemical structures of carbohydrates, proteins, and lipids.
4. Understand the nomenclature and inhibition of enzyme activity.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Basic Biochemistry: Bonds –Types: Ionic, covalent, noncovalent bonds (hydrogen, hydrophobic, electrostatic, Van der Waal forces) and their functions in bio molecules Structure of water molecule (liquid, ice and colloid) Physico-chemical properties of water Concept of acid and base, pH, Sorenson's scale, derivation of Henderson Hasselbalch equation and its applications Concept of Buffer-types of buffer, buffering capacity and buffers in biological system (Phosphate, bicarbonate).	(08)
2.	Carbohydrates: Definition, Classification & Biological importance of Carbohydrates. Isomerism in carbohydrates - Structural and Stereoisomerism.	(05)

Definitions and Significance of Gluconeogenesis, Glycogenolysis and Glycogenesis.

Clinical Significance - Hypoglycemia and Hyperglycemia.

3. Amino acids and Proteins: (06)

General Structure of amino acids and Peptide bond.

Essential and non-essential amino acids.

Types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example), Forces responsible for their stability.

Biological importance of proteins – Biocatalysts, Carrier proteins
Contractile proteins, Hormonal role of proteins.

4. Enzymes: (06)

Nomenclature, Types and properties of enzymes.

Regulatory and non-regulatory enzymes.

Enzyme inhibition.

Factors influencing enzyme activity (pH, temperature, substrate concentration).

Introduction of isoenzymes and cofactor.

Clinical significance of enzymes - PKU and AKU.

5. Lipids: (05)

Introduction.

Fatty acids - Types and nomenclature (saturated and unsaturated).

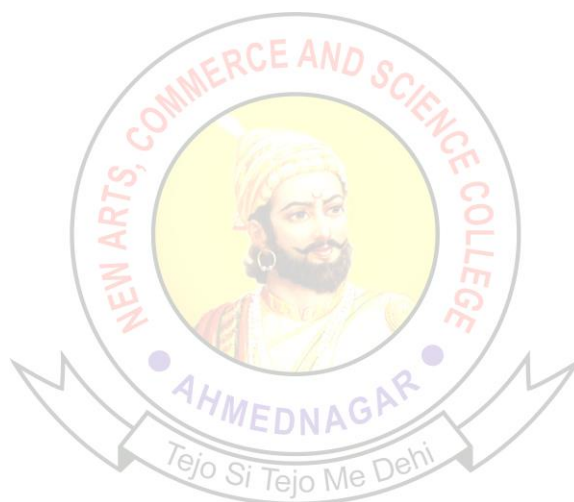
Clinical significance (obesity, atherosclerosis, myocardial infarction).

Biological importance of lipids.

Suggested Reading:

- 1. Principles of Biochemistry**, 1993, Lehninger A. L. Nelson D. L. & Cox M. M. W. H. Freeman Company, USA.
- 2. Biochemistry**, 1995 5th Edn. Zubly G. W, C. Brown Communications USA.
- 3. Harpers Biochemistry**, 1996 26th Edn. p Murray R. K., Granner D. K., Mayes P. A. & Rodwell V. W. Prentice Hall international USA.
- 4. Outline of Biochemistry**, 1995 5th Edn, Conn E. E., Stumph P. K. Bruening G & Doi R. H. John Wiley & Sons, USA.

5. **Principals of Biochemistry**, 1993, 1st Edn., Pattabhiraman T. N. Gajanan Book publishers and distributors Bangalore.
6. **Clinical Biochemistry**, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai.
7. **Biochemistry**, 1995 5th Edn., Stryer San Francisco, W. H. Freeman & Co.
8. **Biochemistry**, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York.
9. **David T. Plummer: An Introduction to Practical Biochemistry**, IIIrd edition (1988)



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Semester – V	Paper - V
Course Code: BSC-ZO 505 T	Title of the Course: Developmental Biology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the basic concepts in Developmental Biology.
2. Understand the concept of gametogenesis and fertilization.
3. Understand various developmental processes.
4. Understand the Chick Embryology.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Fundamentals of Developmental Biology: Definition and scope. Concepts in Developmental Biology: Growth, Differentiation, Dedifferentiation, Cell Determination, Cell communication, Morphogenesis, Induction and Competence, Regeneration, cytoplasmic determinants.	(02)
2.	Gametogenesis: PGCs in mammals: From genital ridge to gonads Structure of sperm and Spermatogenesis with respect to human Structure of ovum and Oogenesis with respect to human. Types of eggs on the basis of: Quantity of yolk and distribution of yolk in the cytoplasm	(04)
3.	Fertilization (with special reference to Sea-urchin) Concept and types.	(06)

- Chemotaxis.
- Sperm penetration: Acrosome reaction, Capacitation and Decapacitation.
- Prevention of polyspermy: Fast block and Slow block.
- Activation of egg metabolism
- Fusion of genetic material (Amphimixis)
- Significance of fertilization.
- 4. Cleavage and Blastula: (04)**
- Planes and symmetry of cleavage
- Types of cleavage: Determinate and indeterminate,
- Holoblastic (Radial, Spiral, Rotational, Bilateral) and meroblastic (Discoidal, Superficial, Bilateral)
- Significance of cleavage
- Types of blastulae: Blastocyst, Amphiblastula, Discoblastula, Periblastula, Coeloblastula, Stereoblastula
- 5. Gastrulation: (03)**
- Concept and significance
- Basic cell movements in gastrulation: Epiboly, Emboly, Convergence, Invagination, Ingression and Involution with reference to frog
- Organizer : Definition and Example
- 6. Chick Embryology: (06)**
- Structure of Hen's egg.
- Fertilization and cleavage in Chick
- Gastrulation: The hypoblast, Formation, elongation and regression of primitive streak, Mesoderm and endoderm formation.
- Formation of neural tube
- 7. The stem cell concept (02)**
- Definition and Types: Totipotent, Pluripotent, Multipotent, Unipotent
- Division and self-renewal
- Applications in medicine
- 8. Development in Health and Disease (02)**

Teratogenesis: Teratogenic agents and their effects on embryonic development

9. Parthenogenesis

(01)

Concept and Example

Suggested Readings:

1. **An Introduction to Embryology, 1981**, Balansky, Saunders college , Philadelphia.
2. **Developmental Biology, 1982**, Saunders, Jw, Coilier, McMillon Publ. London.
3. **Development of chick Embryo Lillie.**
4. **Developmental Biology, 1991**,3rd edn. Siauersin Associatres USA.
5. **Developmental Biology, 1997**, 3rd edn. Gilbert S.F., Sinauer Associates USA



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Syllabus of T.Y. B. Sc. Zoology (Semester-V)
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Semester – V	Paper – VI
Course Code: BSC-ZO 506T	Title of the Course: Parasitology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand basic concepts related with parasites.
2. Understand the life cycle of various parasites.
3. Understand Morphology, Pathogenecity and control measures of Parasitic Arthropoda.

Detailed Syllabus:

Unit	Name of Topic	Hours Allotted
1.	Introduction Definition: host, parasite, vector, commensalism, mutualism and parasitism	(02)
2.	Types of Parasites and Hosts: Ectoparasites. Endoparasites and its subtypes. Types of hosts - Intermediate, definitive, paratenic and reservoir. Host - Parasite relationship	(03)
3.	Host specificity. Types of host specificity: structural specificity, physiological specificity and ecological specificity. Effects of parasites on host. Immunity to parasites	(04)
4.	Study of Parasitic Protists: <i>Entamoeba histolytica</i> - Morphology, Life Cycle, Prevalence,	(05)

Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
Plasmodium vivax - Morphology, Life Cycle, Prevalence, Epidemiology,
 Pathogenicity, Diagnosis, Prophylaxis and Treatment.

5. **Study of Parasitic worms:** (06)
Taenia solium (Tapeworm) - Study of Morphology, Life Cycle,
 Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and
 Treatment.
Ascaris lumbricoides - Study of Morphology, Life Cycle, Prevalence.
 Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
6. **Study of Parasitic Arthropoda:** (10)
 Morphology, pathogenicity and control measures of –
 Soft tick. (*Argas persicus*)
 Head louse. (*Pediculus Humanus*)
 Rat flea. (*Xenopsylla cheopis*)
 Bed bug. (*Cimex lectularius*)
 Mite (*Sarcoptes scabiei*).

Suggested Readings:

1. **Parasitology:** K. D. Chatterjee.
2. **Parasites:** ecology, diseases, and management (2013).
3. **Parasitic Helminths:** Targets, Screens, Drugs, and Vaccines, 201.
4. **Parasitism:** The Diversity and Ecology of Animal Parasites (2014) Tim Goater, Timothy M. Goater, Cameron P. and Esch, Gerald W. Cambridge University Press.
5. **Principles of Veterinary Parasitology (2016)**, 1 st Edn, Dennis E. Jacobs, Mark Fox, Lynda M. Gibbons, Carols Hermosilla, John Wiley & Sons.
6. **Veterinary Parasitology (2013)**, Hany M. Elsheikha, Jon S. Patterson, CRC Press Taylor & Francis Group
7. Textbook of medical parasitology – C. K. Jayaram Panikar.
8. **Textbook of medical parasitology** – Arora & Arora.
9. **Textbook of medical parasitology** – S. C. Parija.
10. **Veterinary Parasitology**, 2013 - (Taylor, M. A.).

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Semester – V	Paper – VII
Course Code: BSC-ZO 507 P	Title of the Course: Zoology Practical Paper- V
Credits: 02	Total Practical: 60 Hrs.

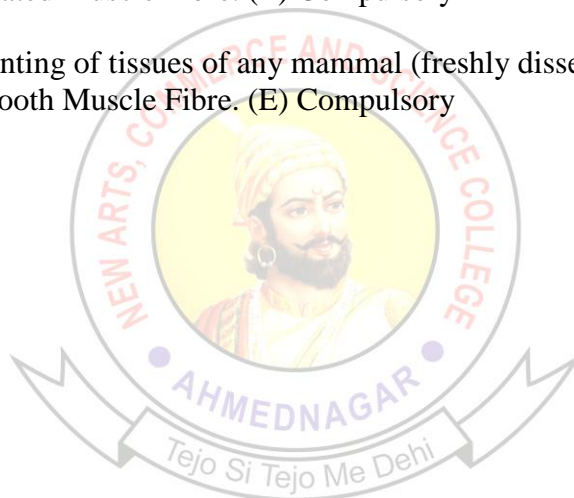
Course Outcomes (COs)

1. Understand Classification and External Morphology Non-chordates.
2. Understand the physiological structures and mechanisms in Non-chordates.
3. Understand the structure and functions of various tissues with permanent slides.
4. Understand the methodology for preparation of temporary mounting of tissues.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	Study of classification with reasons and External Morphology of <i>Paramecium, Hydra, Fasciola, Palamoan, and Sea Star</i> (D)	(02)
2.	Culture of <i>Paramecium</i> and observation of live paramecia for locomotion. Osmoregulation and reproduction (E)	(01)
3.	Study of Cyclosis in <i>Paramecium</i> (E)	(01)
4.	Study the digestive system of Sea Star (D)	(01)
5.	Study the Water Vascular System Sea Star. (D)	(01)
6.	Study of the permanent slides/ temporary mountings of – T. S. of <i>Hydra</i> , Pedicellariae in Sea Star, appendages in <i>Palaemon</i> (D)	(01)
7.	Study the nervous system digestive and excretory system of <i>Palaemon</i> (D)	(01)
8.	Study of the different types of tissues with the help of permanent slides – Epithelial tissue, Connective tissue, Muscular tissue and Nervous tissue. (D)	(01)

9. Study of permanent histological slides of T. S. of skin, V. S. of tooth and C. S. of tongue. (D) (01)
10. Study of permanent histological slides of digestive parts – T. S. of Stomach, T. S. of Duodenum, T. S. of Rectum, C. S. of Liver. (D) (01)
11. Study of permanent histological slides of glands - T. S. of Pituitary gland, T. S. of Thyroid gland, T. S. of Adrenal gland, C. S. of Pancreas. (D) (01)
12. Study of permanent histological slides of reproductive organs- T. S. of Testis, C. S. of Ovary. (D) (01)
13. Study of human blood smear to observe different types of blood cells. (E) Compulsory (01)
14. Temporary mounting of tissues of any mammal (freshly dissected or preserved) - Striated Muscle Fibre. (E) Compulsory (01)
15. Temporary mounting of tissues of any mammal (freshly dissected or preserved) - Smooth Muscle Fibre. (E) Compulsory (01)



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Semester – V	Paper – VIII
Course Code: BSC-ZO 508 P	Title of the Course: Zoology Practical Paper- VI
Credits: 02	Total Practical: 60 Hrs.

Course Outcomes (COs)

1. Understand the External morphology and life cycle of *Bombyx mori*.
2. Understand processes and mechanisms of culturing the animals by demonstration.
3. Understand the basic biochemistry of biomolecules.
4. Understand the working principles of various instruments in Biochemistry.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	study of external morphology and life cycle of <i>Bombyx mori</i> .	(01)
2.	Study of five equipments in sericulture	(01)
3.	Study of different species used in Goat Farming	(01)
4.	Study of various equipments used in Goat Farming	(01)
5.	Study of various diseases in Goat farming	(01)
6.	Preparation of small scale vermiculture in laboratory.	(02)
7.	Study the Process of formation of pearl. (E-demonstration)	(01)
8.	To determine the enzyme activity - salivary amylase/ urease/ invertase.	(01)
9.	To determine specific activity of an enzyme.	(01)
	E	
10.	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests. (C) E	(01)

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|-----|--|------|
| 11. | Isolation of starch from potato and digestion of starch by salivary amylase. (E) | (01) |
| 12. | Preparation of buffer of desired pH and molarity. (E) | (01) |
| 13. | Protein estimation by Lowry et al. method. (E) | (01) |
| 14. | Isolation of Caesin from milk by adjusting iso-electric point. (E) | (01) |
| 15. | Preparation of Acid, Alkali & it's standardisation. (E) | (01) |
| 16. | Principle, Working & Measurement of pH of any three samples. E | (01) |



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Semester – V	Paper – IX
Course Code: BSC-ZO 509 P	Title of the Course: Zoology Practical Paper- VII
Credits: 02	Total Practical: 60 Hrs.

Course Outcomes (COs)

1. Understand classification and identification of museum specimens/ slides of lower invertebrates.
2. Understanding characteristics of lower invertebrates with the help of slides and culturing.
3. Understand the characteristics of the population by quadrat method
4. Understand the physicochemical parameters of water and soil.

Detailed Syllabus: (Amy 12)

Unit	Name of Topic	Practicals Allotted
1.	Study of sperm smear (any one animal), Types of eggs (insect, amphioxus, frog & hen), Types of blastulae and gastrulae (insect, amphioxus and hen) Techniques of cryopreservation of Ova and sperms.	(01)
2.	Study of morphogenetic movements during development	(01)
3.	Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole	(01)
4.	Study of temporary preparation of whole mount of chick embryo	(01)
5.	Study of simple in vitro culture of chick embryo by any suitable method.	(01)

6. Study of chick embryo whole mounts with reference to staging method in chick development (By Hamburger & Hamilton) : 18 h (primitive streak), 21h, 24h, 33h, 48h, 72h of incubation (01)
7. Study of permanent histological slides of chick embryo: Primitive streak (T. S), 24h(T. S. through neural tube) and 33H (T. S. through heart). (01)
8. Study of permanent histological slides of chick embryo: 48h (T. S. through pharynx and T. S. through extra embryonic membrane), 72h embryo (T.S.) (01)
9. To study the morphology and life cycle of *Entamoeba histolytica* through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods.(D) (01)
10. To study the morphology and life cycle of *Plasmodium vivax* through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods.(D) (01)
12. To study the morphology and life cycle of *Taenia solium* through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods. (D) (01)
13. To study the morphology and life cycle of *Ascaris lumbricoides* through permanent slides or photographs and study of their pathogenicity, diagnosis and treatment methods. (D) (01)
14. Study of insect vector-Mosquito, Head louse, Bed bug through permanent slides or photographs. (D) (01)
15. Study of the pathogenicity and control measures of - Tick (soft tick and hard tick) and Mite (*Sarcoptes scabiei*). (D) (01)
17. Study of parasites from the gut of hen. (E) (01)

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Syllabus of T.Y. B. Sc. Zoology (Semester-V)
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Semester – V	Paper – X
Course Code: BSC-ZO 510 T	Title of the Course: Computer Applications in Biology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand about PC, operating system and softwares.
2. Understand the computer networking.
3. Understand the database management systems.

Detailed Syllabus:

Unit	Name of Topic	Hours Allotted
1.	About PC, operating system and software	(15)
	Introduction to PC and Windows operating system, application software (Windows, MS word). Introduction of a spreadsheet (MS Excel): application, formula and functions; performing basic statistics using spreadsheet applications; creating basic graphs using spreadsheet applications, logical (Boolean) operators. MS Powerpoint application and functions, Microphotography and scale calibration and digital image processing.	

2. Computer Networking (05)

Introduction to a computer network, data communication, components of data communication, data transmission mode, data communication measurement, LAN, MAN, WAN, wireless LAN, internet, intranet, extranet; www, telnet, ftp, e-mail, social networks, search engines.

3. Data base management: (10)

Basic features and management systems of following: Nucleic acid sequences databases, Genome databases, Protein sequence, structures and interacting proteins databases, Literature databases, Biodiversity and ecosystem based databases. Introduction to data retrieval systems, Search engines, Entrez, sequence retrieval system (SRS) and protein identification resource (PIR).

Suggested Readings:

- 1. Computer Applications in Biology, Robert J. Rpbbins (1994)**
- 2. Computer Applications in Biosciences, Oxford University Press, Volume 10, 1994.**
- 3. Computer Applications and biostatistics, Dr. S. B. Bhise, Dr. R. J. Dias, K. K. Mali, P. H. Ghanwat, Trinity Publishing House,**

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Semester – V	Paper – XI
Course Code: BSC-ZO 511 P	Title of the Course: Zoology Practical Paper- VIII
Credits: 2	Total Practical: 60 Hrs.

Course Outcomes (COs)

1. Understand the basic terminologies of computers.
2. Understand the MS Office and its software.
3. Understand the database management in relation to biology.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	Understanding the components of the computer	(01)
2.	Types of networking	(01)
3.	Understanding the use of various tools in MS-Word	(02)
4.	Understanding the use of various tools in MS-Excel/ Spreadsheet	(02)
5.	Understanding the use of various statistical tools in MS-Excel/ Spreadsheet	(02)
6.	Understanding tools in MS-Powerpoint Presentation for effective presentation	(02)
7.	Understanding the use of BLAST in bioinformatics	(01)
8.	Understanding the use of FASTA in bioinformatics	(01)
9.	Basic principles of cyber security in day today life.	(01)
10.	Preparation and Submission of Powerpoint Presentations on any topic on zoology	(01)

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Semester – VI	Paper – I
Course Code: BSC-ZO 601 T	Title of the Course: Animal Biology- II
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the systematic position, habit habitat and external morphology of type study.
2. Understand the general physiological mechanism in the type study.
3. Understand the mechanism of reproduction in the type study.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	<i>Scoliodon</i> Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestive System, Circulatory system, Excretory System, Nervous System, Sense Organs, and Urinogenital System.	(08)
2.	<i>Hoplobatrachus tigerinus</i> Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestive System, Circulatory system, Excretory System, Nervous System, Sense Organs, and Urinogenital System.	(08)
3.	<i>Calotes versicolor</i>	(06)

Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestive System, Circulatory system, Excretory System, Nervous System, Sense Organs, and Urinogenital System.

4. *Rattus rattus* (08)

Systematic Position with reasons, Habit, and Habitat, External Morphology, Digestive System, Circulatory system, Excretory System, Nervous System, Sense Organs, and Urinogenital System.

Suggested Readings:

1. **Modern Text-Book of Zoology, vertebrates.** By Kotpal, RL., Rastogi and Co.,
2. **Nigam H.C., Zoology of Chordates,** Vishal Publication, Jalandhar
3. **Jordan, E.L. and P.S.Verma Chordate Zoology,** S. Chand and Co., Ltd. Ram Nagar, New Delhi.
4. **Fundamentals of Zoology** Ghosh, Manna NCBA
5. **Biology of Vertebrate H.C. Nigam** Vishal Publishers
6. **Biology of Chordate H.C. Nigam** Vishal Publishers

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Semester – VI	Paper – II
Course Code: BSC-ZO 602 T	Title of the Course: Animal Physiology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the physiological processes of animals (specific relation to mammals)
2. Understand the anatomical structures of physiological organs.
3. Learn the structure and role of various glands in physiology.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Homeostasis: The central concept in physiology An introduction to Animal Physiology The body fluids of animals Homeostasis Acclimation and Acclimatization	(02)
2.	Nutrition and digestion: Nutritional requirement & balanced diet. Digestion and absorption of carbohydrates, proteins and lipids. Vitamins - outline of fat soluble and water-soluble vitamins; Sources, deficiency and diseases.	(05)
3.	Ventilation and Gas Exchange: Mechanism of respiration: Regulation of ventilation in lungs, exchange of gases at respiratory surface. Respiratory pigments in animals: Haemoglobin, Hemocyanin, Hemerythrin, Chlorocruorin. Transport of gases: O ₂ and CO ₂ transport.	(05)

4. **Circulation:** (05)
Blood: Definition and its constituents, functions of blood.
Heart: Structure of human heart, Pace maker, Cardiac Cycle.
Origin and conduction of heart beat.
5. **Excretion:** (04)
Structure of Uriniferous tubule.
Mechanism of urine formation.
Normal and abnormal constituents of urine, Elementary idea of dialysis.
6. **Muscles:** (04)
Structure of smooth, skeletal and cardiac muscles.
Mechanism of muscle contraction by Sliding filament theory.
7. **Reproduction and Endocrine Glands:** (05)
Physiology of male reproduction, hormonal control of spermatogenesis.
Physiology of female reproduction, hormonal control of menstrual cycle.

Suggested Readings:

1. **Introduction to Animal Physiology**, Ian Kay, 2000, Bios Scientific Publishers Limited.
2. **Textbook of Medical Physiology**, Guyton A. C. & Hall J. E., 2006, 11th Edition, Hercourt Asia Pvt. Ltd. / W. B. Saunders Company
3. **Principles of Anatomy & Physiology, 2006**, 11th Edition, Tortora G. J. & Grabowski S., John Wiley & sons, Inc.
4. **Haematology:** De Gruchi.
5. **Human physiology**, Vol. I & II, 1980, 12th Edn. Dr. C. C. Chatterjee, Medical Applied Agency, Kolkata
6. **Text book of Animal Physiology**, 2008, 2nd Edn. Nagabhushanam, S. V. S. Rana, S. Kalavathy, Oxford University Press, India.
7. **Animal Physiology: Adaptation and Environment**, 1997, Schmidt-Nielsen, Knut, Cambridge University Press.
8. **General and Comparative Physiology**, 1983, 3rd Edn., Hoar W. S., Prentice Hall, UK.7.
9. **Medical Physiology**, 2006, Asis Das, Books and Allied Pvt. Ltd., Kolkata.
10. **Endocrinology**, 2005, Lohar P. S., M J P Publishers, Chennai.
11. **Vander, Sherman, Luciano's Human Physiology: The Mechanisms of Body Function**, 2003, 9 th Edn., Eric P. Widmaier, Hershel Raff, Kevin T. Strang, Mc Graw H.
12. **Tortora, G. J. and Derrickson, B. H. (2009) Principles of Anatomy and Physiology** (12th edition) John Wiley and Sons, Inc.
13. **Widmaier, E. P., Raff, H. and Strang, K. T. (2008) Vander's Human Physiology** (9th edition) McGraw Hill.

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Semester – VI	Paper – III
Course Code: BSC-ZO 603 T	Title of the Course: Applied Zoology II
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the practices involved in apiculture.
2. Understand the agricultural pests and their control methods.
3. Understand the basic information about fishery, culture and harvesting methods of fishes.
4. Understand fish preservation techniques.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Apiculture Definition/Introduction Bee species Bee morphology Caste system / colony organization Life cycle of honeybee and nuptial flight Bee behavior and communication Bee keeping equipments – Honey extractor, Bee-veil, Gloves, Hive tool, Bee brush, Queen excluder, etc. Bee keeping and seasonal management/ rearing of honey bee Bee products – Honey, Wax, Bee venom, Propolis, royal jelly, Pollen Bee diseases and enemies	(10)
2.	Agricultural Pests and their control: An introduction to Agricultural Pests, types of pests (agricultural, store grain, veterinary). Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures) a) Jowar stem borer b) Red cotton bug c) Brinjal fruit borer d) Mango stem borer	(12)

e) Blister beetle
f) Rice weevil
g) Pulse beetle
Non insect pests: Rats, Crabs, Snails, and Squirrels.
Pest control practices in brief: Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Pheromonal control, Autocidal control and Concept of IPM in brief.
Plant protection appliances: Shoulder type Rotary duster, Knapsack sprayer, Cynogas Pump.

3. Fisheries

(08)

Introduction and types
Culture of freshwater (Rohu, Catla, Mrigal) and Marine (any one) water fish
Culture techniques of major carps.
Types of fish culture -Cage culture, Pen culture, Monoculture, Poly culture.
Fishing tools - Crafts – Catamaran, Machwa, Dinghi
Gears – gill net, Dol net, Rampani net, Cast net.
Fish preservation technique – Chilling, Freezing, Salting, Drying, Canning.
Setting up of home aquarium and maintenance of aquarium fishes.
Applications / uses / economic importance of fish and its byproducts.

Suggested Readings:

1. **Apiculture.** Prost, P. J. (1962). Oxford an IBH, New Delhi.
2. **Apiculture,** Bisht. D.S., ICAR Publication.
3. **Beekeeping in India,** Singh S.m Indian council of Agricultural Research, New Delhi.
4. **Fish and fisheries in India.,**Jhingran. V.G.
5. **An introduction to fishes** Khanna. S.S,
6. **A manual of freshwater aquaculture,** Santanam, B. et al,
7. **Pond aquaculture,** Boyd. C.E. & Tucker. C.S.,
8. **Fish and Prawn diseases,** Biswas K.P.,
9. **Aquaculture and Fisheries Biotechnology Genetic Approaches.** Dunham R.A.(2004). ABI
10. **Entomology and Pest Management,** Pedigo, L.P.(2002). Prentice Hall.

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Semester – VI	Paper – IV
Course Code: BSC-ZO 604 T	Title of the Course: Molecular Biology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the structure of nucleic acids.
2. Understand the central dogma of molecular biology.
3. Understand the gene regulation in prokaryotes and eukaryotes.
4. Understand the emerging concepts in gene editing.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Nucleic Acids and Chromatin: Structure of RNA and DNA. Types of DNA – A,B,Z, and H forms Types of RNA (mRNA, rRNA, tRNA), miRNA, siRNA DNA as genetic material - evidences (Griffith's, Avery et al., Hershey and Chase experiment), RNA as genetic material - TMV 4. Structure of Chromatin, packaging of DNA, Heterochromatin, Euchromatin.	(08)
2.	Central Dogma of Molecular Biology: DNA Replication – Semiconservative (Messelson and Stahl experiment), Basic mechanism of replication in prokaryotes and eukaryotes.	(05)

3. **Transcription –** (06)
RNA polymerase
Basic mechanism of transcription in prokaryotes and eukaryotes,
RNA modifications and processing (splicing, capping, polyadenylation)
4. **Translation –** (05)
Genetic code, properties of genetic code, Basic mechanism of Translation in Prokaryotes and eukaryotes.
5. **Gene regulation** (04)
Prokaryotic gene regulation- Concept of operon, Lac operon, Tryptophan operon
Eukaryotic gene regulation- chromatin remodelling, Histone acetylation, histone methylation
Regulatory RNAs-RNA interference
6. **Gene Editing – Concept and CRISPR-Cas9** (01)
7. **Transposable elements: Concept and examples** (01)

Suggested Readings :

1. **Molecular biology of cell, 3rd and 4th edition, Alberts B. D. Lewis J. Raff M. Roberts K. and Watson.**
2. **Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.**
3. **Molecular biology of the Gene, 1993, Watson J. Hopkins, Roberts Steitz & Weiner, Benjamin Cummings.**
4. **Text Book of Molecular Biology, 19994, K. Sivrama Sastry G. Padmanabhan and C. Subramanyam: MacMillan, India.**
5. **Cell and Molecular biology, 1996, G. Karp, John Willey & Sons, U.S.A.**
6. **Principles of Genetics, 1997, P.D. Snustad, M.L.Smmons, J.B. & Jenkins, John Willey & Sons, U.S.A.**
7. **Cell and Molecular biology, De Robertis and De Robertis, 8th & 9th Edition, Saunders Publications.**

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Semester – VI	Paper – V
Course Code: BSC-ZO 605 T	Title of the Course: Evolutionary Biology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the theories of evolution.
2. Understand the evolutionary forces
3. Understand the concept of Speciation
4. Understand the Human Evolution.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Introduction: Concept of Evolutionary Biology Biochemical origin of life (Urey-Miller experiment, co-acervates, protenoid microspheres, protobionts) Origin of eukaryotic cell (Origin of mitochondria and chloroplasts)	(03)
2.	Historical Review of Evolutionary Concept: Lamarckism. Darwinism Mutation Theory. Modern Synthetic theory.	(04)
3.	Evidences of Evolution: Evidences from;	(05)

- Comparative Anatomy and morphology
 Comparative Embryology
 Palaeontology
 Biochemistry and physiology
 Molecular biology and Genetics
 Biogeography
4. **Fossils** (02)
 Definition, types and age determination.
5. **Evolutionary forces** (04)
 Variations, Mutation, Genetic drift, Migration
 Isolation: Concept, Geographical and reproductive (pre-mating and post-mating) and significance
6. **Speciation** (04)
 Biological species concept:
 Speciation and its types: Allopatric, Sympatric, Parapatric and Peripatric.
7. **Mass Extinction** (02)
 Major Events
 Causes
 Role of extinction in evolution
8. **Evolution of man** (04)
 Causes of human evolution
 Evolutionary trends during human evolution
Dryopithecus, Ramapithecus, Ardipithecus, Australopithecus, Homo erectus, Homo sapiens
 (Neanderthal man, Cro-Magnon man) , *Homo sapiens sapiens*
9. **Zoogeographical realms** (02)

Suggested Readings:

1. Mark Ridley. **Evolution. 3rd Edition. Blackwell Publishing. (2004).**
2. Mathur, Tomar, Singh. **Evolution and Behaviour. Rastogi Publication, Merrut.**
3. Veer Bala Rastogi. **Organic Evolution. 14 th edition. MedTech Science Press(2022)**

4. Mohan P. Arora. **Evolutionary Biology**, Himalaya Publishing House, Bombay.
5. P. S. Vermin and V. K. Agarwal. **Cell Biology, Genetics, Molecular Biology, Evolution and Ecology**, Revised Edition. S. Chand Publication (2004).
6. Strickberger. **Evolution**. Prentic Hall. (2002).
7. **Organic Evolution**, Richard Swann Lull, Light and Life Publishers.
8. **Introductions to Evolution**, Paul Amos Moody, Kalyani Publishers, New Delhi.
9. 13. **The origin of species**, 1959, Charles Darwin, New American Library, New York.



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Semester – VI	Paper – VI
Course Code: BSC-ZO 606T	Title of the Course: Entomology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the insect morphology.
2. Understand the anatomy of insects.
3. Understand the types of metamorphosis.
4. Understand the economic importance of insects.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Fundamentals of Entomology: Definition and scope of Entomology. General Characters of Insects.	(01)
2.	Insect Morphology: Insect Integument and its derivatives. Head: General morphology & it's articulation patterns. Antenna: Basic structure & types. Eyes: Location, structure & functions of ocelli & compound eyes. Mouth parts: Basic types. Thorax: Segmentation & various sclerites. Leg: Structure of typical leg & it's modifications (fossorial, cursorial, saltatorial, natatorial, clasporial, raptorial). Wing: Basic structure & wing venation in a generalized insect, wing coupling structures, wing modifications (Tegmina, Elytra, Hemelytra, Halteres, Brachypterous & Hairy fringed wings) Abdomen: Segmentation and Abdominal appendages.	(10)

3. **Insect Anatomy (Cockroach)** (05)
Digestive System.
Circulatory System.
Nervous System.
Respiratory System.
Reproductive System.
4. **Sound production in insects** (02)
Structure & mechanism of sound producing organs in cicada & crickets.
Significance of sound production in insects.
5. **Insect Metamorphosis:** (06)
Definition.
Structure of insect egg & types of eggs, larvae & pupae
Types and examples of Metamorphosis.
Hormonal control of metamorphosis
Insect Pheromones: Alarm, aggregation, trail making, & sex pheromones
6. **Bioluminescence in insects** (02)
Definition with examples of insects.
Structure of light producing organ & its mechanism.
Significance of bioluminescence in insects.
7. **Social organization in Wasps and Termites** (02)
8. **Economic Importance of Insects** (02)
Insects in Research.
Insects in Medicines and Cosmetics.
Insects as Vectors.
Insects as food.

Suggested Readings:

1. **Social Insects: Their Origin and Evolution**, 2006, W. M. Wheeler, Discovery Publishing House, Delhi.
2. **Lives of Social Insects, 1968**, P. P. Larson, M. W. Larson, World Pub. Co.
3. **Modern Entomology**, 2nd edition - By D. B. Tembhare, Himalaya Publication House, Bombay.
4. **Principles of Insect Morphology** - By R. E. Snodgrass, Tata Mc-Graw Hill Bombay.

5. **The Insect: Structure & Function** - By R. F. Chapman, E. L. B. S., & E. U. P. London.
6. **General Entomology, 2nd edition** - By M. S. Mani Oxford & IBH Publishing Company, New Delhi.
7. **A Text book of Entomology** - By H. H. Ross, John Wiley and Sons, Ins. New York.
8. **An Introduction to Entomology** - By J. H. Comstock, Ithaca, New York.
9. **General & Applied Entomology** - By K. K. Nayar, T. N. Anathakrishnan & B.V. David, Tata McGraw-Hill, New Delhi.



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Semester – VI	Paper – VII
Course Code: BSC-ZO 607 P	Title of the Course: Zoology Practical Paper- IX
Credits: 02	Total Practicals: 60 Hrs.

Course Outcomes (COs)

1. Understand the anatomy of *Scoliodon*/ Rat.
2. Understand the comparative structures of chordates.
3. Understand the various physiological parameters with experiments.
4. Understand the working principles of various instruments used in physiology.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	Study of classification with reasons and External Morphology of a. <i>Scolidon</i> b. Frog c. <i>Calotes</i> d. Rat	(01)
2.	Dissection of <i>Scolidon</i> / Rat to study the digestive system	(01)
3.	Dissection of <i>Scolidon</i> / Rat to study the Reproductive System	(01)
4.	Dissection of <i>Scolidon</i> / Rat to study the Brain	(01)
5.	Dissection of <i>Scolidon</i> to study the branchial arteries	(01)
6.	Comparative study of the Kidney of <i>Scoliodon</i> , Frog, <i>Calotes</i> , and Rat	(01)
7.	Comparative study of Heart- <i>Scoliodon</i> , Frog, <i>Calotes</i> , and Rat	(01)
8.	Comparative study of the Brain - <i>Scoliodon</i> , Frog, <i>Calotes</i> , and Rat	(01)
9.	Haemoglobin estimation using Sahli's haemoglobinometer. (E)	(01)
10	Preparation of haemin and haemochromogen crystals. (E)	(01)
11.	To estimate the blood glucose level from given sample. (E)	(01)
12.	Estimation of bleeding and clotting time. (E)	(01)

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| 13. | Study of disorders caused by endocrine glands with the help of photographs. (D) | (01) |
| 14. | Detection of blood groups in human being. (E) | (01) |
| 15. | Qualitative detection of nitrogenous waste products (Ammonia, urea, uric acid) in given sample. (E) | (01) |
| 16. | Demonstration of kymograph unit, Respirometer through available resources. (D) | (01) |
| 17. | Measurement of lung capacity. (E) | (01) |



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Semester – VI	Paper – VIII
Course Code: BSC-ZO 608 P	Title of the Course: Zoology Practical Paper- X
Credits: 02	Total Practicals: 60 Hrs.

Course Outcomes (COs)

1. Understand morphology and life cycle of honey bee.
2. Understand the various pest and their control appliances.
3. Understand the structure of DNA using paper model.
4. Understand the process of isolation/estimation of DNA/RNA.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	Study of external morphology and life cycle of honeybee	(01)
2.	Study of bee keeping equipments and their uses	(01)
3.	Study of following insect pest with respect to marks of identification, nature of damage and control measures of a) Jowar Stem Borer b) Red Cotton Budg c) Brinjal fruit Borer d) Mango Stem Borer	(01)
4.	Study of following pest with respect to marks of identification, nature of damage and control measures of a) Blister Beetle b) Rice Weevil c) Pulse Beetle d) Tick	(01)
5.	Study of any two non-insect pest	(01)
6.	Study of pest control appliances	(01)
7.	Identification, classification and description of fishes up species level with suitable examples from each class	(01)
8.	Fishing crafts and gears,	(01)
9.	Visit to an apiary/ fish farm.	(01)
10.	Preparation of DNA paper model and study its characteristics. (E)	(01)
11.	Staining of DNA and RNA by methyl green – pyronin. (E)	(01)

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| 12. | Estimation of DNA by Diphenylamine method. (E) | (01) |
| 13. | Estimation of RNA by Bial's Orcinol method. (E) | (01) |
| 14. | Isolation of DNA from Bacteria / liver. (E) | (01) |
| 15. | Isolation of nuclei and their counting. (E) | (01) |
| 16. | Isolation of mitochondria and their quantification. (E) | (01) |



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New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus of T.Y. B. Sc. Zoology (Semester-VI)
under
Faculty of Science and Technology

Semester – VI	Paper – IX
Course Code: BSC-ZO 609 P	Title of the Course: Zoology Practical Paper- XI
Credits: 02	Total Practicals: 60 Hrs.

Course Outcomes (COs)

1. Understand the zoogeographical distribution of animals using world map.
2. Understand the stages of human evolution.
3. Understand the morphology of insects.
4. Understand the different types of haematocytes of cockroach.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	To record the zoogeographical distribution of animals on the world map: (lung fishes, marsupials, flightless birds, camel, elephant, ostrich etc.)	(01)
2.	Study of successive stages of evolution of man: a) Australopithecus b) <i>Homo erectus</i> c) <i>Homo neanderthalis</i> , d) <i>Homo cromagon</i> e) <i>Homo sapiens</i> .	(01)
3.	Study of fossil evidences	(01)
4.	Study of homology and analogy from suitable specimens/ pictures.	(01)
5.	Study of external characters of Grasshopper / Cockroach / Beetle. (E)	(01)
6.	Study of Insect Legs, wing and their modifications. (D)	(01)
7.	Study of Digestive system and Reproductive System of Grasshopper / Cockroach / Beetle (E)	(01)
8.	Study of Nervous system of Grasshopper / Cockroach / Beetle. (E)	(01)
9.	Study of Insect vectors - Mosquito, House fly, Cockroaches, Bugs. D	(01)

10. Temporary mountings of Mouthparts, Antennae, Legs and Wings of any locally available insect pest. (E) (01)
11. Compulsory field visit to a Wildlife Sanctuary / National Park / Tiger Reserve / E (01)
12. Study of different types of hematocytes in cockroach & haemocyte count. (01)
13. Study of Von Wisseling's test for presence of chitin in insects cuticle (01)



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Semester – VI	Paper – X
Course Code: BSC-ZO 610T	Title of the Course: Recombinant DNA Technology
Credits: 02	Total Lectures: 30 Hrs.

Course Outcomes (COs)

1. Understand the tools required for gene cloning.
2. Understand the techniques involved in rDNA Technology.
3. Understand the applications of rDNA technology in various fields.
4. Understand the ethical issues associated with genetic engineering.

Detailed Syllabus

Unit	Name of Topic	Hours Allotted
1.	Introduction to Gene Cloning	(01)
2.	Hosts and vectors in rDNA technique Host organisms: Prokaryotic and Eukaryotic Cloning vectors: Bacterial plasmid vector(pBR322), Bacteriophage vectors(Phage λ), Cosmids, Yeast artificial chromosome, Bacterial artificial chromosomes	(06)
3.	Restriction Enzymes Exonucleases, endonucleases, Restriction endonucleases (Nomenclature and examples), linkers and adapters.	(03)
4.	Techniques in rDNA technology:	(12)

Screening of recombinants - Antibiotic resistance, lacZ complementation (Blue-white selection), fluorescent markers (e.g. GFP), Agarose gel electrophoresis

Southern, Western and Northern – blotting techniques,

SDS-PAGE

Radiolabelling of nucleic acids

PCR (Working and applications)

Gene transfer techniques (chemical treatment, electroporation, lipofection, microinjection,

retro viral vector method, embryonic stem cell method and shot gun method)

5. Applications of rDNA Technique (08)

Medicine: Production of recombinant pharmaceuticals: Insulin, Human Growth Hormone, Recombinant vaccines: Hepatitis B

Transgenic Animals: Methods of creation of transgenic animals and applications.

DNA Fingerprinting: Method and Applications

Gene therapy: Introduction, Types (Somatic and germline gene therapy) and applications.

Genetically modified organisms: Concept of GMO, Biosafety regulatory frame work for GMOs, Use of genetically modified organisms and their release in environment, Cartagena Protocol on biosafety

Bioethics: Ethical issues in genetic engineering

Suggested Readings:

1. **Principles of Gene Manipulation and Genomics (2006)** by S. B. Primrose and R. M. Twyman, Blackwell Scientific Publications.
2. **An introduction to Genetic Engineering (2004)** by Desmond S.T. Nicholl, Cambridge University Press
3. **Recombinant DNA (1992)** by J.D. Watson, M. Gilman, J. Witowski and Mark Zoller, Scientific American Books
4. **Biotechnology** by Trehan
5. **Comprehensive Biotechnology 4th edn.,2009**, K.J.Ramawat and Shaily Goyal,Chand

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Semester – VI	Paper- XI
Course Code: BSC-ZO 611Pr	Title of the Course: Project
Credits: 02	

Course Outcomes (COs)

After the successful completion of the project students are able to ---

1. Understand the process of defining research problem.
2. Understand the use of research methodologies.
3. Understand the data presentation and analytical skills.

Guidelines:

The individual project aims to develop an aptitude for research in zoology and to inculcate proficiency to identify appropriate research topics and presentations. The topics of biological interest and significance can be selected for the project.

1. The project guide and project topic selection process will be initiated at the end of semester second to enable students to initiate a work literature survey and develop a hypothesis.
2. The student will undertake the project under the guidance of the supervisor. The student and the supervisor will meet periodically to review the progress of the project.
3. The head of the department may arrange the presentations of the students to assess the progress of project work.
4. Project topic once chosen previously shall not be repeated by any student.
5. Students and guides are not allowed to compromise their regular theory and practical sessions for project work.
6. Student will maintain the daily diary of project work and submit the same along with the project report to the department.
7. For field visits students need to get the permission from department/ college.
8. A candidate may, however, in certain cases be permitted to work in industrial/ research organization/ Institute/ college on the recommendation of the supervisor for partial project work.

9. The project report will be checked for plagiarism before final submission.
10. The project will be evaluated in 30:70 pattern (15 Internal and 35 External).

The project report may have the following sections:

1. Preliminary (Title page, declaration, certificate of the Supervisor, content, etc.)
2. Introduction with relevant literature review
3. Objective
3. Materials and Methods
4. Result
5. Discussion
6. Conclusion / Summary
7. References.

The project report should be submitted on A4 paper, in Times New Roman font, 12 Font size and 1.5 line space in spirally bound form and duly attested by the supervisor and the Head of the Department on the day of practical examination.

Project Evaluation Criteria:

Sr. No.	Component	Marks
1.	Topic/ Area selected	05
2.	Literature survey	05
3.	Experimentation/ Data collection	10
4.	Methodology and compilation	05
5.	Results and conclusion	10
6.	Presentation	05
7.	Total	35

The external evaluation panel for project:

1. Head of the Department or Internal Examiner appointed by the Head of the Department.
2. An External Examiner.