

PANJAB UNIVERSITY CHANDIGARH- 160 014 (INDIA)

(Estded. under the Panjab University Act VII of 1947-enacted by the Govt. of India)

FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc.(Honours School) Zoology

1ST TO 6TH SEMESTER

And

M.Sc.(Honours School) Zoology

1ST to 4TH SEMESTER

EXAMINATIONS 2013 - 2014

**OUTLINE OF TESTS AND SYLLABI IN THE SUBJECT OF ZOOLOGY FOR B.Sc.
(HONOURS SCHOOL) (SEMESTER SYSTEM) FOR THE EXAMINATION 2013-2014.**

**B.Sc. (HONS.SCHOOL) FIRST SEMESTER
OUTLINES OF TESTS**

Paper-I	English	Total Marks : 500
Paper-II	Chemistry/Bio-Chemistry	.. Preliminary : 100
Paper-III	Botany	.. Subsidiary I : 100
Paper-IV	Zoology-I (Biodiversity : Invertebrates -I)	.. Subsidiary II: 100
		.. Major
		<u>Total Marks</u> : 100
		<u>Theory</u> : 75
		Internal Ass. : 15
		Annual Exam. 60
		<u>Practical</u> : 25
		Internal Ass. : 05
		Annual Exam: 20
Paper-V	Zoology- II (Biodiversity : Chordates-I)	.. Major
		<u>Total Marks</u> : 100
		<u>Theory</u> : 75
		Internal Ass. : 15
		Annual Exam : 60
		<u>Practical</u> : 25
		Internal Ass. : 05
		Annual Exam: 20

IMPORTANT NOTE :

The students of B.Sc.(Honours School) have also to study the subject of “Environment & Road Safety Education”. This is a **compulsory qualifying paper** which the students have to study and are required to qualify. The examination would be conducted by the University.

ENVIRONMENT AND ROAD SAFETY EDUCATION

(25 hr. course)

UNIT I (ENVIRONMENT)

1. **Environment Concept :**

Introduction, concept of biosphere—lithosphere, hydrosphere, atmosphere; Natural resources—their need and types; principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

2. **Atmosphere :**

Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

3. **Hydrosphere :**

Types of aquatic systems. Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

4. **Lithosphere :**

Earth crust, Soil—a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

5. **Forests :**

Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of India, Urban forests, Chipko Andolan.

6. **Conservation of Environment :**

The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems—soil, water, air, wildlife, forests.

7. **Management of Solid Waste :**

Merits and demerits of different ways of solid waste management—open, dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

8. **Indoor Environment :**

Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

9. **Global Environmental Issues :**

Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

10. **Indian Laws on Environment :**

Indian laws pertaining to Environmental protection : Environment (Protection) Act, 1986; General information about Laws relating to control of air, water and noise pollution. What to do to seek redressal.

11. Biodiversity :

What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.

12. Noise and Microbial Pollution :

Pollution due to noise and microbes and their effects.

13. Human Population and Environment :

Population growth and family welfare programme, Human Health, HIV/AIDS, Human rights.

14. Social Issues :

Environmental Ethics : Issues and possible solutions, problems related to lifestyle, sustainable development; Consumerisms and waste generation.

15. Local Environmental Issues :

Environmental problems in rural and urban areas, Problem of Congress grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

Practicals :

Depending on the available facility in the college, a visit to Vermicomposting units or any other such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

Note : Above 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topics from 2 to 11 and one each for the topics 1 and 12 to 15.

UNIT II (ROAD SAFETY)

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
3. Traffic Rules.
4. Traffic Signs.
5. How to obtain Driving License.
6. Traffic Offences, Penalties and Procedures.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.
10. Traffic Police-Public Relationship.

Examination Pattern :

- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted question).
- The paper shall have two units: **Unit I (Environment) and Unit II (Road Safety)**.
- Unit I shall comprise of 50 questions with minimum of 2 questions from each topics 1, and 12 to 15 and minimum of 4 questions from topics 2 to 11.
- Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.
- The entire syllabus of Unit I is to be covered in 25 hours and that of Unit II is to be covered in 10 hours.
- All questions are to be attempted.
- Qualifying Marks 33 per cent i.e. 23 marks out of 70.

- Duration of examination : 90 minutes.
- The paper setters are requested to set the questions strictly according to the syllabus.

Suggested Readings

1. The Motor Vehicle Act, 1988 (2010), Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

Websites:

- (a) www.chandigarhpolice.nic.in
- (b) www.punjabpolice.gov.in
- (c) www.haryanapolice.gov.in
- (d) www.hppolice.nic.in

Syllabus and Courses of Reading for B.Sc. (Hons. School) (courses where English is taught as a subsidiary subject) for the session 2013-2014.

FIRST SEMESTER

Objectives:

The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general. It is with this aim in mind that the new text has been selected and it is hoped that the objectives of the course will not only be reflected but also realized through necessary shift in the teaching practices, design of the question paper and mode of evaluation.

Note:

- (i) There will be one paper of 80 marks, 10 marks are reserved for the Internal Assessment and 10 for the Practical Work. Total is 100.
- (ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.
- (iii) For Unit I, the prescribed text is **Varieties of Expression**, Ed. A. H. Tak, Foundation Books, which shall replace the existing text **Patterns in Prose** by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e. **prose and drama** are prescribed. Poetry has been deleted completely. Only five prose and five plays have been recommended for the study. The relevant sections, however, are as follows:
Prose:
 - I. The Judgement Seat of Vikramaditya, *Sister Nivedita*
 - II Engine Trouble, *R. K. Narayan*
 - III The Conjuror's Revenge, *Stephen Leacock***Drama:**
 - I *The Rising of the Moon*, Lady Gregory
 - II *Waterloo*, Arthur Conan Doyle
- (iv) No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end Unit II shall consist of the following:

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (no exceeding 200 words); public notices and advertisements relating to product promotion etc.,

Modern Forms of Communication: Here special emphasis shall be given to teaching the format of e-mails, fax messages, telegrams, audio-visual aids and power-point presentations. Apart from this, the students shall also be given basic lessons in effective listening, non-verbal communication, how to prepare for an interview and group discussion etc.,

Practical work:-

Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of science. However, the evaluation of the projects should be

done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

Note: In case of private candidates and students of School of Open Learning, the marks obtained by them out of 80 will be proportionately increased out of 100).

Testing Scheme:

The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Section I shall be as follows:

Section I (It is text-based and corresponds to unit I in the syllabus)

Q1. It shall consist of *five* short questions (not exceeding 100-120 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text **Varieties of Expression** and cover a wide range of issues, topics and problems. It shall consist of **12 marks**.

Q2. It shall consist of *two* long questions (not exceeding 300-350 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text **Varieties of Expression**. This shall carry **10 marks**.

Note: The question 1 & 2 should be so designed as to cover all the chapters prescribed, as well as the major issues and problems listed therein.

Q3. It shall consist of an **Unseen Passage for Comprehension** (not more than 800 words), with minimum six questions at the end. These questions should be designed in such a way that we are able to test a student's comprehension ability, language/presentation skills and vocabulary etc. This question shall be of **12 marks**.

Q.4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column, This shall carry **6 marks**.

Section II (Based upon Unit II)

Q.5 (a) The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry 8 marks.

Q.5 (b) This question shall be on notices/advertisements of various types (as mentioned in the syllabus). It'll carry **4 marks**.

Q.6. This question shall test a student's ability to write letters of various kinds (in not more than 250 words). Again, there will be internal choice here and the question will be of **8 marks**

Q.7 There will test a student's ability to write a Précis, A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry **10 marks**.

Q.8 This question shall test a student's understanding of various aspects of communication and modern forms of communication. It shall be divided into two parts:

(a) Two short questions to be attempted (in not more than 100-120 words each) on different aspects of communication. It'll carry **6 marks**.

(b) Definitions/format of modern forms of communication to be tested. This shall again carry **4 marks**.

Suggested Reading:

1. *Business Communication*, Ed. Om. P. Juneja & Aarti Mujumdar, Hyderabad: Orient Blackswan, 2010.
2. *Textbook of Business Communication*, Anjali Kalkar, R.B. Suryawanshi, Amlanjyoti Sengupta, Hyderabad: Orient Blackswan, 2010.

SYLLABUS
ZOOLOGY MAJOR
Zoology – I (Biodiversity : Invertebrates-I) (BZO 1001)

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 4	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To enable the students to develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from acellular to multicellular animals. Studies on this group of animals bring to light knowledge of basic functions of life viz., nutrition, respiration, excretion, reproduction etc. and how the organisms of various phyla structurally and functionally adapt themselves for surviving in different ecological conditions.

Classification and general characters of the following phyla up to orders with a detailed study of the animals mentioned against each phylum in Units given below :

UNIT-I

Protozoa : *Amoeba, Euglena, Paramecium, Plasmodium*

UNIT-II

Porifera : *Sycon*
Coelenterata : *Obelia, Aurelia, Sea anemone*

UNIT-III

Platyhelminthes : *Planaria, Fasciola, Taenia*

UNIT-IV

Nematoda : *Ascaris, Enterobius, Hookworm*

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Books Recommended

1. Dhama, P.S. and Dhama, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
2. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut, 2012.
3. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors., Delhi, 1992.
4. Barnes, R.D., Invertebrate Zoology, Saunders W.B., Co., Philadelphia, 1980.

Zoology-II (Biodiversity : Chordates-I) (BZO 1002)

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 4	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I

Urochordata : *Herdmania* including development and affinities, alternation of generation in Urochordata.

UNIT-II

Cephalochordata : *Branchiostoma* including its development and affinities.

Cyclostomata : *Petromyzon* including its migration.

UNIT-III

Pisces : *Labeo*

Amphibia : *Rana*

UNIT-IV

Reptilia : *Uromastix*

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Book Recommended

1. Dhama, P.S., Dhama, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut, 2012.
3. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vertebrates, 7th ed. Vol. II (eds. A.J. Marshall & Williams, W.D.), Mac Millan, London, 1972.
4. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.
5. Bhamrah, H.S. and Juneja, K., An introduction to fishes, Anmol Publications, New Delhi, 1990.

Practical-I based on Theory Paper BZO 1001 (BZO 1051)

Marks : 25

Internal Ass. : 05

Annual Exam.: 20

Classification up to orders and study of the specimens mentioned against each phylum with ecological note.

1. Protozoa (a) Culture of *Amoeba*, *Euglena*, *Paramecium* and *Vorticella*.
(b) Prepared slides of *Balantidium*, *Nyctotherus*, *Opalina*, *Radiolarian* and Foraminiferan.
2. Porifera (a) Specimens : *Sycon*, *Grantia*, *Spongilla*, *Euplectella*, *Hyalonema*, *Chalina*, *Euspongia*.
(b) Prepared slides : Spicules, Gemmules, *Sycon* (T.S. and L.S.).
(c) Temporary mounts : Gemmules and spicules of *Sycon*.
3. Coelenterata (a) Specimens : *Porpita*, *Verella*, *Physalia*, *Aurelia*, *Metridium*, *Alcyonium*, *Tubipora*, *Zooanthus*, *Madrepora*, *Favia*, *Fungia*, *Gorgonia* and *Pennatula*.
(b) Prepared slides : *Hydra* (W.M.) with bud, T.S. through the regions of testis and ovary, *Obelia* (colony, medusa and polyp), *Sertularia*, *Tubipora*, *Plumularia*, *Pennaria*, *Bougainvillea*.
(c) Permanent preparations : W.M. of *Hydra*, *Obelia*, *Sertularia*, *Tubularia*, *Plumularia*, Statocyst of *Aurelia*.
4. Platyhelminthes (a) Specimens : *Planaria*, *Fasciola*, *Taenia*, *Ascaris* (male and female).
(b) Prepared slides : *Planaria* (W.M.), *Fasciola* (W.M. & T.S.), miracidium larva, sporocyst, redia, cercaria, *Taenia* (scolex. Proglottid-mature and gravid, T.S.), *Ascaris* (T.S. male and female-gravid)
(c) Permanent preparations : *Planaria*, *Fasciola*, (W.M. of Larvae : miracidium, sporocyst, redia, cercaria), *Taenia* (scolex, mature and gravid proglottids).

Note: Candidate will be required to submit duly signed note-books of practical record.

Practical – II based on Theory Paper BZO 1002 (BZO 1052)

Marks : 25

Internal Ass. : 05

Annual Exam.: 20

1. Dissections of the following Animals to study :
 - (a) *Herdmania* : General Anatomy.
 - (b) *Labeo* : Digestive and reproductive systems
2. Skeleton : To study the skeleton of *Labeo*, *Rana*, *Varanus*.

3. Permanent mounts : *Salpa, Doliolum*, pharynx of *Herdmania* and *Branchiostoma*, spicules of *Herdmania*, Cycloid scales of *Labeo*.
4. Prepared Slides : T.S. *Branchiostoma* through different regions, cycloid and ctenoid scales of fishes.
5. Specimens : General survey and classification up to orders, (except Pisces and Aves where it is required only upto sub-classes), habitat, habits, external characters and economic importance (if any) of the following animals.

Protochordata - *Herdmania, Molgula, Ciona, Ascidia, Botryllus, Pyrosoma, Salpa, Doliolum, Oikopleura* and *Branchiostoma*.

Cyclostomata – *Myxine, Petromyzon* and *Ammocoetes* larva. Chondrichthyes - *Zygaena, Pristi., Narcine, Trygon* and *Rhinobatos*.

Actinopterygii – *Polypterus, Acipenser, Lepidosiren, Mystus, Catla, Labeo rohita, Cirrhinus mrigala, Cyprinus carpio, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echeneis, Lophius, Solea* and *Anguilla*.

Dipneusti (Dipnoi) – Any of the lungfishes.

Amphibia – *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma, Triton, Hyla, Rhacophorus, Uraeotyphlus, Ichthyophis* and *Axolotl* larva.

Reptilia- Tortoise, Turtle, *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Erys, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis* and Alligator.

Note : The candidates are required to submit duly signed note books of practical record and the prepared slides.

ZOOLOGY SUBSIDIARY

Zoology Paper – I (Invertebrate-I) (BZO 1031)

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	:	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To enable the students to understand the basic biology of Invertebrates. To understand that the biological science is fundamental to creative thought and the diversity of invertebrate species provides the excellent examples for some of these central principles.

Classification and general characters of following Phyla up to orders with a detailed study of the animals mentioned against each phylum in the Units given below :

		UNIT – I
Protozoa	:	<i>Amoeba, Euglena, Paramecium</i> and <i>Plasmodium</i> .
		UNIT-II
Porifera	:	<i>Sycon</i>
Coelenterata	:	<i>Obelia</i>
		UNIT –III
Platyhelminthes	:	<i>Planaria, Fasciola hepatica, Taenia solium</i> , Parasitic adaptations of Platyhelminthes.
		UNIT-IV
Nematoda	:	<i>Ascaris</i> , Hook worm, Enterobious

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Books Recommended

1. Dhama, P.S. and Dhama, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
2. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut, 2012.
3. Chaudhry, S., Fundamental Invertebrate Zoology, Vikas, S. & Company, Fatehpura, Jalandhar, 2003.

Zoology Subsidiary

Practical – I based on Theory Paper BZO 1031 (BZO 1071)

Total Marks : 25

Internal Ass. : 05

Annual Exam.: 20

Classification up to orders and important characters alongwith ecological note of the specimens mentioned against each phylum.

1. Protozoa (a) Culture of *Amoeba, Euglena, Paramecium* and *Vorticella*.
(b) Prepared slides : *Balantidium, Nyctotherus, Opalina*, Radiolarian and Foraminiferan oozes.
2. Porifera (a) Specimens : *Sycon, Grantia, Spongilla*.
(b) Prepared slides : Spicules, Gemmules, *Sycon* (T.S. and L.S.)
(c) Permanent mount : Gemmules and Spicules.

3. Coelenterata (a) Specimens : *Porpita*, *Velella*, *Physalia*, *Aurelia*, *Metridium*,
Alycyonium, *Tubipora*, *Zooanthus*, *Madrepora*, *Favia*, *Fungia*.
(b) Prepared slides : *Hydra* (W.M. with bud, T.S. through the regions of
testis and ovary), *Obelia* (colony and medusa), *Sertularia*, *Tubularia*,
Plumularia.
(c) Permanent mount : W.M. of *Hydra*, *Obelia*, *Sertularia*, *Tubularia*,
Plumularia.
4. Platyhelminthes (a) Specimens : *Planaria*, *Fasciola*, *Taenia*, *Ascaris* (male & female).
and Nematoda (b) Prepared slides : *Planaria* (W.M.), Liver fluke (W.M., T.S., Larvae :
miracidium, sporocyst, redia, cercaria), *Taenia* (mature and gravid
proglottids, scolex), *Ascaris* (T.S. of male and female- gravid).

Note : Candidates will be required to submit duly signed note-books of practical record and prepared slides.

**OUTLINES OF TESTS AND SYLLABI IN THE SUBJECT OF ZOOLOGY FOR B.Sc.
(HONOURS SCHOOL) (SEMESTER SYSTEM)**

B.Sc. (HONS.SCHOOL) SECOND SEMESTER

Paper-I	English	Total Marks : 500
Paper-II	Chemistry/Bio-Chemistry	.. Preliminary: 100
Paper-III	Botany	.. Subsidiary I: 100
Paper-IV	Zoology-III (Biodiversity : Invertebrates-II)	.. Subsidiary II: 100
		.. Major
		<u>Total Marks</u> : 100
		<u>Theory</u> : 75
		Internal Ass. : 15
		Annual Exam. 60
		<u>Practical</u> : 25
		Internal Ass. : 05
		Annual Exam: 20
Paper-V	Zoology- IV (Biodiversity : Chordates-II)	.. Major
		<u>Total Marks</u> : 100
		<u>Theory</u> : 75
		Internal Ass. : 15
		Annual Exam : 60
		<u>Practical</u> : 25
		Internal Ass. : 05
		Annual Exam: 20

SECOND SEMESTER

Objectives:

The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general. It is with this aim in mind that the new text has been selected and it is hoped that the objectives of the course will not only be reflected but also realized through necessary shift in the teaching practices, design of the question paper and mode of evaluation.

Note:

- (i) There will be one paper of 80 marks, 10 marks are reserved for the Internal Assessment and 10 for the Practical Work. Total is 100.
- (ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.
- (iii) For Unit I, the prescribed text is **Varieties of Expression**, Ed. A. H. Tak, Foundation Books, which shall replace the existing text **Patterns in Prose** by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e **prose and drama** are prescribed. Poetry has been deleted completely. Only five prose and five plays have been recommended for the study. The relevant sections, however, are as follows:

Prose:

- I J. C. Bose, *Aldous Huxley*
- II The Position of Women in Ancient India, *Padmini Sen Gupta*

Drama:

- I *The Proposal*, Anton Chekhov
 - II *Riders to the Sea*, J. M. Synge
 - III *Lithuania*, Rupert Brooke
- (iv) No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end Unit II shall consist of the following:

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (no exceeding 200 words); public notices and advertisements relating to product promotion etc.,

Modern Forms of Communication: Here special emphasis shall be given to teaching the format of e-mails, fax messages, telegrams, audio-visual aids and power-point presentations. Apart from this, the students shall also be given basic lessons in effective listening, non-verbal communication, how to prepare for an interview and group discussion etc.

Practical work:-

Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of science. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

Note: In case of private candidates and students of School of Open Learning, the marks obtained by them out of 80 will be proportionately increased out of 100).

Testing Scheme:

The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Section I shall be as follows:

Section I (It is text-based and corresponds to unit I in the syllabus)

Q1. It shall consist of *five* short questions (not exceeding 100-120 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text **Varieties of Expression** and cover a wide range of issues, topics and problems. It shall consist of **12 marks**.

Q2. It shall consist of *two* long questions (not exceeding 300-350 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text **Varieties of Expression**. This shall carry **10 marks**.

Note: The question 1 & 2 should be so designed as to cover all the chapters prescribed, as well as the major issues and problems listed therein.

Q3. It shall consist of an **Unseen Passage for Comprehension** (not more than 800 words), with minimum six questions at the end. These questions should be designed in such a way that we are able to test a student's comprehension ability, language/presentation skills and vocabulary etc. This question shall be of **12 marks**.

Q.4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column, This shall carry **6 marks**.

Section II (Based upon Unit II)

Q.5 (a) The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry **8 marks**.

Q.5 (b) This question shall be on notices/advertisements of various types (as mentioned in the syllabus). It'll carry **4 marks**.

Q.6. This question shall test a student's ability to write letters of various kinds (in not more than 250 words). Again, there will be internal choice here and the question will be of **8 marks**

Q.7 There will test a student's ability to write a Précis, A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry **10 marks**.

Q.8 This question shall test a student's understanding of various aspects of communication and modern forms of communication. It shall be divided into two parts:

(a) Two short questions to be attempted (in not more than 100-120 words each) on different aspects of communication. It'll carry **6 marks**.

(b) Definitions/format of modern forms of communication to be tested. This shall again carry **4 marks**.

Suggested Reading:

1. *Business Communication*, Ed. Om. P. Juneja & Aarti Mujumdar, Hyderabad: Orient Blackswan, 2010.
2. *Textbook of Business Communication*, Anjali Kalkasr, R.B. Suryawanshi, Amlanjyoti Sengupta, Hyderabad: Orient Blackswan, 2010.

SYLLABUS
ZOOLOGY MAJOR
Zoology – III (Biodiversity : Invertebrates-II) (BZO 1003)

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 4	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To enable the student to develop an appreciation for the biodiversity of invertebrate species and to impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellulars. Studies on this group of animals bring to light variety of modes of performing basic functions of life viz., nutrition, respiration, excretion, reproduction etc. and how the organisms of various phyla structurally and functionally adapt themselves for surviving in different ecological conditions.

Classification and general characters of the following phyla up to orders with a detailed study of the animals mentioned against each phylum in Units given below. :

UNIT-I

Annelida : *Nereis*, Earthworm

UNIT-II

Arthropoda : *Palaemon*, Cockroach

UNIT-III

Mollusca : *Pila*, *Anodonta*

UNIT-IV

Echinodermata : *Asterias*, Sea urchin, Sea cucumber
Hemichordata : *Balanoglossus* (external characters only) and its systematic position.

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Books Recommended

1. Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
2. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut, 2012.
3. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors., Delhi, 1992.
4. Barnes, A., Invertebrate Zoology, Harcourt Publishers, International Company, 2001.
5. Chaudhry, S., Fundamental Invertebrate Zoology, S.Vikas & Co. Fatehpura, Jalandhar, 2003.

Zoology-IV (Biodiversity : Chordates-II and Evolution) (BZO 1004)

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 4	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To acquaint the students about the structure and function of chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I

Aves : *Columba*

UNIT-II

Mammalia : *Oryctolagus*

UNIT-III

Origin of life : Origin of bio molecules (DNA, RNA) and its scientific evidence, Origin of prokaryote and eukaryote cells, Origin of unicellularity and multicellularity.

Evidences from Zoogeography, taxonomy, comparative morphology and anatomy, Palaeontology, Comparative physiology, embryology, genetics, molecular biology and biochemistry.

UNIT-IV

Theories : Lamarckism and Neo-Lamarckism; Darwinism and Neo- Darwinism (Synthetic theory) : Weismann's theory; Mutation theory; mutation, variations and selection; modern concept of interpretation of evolution and future of evolutionary process.

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Book Recommended

1. Dhama, P.S. and Dhama, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publishers, Meerut, 2012.
3. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vertebrates, 7th ed. Vol. II (eds. A.J. Marshall & Williams, W.D.), Mac Millan, London, 1972.
4. Dodson., A Text Book of Evolution, Saunders, W.B., Philadelphia, London, 1952.

5. Shull., Evolution, 2nd Edition, Jodhpur, J.V., Publishing House, 2008.
6. Lull, R.S., Organic Evolution, 1st Edition, The McMillan Company, 1961.
7. Stirton, R.A., Time, Life and Man, John, Wiley and Sons, 1959.
8. Colbert, E.H., Evolution of Vertebrates, John, Wiley and Sons, 1955.
9. Hall., B.K. and Grimsson, B.H., Strickberber's Evolution, Jones and Bartlett Publishers Sudburg, Massachosetts, 2000.

Practical-I based on Theory Paper BZO 1003 (BZO 1053)

Marks :25

Internal Ass. : 05

Annual Exam.: 20

Classification up to orders and study of the specimens mentioned against each phylum with ecological note.

1. Annelida
 - (a) Dissections : Earthworm (*Eutyphoeus/ Pheretima*), *Nereis*. (Nervous, digestive, excretory and reproductive systems).
 - (b) Specimens : *Pheretima*, *Eutyphoeus*, *Lumbricus*, *Nereis*, *Heteronereis*, *Polynoe*, *Aphrodite*, *Amphitrite*, *Chaetopterus*, *Arenicola*, *Hirudinaria*, *Pontobdella*.
 - (c) Prepared slides : Earthworm (T.S. typhlosolar region, setae, pharyngeal nephridia, septal nephridium and integumentary nephridium).

Nereis (parapodium of *Nereis* and *Heteronereis*),
Permanant preparations : Setae and nephridia of earthworm, parapodium of *Nereis*, and nephridia of earthworm, parapodium of *Nereis*.

2. Arthropoda
 - (a) Dissections: Cockroach (digestive, nervous and reproductive systems), Prawn (appendages, digestive and nervous systems).
 - (b) Specimens : *Peripatus*, *Lepisma*, cockroach, grasshopper, praying mantis, earwig, dragonfly, termite (queen and other castes), ant, butterfly, moth, beetle, wasp, honeybee, crab, prawn, *Lepas*, *Balanus*, *Apus*, *Limulus*, scorpion, spider, millipede and centipede.
 - (c) Permanant mounts : Trachea of insect, mouthparts of cockroach, *Cypris*, *Cyclops*, *Daphnia*, Gill and statocyst of prawn.

Prepared slides : Body louse, bed-bug, ratflea, *Cypris*, *Cyclops*, *Daphnia*, trachea of insects, genitalia of cockroach, gill and statocyst of prawn.

3. Mollusca
 - (a) Dissection : *Anodonta* (digestive and nervous system), *Pila* (pallial complex, digestive and nervous systems).
 - (b) Specimens : *Anodonta*, *Mytilus*, *Pholas*, *Pecten*, *Haliotis*, *Aplysia*, *Doris*, *Limax*, *Pila*, *Sepia*, *Octopus*, *Nautilus*, *Chiton* and *Anodonta*.
 - (c) Prepared slides : Glochidium larva, radula of *Pila* and gill lamina of *Anodonta*.
 - (d) Permanant mount : Glochidium larva and radula of *Pila*.

4. Echinodermata
 - (a) Specimens : *Asterias*, *Echinus*, *Cucumaria*, *Antedon*, *Ophiothrix*.
 - (b) Prepared slide : T.S. of Star-fish.

5. Hemichordata (a) Specimens : *Balanoglossus*.
 (b) Prepared slide : T.S. *Balanoglossus*, Tornaria larva.

Note: Candidate will be required to submit duly signed note-books of practical record.

Practical – II based on Theory Paper BZO 1004 (BZO 1054)

Marks : 25
Internal Ass. : 05
Annual Exam.: 20

1. Dissections of the following Animals .
 (a) Fowl : Digestive, arterial, venous and urinogenital systems.
 (b) Rat : Digestive, arterial, venous and reproductive systems.
2. Skeleton : *Gallus* and *Oryctolagus*.
3. Specimens : Aves : *Anas, Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis, Casuarius;* and *Struthio*.

Mammalia – *Echidna, Ornithorhynchus, Macropus, Erinaceus, Sorex, Loris, Macaca, Manis, Hystrix, Funambulus, Felis, Capra, Canis, Herpestes, Pteropus* and *Leo*.

Note : The candidates are required to submit duly signed note books of practical record.

ZOOLOGY SUBSIDIARY
Zoology Paper – II (BZO 1032)

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 4	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To enable the students to understand the basic biology of Invertebrates. To understand that the biological science is fundamental to creative thought and the diversity of invertebrate species provides the excellent examples for some of these central principles.

Classification and general characters of following Phyla up to orders with a detailed study of the animals mentioned against each phylum in the Units given below :

UNIT-I

Annelida : Earthworm

UNIT-II

Arthropoda : *Palaemon, Cockroach*

UNIT – III

Mollusca : *Anodonta, Pila*

UNIT-IV

Echinodermata : *Asterias*

Hemichordata : *Balanoglossus* (external characters and its systematic position)

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Books Recommended

1. Dhama, P.S. and Dhama, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
2. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut, 2012.
3. Chaudhry, S., Fundamental Invertebrate, S.Vikas & Co. Fatehpura, Jalandhar, 2003.

Zoology Subsidiary

Practical – I based on Theory Paper BZO 1032 (BZO 1072)

Total Marks : 25

Internal Ass. : 05

Annual Exam.: 20

Classification up to orders and important characters alongwith ecological note of the specimens mentioned against each phylum.

1. Annelida (a) Dissections : Earthworm (entire anatomy)
(b) Specimens : *Pheretima, Nereis, Heteronereis, Polynoe, Aphrodite, Amphitrite, Chaetopterus, Arenicola* and *Pontobdella*.
(c) Permanent mount : Setae of earthworm.
2. Arthropoda (a) Dissections : Cockroach (digestive, nervous and reproductive systems), Prawn (appendages, digestive, nervous and reproductive systems).
(b) Specimens : *Peripatus, Lepisma*, Cockroach and Grasshopper praying mantis, Earwig, Dragonfly, Termite, (queen and other castes), ant, Butterfly Moth, Beetle, Wasp, Honeybee, Crab, Prawn, *Lepas, Balanus, Apis, Limulus*, Scorpion, Spider, Millepede and Centipede.
(c) Permanent mount : Trachea of insect, mouth parts of cockroach, *Cypris, Cyclops, Daphnia*, gill and statocyst of prawn.
(d) Prepared slides : Body louse, bed-bug, rat flea, *Cypris, Cyclops, Daphnia*, trachea of insects, genitalia of cockroach, gill and statocyst of prawn.

3. Mollusca
 - (a) Dissection : *Anodonta* (digestive and nervous systems), *Pila* (pallial complex, digestive and nervous systems).
 - (b) Specimens : *Anodonta*, *Mytilus*, *Pholas*, *Pecten*, *Haliotis*, *Aplysia*, *Doris*, *Limax*, *Pila*, *Octopus*, *Nautilus* shell, *Chiton* and *Dentalium*.
 - (c) Prepared slides : Glochidium larva, radula of *Pila*, gill lamina of *Anodonta*.
 - (d) Permanant mount : Glochidium larva and radula of *Pila*.
4. Echinodermata
 - (a) Dissection: *Asterias* (digestive and water vascular systems).
 - (b) Specimens : *Asterias*, *Echinus*, *Cucumaria*, *Antedon*, *Ophiothrix*.
 - (c) Prepared slide : T.S. of Star-fish.
5. Hemichordata
 - (a) Specimens : *Balanoglossus*.
 - (b) Prepared slide : T.S. *Balanoglossus*.

Note : Candidates will be required to submit duly signed note-books of practical record.

1st Year B.Sc. (Hons. School)
Zoology Subsidiary (BZO 1033)

(For Basic Medical Sciences only)
Theory

	Total Marks : 100
Theory hours per week : 1	Theory : 75
Practical hours per week : 2	Internal Ass. : 15
	Annual Exam. : 60
	Practical : 25
	Internal Ass. : 05
	Annual Exam : 20

20

Objectives

To enable the students to identify, classify and study the general characters of invertebrates and vertebrates. To make the students understand the concept of speciation and origin of life. To enable the students to understand the structure of cell, its organelles and types of cell division.

UNIT-I

1. Classification and general characters of invertebrates and vertebrates up to class with important examples.

UNIT-II

2. Detailed study of *Plasmodium*, *Fasciola*, *Ascaris*, cockroach and rabbit.

UNIT-III

3. Study of cell and its organelles, mitosis and meiosis, and their importance.
4. Study of simple and compound tissues.

UNIT-IV

5. Mendel's laws, chromosomal theory of inheritance.
6. Evidences and theories of evolution.

Note : Examiner will set a total of **nine** questions comprising **two** questions from each Unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Books Recommended

1. Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
2. Kotpal, R.L., Modern Text Book of Zoology, Invertebrates, 10th ed., Rastogi Publications, Meerut, 2012.
3. Dhami, P.S. and Dhami, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
4. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publishers, Meerut, 2012.

Practical based on theory Paper BZO 1033 (BZO 1073) (For Basic Medical Sciences only)

Marks : 25
Internal Ass. : 05
Annual Exam. :20

Classification up to orders of the following specimens with important characters:

Protozoa	:	<i>Amoeba, Paramecium, Euglena, Volvox</i>
Porifera	:	<i>Sycon</i>
Platyhelminthes	:	<i>Fasciola, Tapeworm, Ascaris</i>
Annelida	:	<i>Nereis, Pheretima, Hirudinaria</i>
Arthropoda	:	Cockroach, Prawn, Scorpion
Mollusca	:	<i>Unio, Pila, Sepia</i>
Echinodermata	:	<i>Asterias, Echinus, Cucumaria</i>
Hemichordata	:	<i>Balanoglossus</i>
Urochordata	:	<i>Herdmania</i>
Cephalochordata	:	<i>Branchiostoma</i>
Cyclostomata	:	<i>Petromyzon</i>
Chondrichthyes	:	<i>Scoliodon</i>
Osteichthyes	:	<i>Labeo</i>
Amphibia	:	Frog and Toad
Reptilia	:	<i>Uromastix, Wall lizard, Python, Cobra, Krait and Viper</i>
Aves	:	<i>Columba</i>
Mammalia	:	<i>Oryctolagus</i>
Dissections	:	Rabbit/Rat (digestive, circulatory, reproductive systems)
Skeleton	:	Rabbit
Permanent slides	:	Simple tissues, mouth parts of cockroach.

Note : Candidate will be required to submit the original duly signed note books containing a record of their laboratory work.

B.Sc. (Honours School) - Zoology
SECOND YEAR (THIRD SEMESTER) EXAMINATION

OUTLINES OF TESTS

		Total Marks: 500	
Paper-I	Biochemistry	Subsidiary I	100 marks
Paper-II	Botany	Subsidiary II	100 marks
Paper-III	Zoology V – Functional Anatomy of Non-Chordates-I (Protozoa, Porifera, and Coelenterata)	Major	100 marks
Paper-IV	Zoology VI- Functional Anatomy of Non-Chordates-II (Helminths)	Major	100 marks
Paper-V	Zoology VII – Functional Anatomy of Non-Chordates-III (Arthropoda-I)	Major	100 marks
Paper-III	Zoology V – Functional Anatomy of Non-Chordates-I (Protozoa, Porifera, and Coelenterata)		

	Total Marks : 100
Theory hours per week : 3	Theory : 75
Practical hours per week : 3	Internal Ass. : 15
	Annual Exam. : 60
	Practical : 25
	Internal Ass. : 05
	Annual Exam : 20

Objectives:

- To acquaint the students with the variety of non- chordates from Protozoa, Porifera and Coelenterata to study their functional anatomy.
- To enable the students to understand the difference in their morphology and general anatomy and to classify and study their general characters.

Protozoa

Unit –I

- Protozoa: General organisation, comparative account of morphology (size, shape, skeleton, nucleus, locomotor organelles etc.), nutrition, locomotion, reproduction, excretion, behaviour, osmoregulation etc.

Unit-II

- Detailed classification of Protozoa (N.D. Levine, 1980).
- General account including morphology, life cycle, pathogenicity, diagnosis and prophylaxis of important parasitic protozoan's of man representing each taxon for example: - *Leishmania*, *Trypanosoma*, *Balantidium*, *Giardia*, *Entamoeba*, *Toxoplasma*, *Trichomonas*.

Unit-III

Porifera

- General organisation, classification up to orders of Porifera mentioning their characteristic features with examples.
- Comparative account of canal system, skeletal system, reproduction and development of sponges.

Unit-IV

Coelenterata

- General organisation, classification up to orders of Coelenterates giving their characteristic features with examples.
- Corals and coral formation, polymorphism and affinities of the group.
- Life history and alternation of generation in coelenterata.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical - Paper-III : Zoology V – Functional Anatomy of Non-Chordates-I (Protozoa, Porifera, and Coelenterata)

Protozoa

- Prepare permanent stained preparations of protozoans from fresh water culture and intestine of cockroach.
- Prepare permanent, stained preparations of *Volvox*, *Ceratium*, *Vorticella*.
- Study of permanent slides from the museum of the Department.

Porifera

- General survey of sponges by the study of specimens and slides of important representatives from various poriferan classes.
- Permanent slides for the study of canal system, spicules and various developmental stages.
- Preparation of slides of spicules and developmental stages.

Coelenterata

- General survey of coelenterates by the study of specimens and permanent slides of important representatives.
- Preparation of permanent stained slides of various representatives.

Books recommended

1. Jordan, E.L. and Verma, P.S., Invertebrate Zoology, S. Chand and Company Ltd., New Delhi, 1999.
2. Hyman, L.H., Invertebrates, VOL. I, II, III, IV, and V, Mc Graw-Hill Book Company. Inc., New York London, Toronto, 1959.
3. Hall, Protozoology, Prentice Hall, New York, 1953.
4. Smyth, J.D., Introduction of animal parasitology, 1968.
5. Chattergy, K.D., Parasitology, Medical Publishers, Hodder and Stoughton, London, 1969.
6. Parker, T.J. and Haswell, W.A., Text book of zoology, invertebrate, Vol. I edited by Marshall, A. J. And William, W.D., CBS Publication and Dist., Delhi, 1992.
7. Barnes, R.D., Invertebrate zoology, Saunders, W.B. and Co., 1980.
8. Barrington, Invertebrate structure and function, E.J.W. Nelson, London, 1969.
9. Chaudhary, S., Fundamental Invertebrate Zoology, Vikas, S, and Co., Jalandhar City, 2003.
10. Richard, C. and Gary, J. Invertebrates, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA, 1990.

**Paper-IV : Zoology VI - Functional Anatomy of Non-Chordates-II
(Helminths)**

Theory hours per week	: 3	Total Marks	: 100
Practical hours per week	: 3	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

- To acquaint the students with the latest classification, general organization, comparative account of morphology and physiology of Platyhelminthes & Nematodes.
- To introduce the student to the important parasites causing diseases in animals and men.
- To make the students study a comparative account of variation in their morphology, lifecycles, pathogenicity etc.

Unit-I

Platyhelminthes

1. Turbellaria: General organisation, classification and ecology.
2. Trematoda: General organisation, classification and ecology.
- Monogenea: General account, structure and function, development and ecology of important forms.
- Digenea:
 - i. General account, structure and functions, development and ecology of important forms representing the following families: Dicrocoeliidae, Opisthorchiidae, Troglotrematidae, and Schistosomatidae.
 - ii. Varied types of cercariae and other larval forms, variation in life cycles in Digenea.

Unit-II

3. Cestoda: General organisation, structure, classification and ecology.
 - i. Cestodaria: General account with special reference to the morphology and functions, and life cycles of typical cestodians.
 - ii. Eucestoda: General account and classification with special reference to the structure and functions, development and effect of the important forms representing Pseudophyllidea and Cyclophyllidea and also with special reference to the distribution, patterns of life cycles and larval forms met within the group.

Unit-III

Aschelminthes

- General characters and classification with special reference to morphology and functions and life cycle of a typical nematode and other important forms representing the following families: Trichuridae, Ancylostomatidae, Oxyuridae, Filaridae, Dracunculidae, Strongylidae, Trichinellidae.

Unit-IV

- Comparative account of the pharynx, excretory and reproductive systems in Nematoda.
- A brief account of plant parasitic nematodes.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

**Practical - Paper-IV : Zoology VI- Functional Anatomy of Non-Chordates-II
(Helminths)**

Trematoda

- Collection, fixation, preservation and staining of trematodes from rumen of a ruminant, intestine of fish, fowl and goat/sheep.
- Preparation of permanent slides of different larval stages from snails.
- Preparation of permanent stained slides of trematodes of the preserved material
- Study of permanent slides (W.M. and T.S.) and specimens from the museum of the Department.

Cestoda

- Collection, fixation, preservation and staining of cestodes from: intestine of fish, fowl and sheep or goat.
- Preparation of permanent stained slides of cestodes from the preserved material
- Study of permanent slides (W.M. and T.S.) and specimens from the museum of the Department.

Nematoda

- Collection, fixation, preservation and study of nematodes from intestine of cockroach, fish, fowl, and sheep or goat.
- Study of anatomy of *Ascaris*.
- Study of permanent slides (W.M. and T.S.) and specimens from the museum of the Department.
- Collection and study of plant parasitic and free-living nematodes.

Books Recommended

1. Jordan E.L. and Verma, P. S., Invertebrate Zoology, S. Chand and Co., Ltd., New Delhi, 1999.
2. Hyman, L.H., Invertebrates, VOL. I, II, III, IV, and V, Mc Graw-Hill Book Company. Inc., New York London, Toronto, 1959.
3. Smyth, J.D., Introduction of animal parasitology, 1968.
4. Chattergy, K.D., Parasitology, Medical Publishers, Hodder and Stoughton, London, 1969.
5. Parker, T.J. and Haswell, W.A., Text book of zoology, invertebrate, Vol. I edited by Marshall, A. J. And William, W.D., CBS Publication and Dist., Delhi, 1992.
6. Barnes, R.S., Invertebrates Zoology, Saunders, Philadelphia, 2001.
7. Barrington, Invertebrate structure and function, E.J.W. Nelson, London, 1969.
8. Chaudhary, S., Fundamental Invertebrate Zoology, Vikas, S, and Co., Jalandhar City, 2003.
9. Richard, C. and Gary, J. Invertebrates, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA, 1990.

**Paper-V : Zoology VII – Functional Anatomy of Non-Chordates-III
(Arthropoda-I)**

Theory hours per week	: 3	Total Marks	: 100
Practical hours per week	: 3	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

- To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.
- To impart in depth knowledge about their different modes of living and structural modification acquired to suit varied living conditions.

Unit-I

- General characters and classifications up to orders with examples of class Crustacea.
- General characters and classifications up to orders with examples of class Arachnida.
- General account of classes Trilobita, Onychophora, Symphyla, Chilopoda and Diplopoda.

Unit-II

- Larvae of Crustacea.
- Comparative functional anatomy of digestive, respiratory, circulatory, nervous and reproductive systems of Crustacea.
- Endocrine glands and their function in moulting, pigmentation and reproduction in Crustacea.

Unit-III

- Structural organisation of class Insecta, criteria and history of classification.
- Salient features of various apterygote orders and important pterygote orders (Ephemeroptera, Odonata, Orthoptera, Hemiptera, Lepidoptera, Diptera, Hymenoptera, Coleoptera) with examples.

Unit-IV

- Development of head and the study of head capsule in insecta; general structure and the functional modifications in tentorium, antennae and mouthparts in insects.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

**Practical Paper V : Zoology VII – Functional Anatomy of Non-Chordates-III
(Arthropoda-I)**

1. General survey of Arthropoda other than insects by the study of specimens and slides of important representatives from various classes.
2. Study of different types of larvae of crustaceans with the help of slides and preserved material.
3. Study of insects from different orders.
4. Study of small insects forms by preparing permanent stained preparations.

5. Comparative study of the external functional morphology of insects by preparing permanent stained preparations of :
 - (a) Head capsule
 - (b) Head appendages
 - (c) Tentorium
6. Appendages of available crustacea.

Books recommended

1. Snodgrass, R.E. Principles of Insect Morphology, CBS Publishers and distributors, Delhi, 1994.
2. Richard, O. W. and Davies, R.G., Imm's Text book of Entomology, 10th ed., Vol I & II, B1 publications Pvt. Ltd. New Delhi, 1997.
3. Chapman, R.F., The Insects; structure and Function, The English Language Book Society, and Hodder and Stoughton, Kent, 1980.
4. Mani, M.S., General Entomology, Oxford and IBH, New Delhi, Kalcutta, 1990.
5. Marshall, A. J. And William, W.D., Text Book of Zoology, Invertebrate, Vol. I, CBS Publication and Dist., Delhi, 1992.
6. Barrington, Invertebrate structure and function, E.J.W. Nelson, London, 1969.
7. Kotpal, R.L., Invertebrate Zoology, 10th ed., Rastogi Publishers, Meerut, 2012.
8. Chaudhary, S., Fundamental Invertebrate Zoology, Vikas, S, and Co., Jalandhar City, 2003.

ZOOLOGY SUBSIDIARY

Zoology-III (Biodiversity: Chordates-I)

	Total Marks : 100
Theory hours per week : 4	<u>Theory</u> : 75
Practical hours per week : 4	Internal Ass. : 15
	Annual Exam. : 60
	<u>Practical</u> : 25
	Internal Ass. : 05
	Annual Exam : 20

Objectives

To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I

- Urochordata : *Herdmania* including retrogressive metamorphosis (excluding embryology) and its affinities.
- Cephalochordata : *Branchiostoma* (excluding embryology) and its affinities.

UNIT-II

- Cyclostomata : *Petromyzon* (external characters) and its migration.
- Pisces : *Labeo*

UNIT-III

Amphibia : *Rana*

UNIT-IV

Reptilia : *Uromastix*

Note : Examiner will set a total of **nine** questions comprising **two** questions from Each unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Book Recommended

1. Dhami, P.S. and Dhami, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, 3rd ed., Rastogi Publishers, Meerut, 2012.
3. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vertebrates, 7th ed. Vol. II (eds. A.J. Marshall & Williams, W.D.), Mac Millan, London, 1972.
4. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.
5. Bhamrah, H.S. and Juneja, K., An introduction to fishes, Anmol Publications, New Delhi, 1990.

Practical: Zoology-III (Biodiversity: Chordates-I)

Marks : 25
Internal Ass. : 05
Annual Exam.: 20

1. Dissections of the following Animals to study :
 - (a) *Herdmania* : General Anatomy.
 - (b) *Labeo* : Digestive, arterial and reproductive systems
2. Skeleton : To study the skeleton of *Labeo*, *Rana* and *Varanus*.
3. Permanent mounts : *Salpa*, *Doliolum*, pharynx of *Herdmania* and *Branchiostoma*. Spicules of *Herdmania*.
4. Prepared Slides : Tornaria larva, T.S. *Branchiostoma* through different regions, cycloid and ctenoid scales of fishes.
5. Specimens : General survey and classification up to orders, (except Pisces where it is required only upto sub-classes), habitat, habits, external characters and economic importance (if any) of the following animals.
Protochordata - *Herdmania*, *Molgula*, *Ciona*, *Ascidia*, *Botryllus*, *Pyrosoma*, *Salpa*, *Doliolum*, *Oikopleura* and *Branchiostoma*.
Cyclostomata - *Myxine*, *Petromyzon* and *Amnocoetes* larva.

Chondrichthyes - *Zygaena*, *Pristi*, *Narcine*, *Trygon* and *Rhinobatus*.

Actinopterygii – *Polypterus*, *Acipenser*, *Lepidosiren*, *Mystus*, *Catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Hippocampus*, *Syngnathus*, *Exocoetus*, *Anabas*, *Diodon*, *Ostracion*, *Tetradon*, *Echeneis*, *Lophius*, *Solea* and *Anguilla*.

Dipneusti (Dipnoi) – Any of the lungfishes.

Amphibia – *Necturus*, *Proteus*, *Amphiuma*, *Salamandra*, *Ambystoma*, *Triton*, *Hyla*, *Rhacophorus*, *Uraeotyphlus*, *Ichthyophis* and *Axolotl* larva.

Reptilia- Tortoise, Turtle, *Hemidactylus*, *Calotes*, *Draco*, *Varanus*, *Phrynosoma*, *Chamaeleon*, *Typhlops*, *Python*, *Eryx*, *Ptyas*, *Bungarus*, *Naja*, *Hydrus*, *Vipera*, *Crocodylus*, *Gavialis* and Alligator.

Note : The candidates are required to submit duly signed note books of practical record and the prepared slides.

B.Sc. (Honours School) - Zoology
SECOND YEAR (FOURTH SEMESTER) EXAMINATION

OUTLINES OF TESTS

Total Marks: 500

Paper-I	Biochemistry	Subsidiary I	100 marks
Paper-II	Botany	Subsidiary II	100 marks
Paper-VI	Zoology VIII – Functional Anatomy of Non-Chordates-IV (Arthropoda –II)	Major	100 marks
Paper-VII	Zoology IX- Functional Anatomy of Non-Chordates-V (Annelida and Minor phyla)	Major	100 marks
Paper-VIII	Zoology X– Functional Anatomy of Non-Chordates-VI) (Mollusca and Echinodermata)	Major	100 marks

Paper-VI : Zoology VIII – Functional Anatomy of Non-Chordates-IV)
(Arthropoda –II)

Theory hours per week	: 3	Total Marks	: 100
Practical hours per week	: 3	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

- To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.
- To impart in depth knowledge to students about the different modes of living and structural modification acquired to suit varied living conditions.

Unit-I

- Preliminary knowledge of thoracic and abdominal segments of insects.
- General structure and functional modifications in the wings and legs in different insect groups.
- External male genitalia and external female genitalia in different insect group.

Unit-II

- Comparative account of the structure and functions of digestive system in insects with special reference to the functional modifications like filter chamber and peritrophic membrane and digestive glands.
- Comparative account of the nervous in insects.

Unit-III

- Comparative account of the male and female reproductive systems in insects.
- General structure and functions of excretory, respiratory and circulatory systems in insects.

Unit-IV

- Postembryonic development and types of metamorphosis in insects.
- Structural modifications in larvae and pupae and relationship of nymphs and naiads.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical- Paper-VI Zoology VIII – Arthropoda –II (Functional Anatomy of Non-Chordates-IV)

1. Comparative study of the external functional morphology of insects by preparing permanent stained preparations of :
Wings
Legs
Genitalia
2. Dissection of suitable insects for the study of internal functional anatomy :
Digestive System
Nervous system
Reproductive systems
3. Study of different types of insect larvae and pupae.

Books recommended

1. Snodgrass, R.E. Principles of Insect Morphology, CBS Publishers and distributors, Delhi, 1994.
2. Richard, O. W. and Davies, R.G., Imm's Text book of Entomology, 10th ed., Vol I & II, B1 publications Pvt. Ltd. New Delhi, 1997.
3. Chapman, R.F., The Insects; structure and Function, The English Language Book Society, and Hodder and Stoughton, Kent, 1980.
4. Mani, M.S., General Entomolgy, Oxford and IBH, New Delhi, Kalcutta, 1990.
5. Marshall, A. J. And William, W.D., Text Book of Zoology, Invertebrate, Vol. I, CBS Publication and Dist., Delhi, 1992.
6. Barrington, Invertibrate structure and function, E.J.W. Nelson, London, 1969.
7. Kotpal, R.L., Modern Text Book of Zoology Invertebrates, 10th ed., Rastogi Publishers, Meerut, 2012.
8. Chaudhary, S., Fundamental Invertebrate Zoology, Vikas, S, and Co., Jalandhar City, 2003.

**Paper-VII- Zoology IX- Functional Anatomy of Non-Chordates-V
(Annelida and Minor phyla)**

Total Marks : 100

Theory hours per week : 3
Practical hours per week : 3

Total Marks : 100
Theory : 75
Internal Ass. : 15
Annual Exam. : 60
Practical : 25
Internal Ass. : 05
Annual Exam : 20

Objectives

- To acquaint the students with the variety of Annelida and various minor phyla so as to make them aware of the diversity and evolutionary affinities.
- To enable the students to understand the difference in the morphology and general anatomy and to classify and study the general characters of these groups.

Unit-I

Annelida

- General organization and classification of Annelida.
- Comparative account of excretory, respiratory and reproductive systems.
- Regeneration and sexual reproduction.

Unit-II

Nemertine or Rhyncocoela

- General organisation and classification.
- Life history of a typical nemertine.
- Affinities of the group.

Nematomorpha

- General organisation and classification.
- Life history of a typical nematomorph.
- Affinities of the group.

Unit-III

Acanthocephala

- General organisation and classification.
- Life history of a typical Acanthocephala.
- Affinities of the group.

Rotifera

- General organisation and classification.
- Life history of a typical Acanthocephala.
- Affinities of the group.

Unit-IV

Other Minor Phyla

- General organization, classification, development and ecology of the animals belonging to the following minor phyla:
 - Gastrotricha
 - Kinorhyncha,
 - Bryozoa
 - Brachiopoda
- Comparative account of body wall, digestive, circulatory and nervous system.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

**Practical – Paper : VII - Zoology IX- Functional Anatomy of Non-Chordates-V
(Annelida and Minor phyla)**

Annelida

- Dissection of *Nereis*, earthworm and leech.
- Study of T.S. of various annelids.
- Preparation of permanent slides of the various structures such as parapodia and nephridia. General survey of Annelida.

Nemertine or Rhynchocoela

- Study of the specimens from museum and mounted slides representing families as prescribed from the theory.

Nematomorpha

- Study of *Gordius* from specimen and prepared slides.

Acanthocephala

- Study of the specimens from museum and mounted slides representing families as prescribed from the theory: *Echinorhynchus*, *Macracanthorhynchus*, *Centrorhynchus*.
- Making permanent stained preparation of the ananthocephalans from crows and frogs etc.
- Histology of Acanthocephala from the slides.
-

Other Minor Phyla

- Identification of museum specimens and permanent mounts from various minor phyla as per the theory course.
- Temporary preparations of permanent mounts of the animals or their parts from the above phyla.

Books Recommended

1. Kotpal, R.L., Modern Text Book of Zoology Invertebrates, 10th ed., Rastogi Publishers, Meerut, 2012.
2. Kotpal, R.L., Minor phyla, 5th ed., Rastogi Publishers, Meerut, 2006.
3. Dhama, P.S. and Dhama, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.

**Paper-VIII : Zoology X– Functional Anatomy of Non-Chordates-VI
(Mollusca and Echinodermata)**

Theory hours per week	: 3	Total Marks	: 100
Practical hours per week	: 3	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

- To acquaint the students with the variety of non-chordates from Mollusca and Echinodermata and to study their functional anatomy.

- To enable the students to understand the differences in the morphology and general anatomy molluscus and echinodermes to classify and study their general characters.

Unit-I

Mollusca

- General organisation and classification of Mollusca up to orders.
- Comparative account of :
 - (i) Digestive system
 - (ii) Nervous systems and sense organs
 - (iii) Reproductive system
 - (iv) Respiratory system
 - (v) Circulatory system
 - (vi) Excretory system

Unit-II

- Shell and its development
- Torsion and detorsion in gastropods
- Organs of locomotion
- Different types of larvae

Unit-III

Echinodermata

- General organization, classification, development and ecology of important animals belonging to the five different classes of the phyla i.e. Asterozoa, Echinozoa, Holothurozoa, Crinozoa and Ophiurozoa.
- Comparative account of the larvae.

Unit-IV

- Development of internal organs and metamorphosis.
- Affinities of the group.
- Important fossil forms.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Books recommended

1. Jordan E.L. and Verma, P. S., Invertebrate Zoology, S. Chand and Co., Ltd., New Delhi, 1999.
2. Hyman, L.H., Invertebrates, VOL. I, II, III, IV, and V, Mc Graw-Hill Book Company. Inc., New York London, Toronto, 1959.
3. Parker, T.J. and Haswell, W.A., Text book of zoology, invertebrate, Vol. I edited by Marshall, A. J. And William, W.D., CBS Publication and Dist., Delhi, 1992.
4. Barnes, R.S., Invertebrates Zoology, Saunders, Philadelphia, 2001.
5. Barrington, Invertebrate structure and function, E.J.W. Nelson, London, 1969.
6. Chaudhary, S., Fundamental Invertebrate Zoology, Vikas, S, and Co., Jalandhar City, 2003.
7. Richard, C. and Gary, J. Invertebrates, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA, 1990.

**Practical Paper VIII : Zoology X- Functional Anatomy of Non-Chordates-VI
(Mollusca and Echinodermata)**

Mollusca

- General survey of molluscs by the study of specimens and slides.
- Study of permanent slides and preparation of permanent stained slides of various forms from various classes.

Echinodermata

- General survey of echinoderms by the study of specimens and slides.
- Study of permanent slides and preparation of permanent stained slides of various forms from various classes.

**ZOOLOGY SUBSIDIARY
Zoology-IV (Biodiversity: Chordates-II)**

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 4	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To acquaint the students about the structure and function of protochordates and chordates and to make the student understand the basic characters, advancements and adaptations of different types of vertebrates.

Detailed study (morphology & anatomy), systematic position, distinctive characters, distribution, ecology, economic importance, if any, of the following animals:

UNIT-I

Aves : *Columba*

UNIT-II

Mammalia : *Oryctolagus*

UNIT-III

Ecology : Definition, subdivisions and scope of ecology, Ecosystem- Definition, components and functioning of pond ecosystem; Food chain and food web; concepts of ecological niche; Ecological adaptations- Aquatic, Volant and desert adaptations.

UNIT-IV

Behaviour : Parental care, migration with particular reference to Fishes and birds.

Physiology : Introduction to the physiology, physiology of digestion, circulation, respiration, conduction of nerve impulse and muscle contraction. Introduction to endocrinology with detailed account of hormones.

Note: Examiner will set a total of **nine** questions comprising **two** questions from each unit, and **one compulsory question** of short answer type covering the whole syllabus. It will consist of **eight short answer questions** of 1½ marks each. Students will attempt **one** question from each Unit and the **compulsory questions**. All questions may carry equal marks.

Book Recommended

1. Dhama, P.S. and Dhama, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi, 2006.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publishers, Meerut, 2012.
3. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vertebrates. Vol. II- edited by A.J. Marshall & Williams, W.D, CBS Publishers & Distributors, Delhi.
4. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.
5. Bhamrah, H.S. and Juneja, K., An introduction to fishes, Anmol Publications, New Delhi, 1990.
6. Mathur, R., Animal Behaviour, 1st ed., Rastogi Publishers, Meerut, 2011.
7. Singh, H.R. and Kumar, N., Ecology and Environmental Science, 7th ed., Vishal Publishing Co., Jalandhar, 2010.
8. Sharma, P.D., Ecology and Environment, 7th ed., Rastogi Publishers, Meerut, 2003

Practical: Zoology-IV (Biodiversity : Chordates-II)

Marks : 25

Internal Ass. : 05

Annual Exam.: 20

1. Chick- Digestive, arterial, venous and reproductive system.
2. Rat- digestive, arterial, venous and reproductive system.
3. To study prepared slides of developmental stages in the life history of chick upto 24hrs stage.
4. To study skeletons of *Gallus* and *Oryctolagus*.
5. General survey and classification upto orders, habitat, habits, external characters and economic importance (if any) of the following animals:
 Aves- *Anas, Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis, Casuarius;*
 and *Struthio*.
 Mammalia – *Echidna, Ornithorhynchus, Macropus, Erinaceus, Sorex, Loris,*
Macaca, Manis, Hystrix, Funambulus, Felis, Capra, Canis, Herpestes,
Pteropus and *Leo*.
6. Physiology:
 - a. Diffusion and dialysis through Cellophane/dialysis Membrane.
 - b. Effect of isotonic, hypotonic and hypertonic solutions on erythrocytes.
 - c. Demonstration of the different types of human blood groups.
 - d. Estimation of haemoglobin percentage in the human blood.
 - e. Study of the sections of thyroid, pancreas, adrenal and ovary (corpus luteum) of mammal from the prepared slides.
7. Ecology: Study of ecological adaptations and inter-specific relationship with the help of specimens and charts.

Note : The candidates are required to submit duly signed note books of practical record and the prepared slides.

**OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR
B.Sc. (Honours School) - Zoology
THIRD YEAR (FIFTH SEMESTER) EXAMINATION
OUTLINES OF TESTS**

Paper	Title of the Paper	Marks	
Paper-VI	General account of Vertebrates - I	100	} Final Theory: 75 Practicals : 25
Paper-VII	Comparative anatomy of Vertebrates -I and Zoogeography	100	
Paper-VIII	Cell Biology	100	
Paper-IX	Animal Physiology	100	
Paper-X	Taxonomy, Ecology and Palaeontology-I	100	
Total :		<u>500</u>	

Paper VI: General Account of Vertebrates (Fishes, Amphibians and Reptiles) - I

	Total Marks	: 100
Theory hours per week	: 4	<u>Theory</u> : 75
Practical hours per week	: 3	Internal Ass. : 15
		Annual Exam. : 60
		<u>Practical</u> : 25
		Internal Ass. : 05
		Annual Exam : 20

Objectives

To acquaint the students with the classification and general characters including morphology and physiology of different vertebrates from fishes to mammals including their behaviour and physiological adaptations. To educate the students about the importance of wildlife conservation.

UNIT-I

Fishes

Form and locomotion: Body form in various groups of fishes (cartilaginous and bony fishes). Locomotion: Passive and active locomotion (body muscles, fins and other miscellaneous methods).

Body coverings: Scales, types (placoid, Cosmoid, ganoid, cycloid, ctenoid), functions and modifications.

Fins: Structure of typical fin of a bony fish, paired fins, unpaired fins and the modifications of the fins.

Buoyancy : Structure of swim bladder, variations of swim bladder in different groups of fishes, functions of swim bladder. Weberian ossicles and swim bladder.

UNIT-II

Fishes

Respiration: Structure of typical gill, types and variations of gills in various groups of fishes, air breathing organs in fishes.

Age determination and growth in fishes, age determination in Indian freshwater fishes using hard parts (scales, vertebrae, opercular bones etc.) Growth measurements using Fraser-Lee equation.

Reproduction: Breeding behaviour, breeding and migration in *Salmon* and *Anguilla*.

UNIT-III

Amphibia

Classification upto orders (only living forms), general characters and peculiar features of the class Amphibia; adaptive radiations in Amphibia; morphological and physiological adaptations; parental care and neoteny in Amphibia; migration in Amphibia.

UNIT-IV

Reptilia

Classification upto orders (only living forms) of class Reptilia, general, distinctive peculiar features of the class Reptilia; adaptive radiations in Reptilia; shell in Chelonia; epidermal and dermal Plates and modifications in various families; identification of poisonous and non-poisonous snakes, poison apparatus, fangs and physiology of poison and its treatment. Jacobsons organs. Affinities of Reptiles.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical:

Dissection of a bony fish : Alimentary canal, cranial nerves, afferent and efferent vessels, reproductive organs.

Weberian Ossicles of bony fishes : Air breathing organs of bony fishes.

Variations in the body form and fins in fishes.

Study of different types of scales in fishes, permanent preparations of scales.

Museum specimen : Study of museum specimens belonging to different groups with classification, morphological characters and ecological notes.

BOOKS RECOMMENDED

1. Parker, T.J. and Haswell, W.A., textbook of zoology, invertebrates, Vol. I edited by Marshall, A.J. And Wiiliam, W.D., CBS publication and Dist., Delhi, 1992.
2. Weichert, C.K., Principles of Chordates , McGraw Hill Book Co. Inc., London, 1970.
3. Walter, H.E. and Slaves, L.P., Biology of vertebrates, McMillan Co., New York, 1959.
4. Norman, J.R., History of Fishes, Earnest Benn Ltd., London, 1975.
5. Lagler, K.F., Bardach, J.E., Miller, R.R. and MayPissino, D.R., Ichthyology, John Wiley and Sons, New York, 1997.
6. Peter, B.M. and Joseph, J., Fishes: An introduction to ichthyology, Prentice Hall, Inc., New Jersey, USA, 2000.
7. Kent, G.C. and Carr R.K., Comparative anatomy of vertebrates, 9th ed., McGraw Hill, New York, 2001.
8. Liem, K.F., Bemis, W.E., Walker, W.F. and Grandi, L., Functional Anatomy of Vertebrates an evolutionary perspective, 3rd ed., Harcourt College Publishers, Orlando, Florida, 2001.

Paper VII: Comparative Anatomy of Vertebrates - I and Zoogeography

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 3	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To enable the students to draw a comparative account of the morphology and general anatomy of the vertebrates and to understand evolution of different system in vertebrates. To enable the students understand the scope and importance of zoogeography..

UNIT -I

Integument : Basic microscopic structure in different groups, types of integumentary glands and their functions.

Exoskeleton : A general account of scales in the vertebrates, morphology of horn, antlers, feathers and hair.

UNIT -II

Endoskeleton : Chondrocranium, Splanchnocranium, modification of visceral arches, Jaw suspension, Dermatocranium.

UNIT-III

Zoogeography.

Scope and importance of zoogeography.

Zoogeography, divisions and the distribution of the vertebrates in the Palaearctic, Oriental, Ethiopian, Nearctic, Neotropical and Australian regions.

UNIT-IV

Island faunas: Recent continental island, Fringing Archipelagos and other islands and archipelagos.

Dispersal and migration of vertebrates.

Continental drift theory, Gondwana Mass and its dismemberment.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical

1. Permanent Slides: Study of histology of integument of different vertebrates from museum slides.
2. Skeletons: A detailed study of the axial and appendicular skeletons of fishes, amphibians, reptiles, birds and mammals. Study of palates, temporal vacuities in reptilia.

Zoogeography:

3. Study of the world maps to draw political, physical, climatical, vegetational and animal distribution in them.
4. Study of continental shelves of various parts of the world to determine land connections with various island of the world.
5. Map study of continents in relations to distribution of animals peculiarities.
6. To draw line maps and fill in names of important animals, vegetation and climate

Books Recommended

1. Kent, G.C. and Carr R.K., Comparative anatomy of vertebrates, 9th ed., McGraw Hill, New York, 2001.
2. Liem, K.F., Bemis, W.E., Walker, W.F. and Grandi, L., Functional Anatomy of Vertebrates an evolutionary perspective, 3rd ed., Harcourt College Publishers, Orlando, Florida, 2001.
3. Weichert, C.K., Principles of Chordates , McGraw Hill Book Co. Inc., London, 1970.
4. Walter, H.E. and Slaves, L.P., Biology of vertebrates, McMillan Co., New York, 1959.
5. Chordate Morphology by M. Jolly, Van Nostrad, USA.
6. Wildlife in India by Saharai, Bishan Singh Mohinder Singh, Dehradun, India.
7. Wildlife Biology by Raymond Dasmann, Wiley Eastern Ltd., New Delhi.
8. Zoogeography by Darlington, John Wiley & Sons, New York

Paper VIII: Cell Biology

	Total Marks	: 100
Theory hours per week	Theory	: 75
Practical hours per week	Internal Ass.	: 15
	Annual Exam.	: 60
	Practical	: 25
	Internal Ass.	: 05
	Annual Exam	: 20

Objectives

To enable the students to learn various aspects of cell biology.

UNIT I

Plasma membrane : Different models of plasma membrane (in brief), fluid mosaic model in detail, differentiation at cell surface.

Endoplasmic reticulum :Morphology, Chemical composition, morphological differentiation, functions and its role during mitosis.

Microbodies : Structure, chemical composition, functions and origin of peroxisomes and glyoxysomes.

UNIT-II

Mitochondria : Morphology including vital examination, light and ultramicroscopic structures, structural variations with regard to functions, chemical composition, role in cell physiology, mitochondria as semi-autonomous organoids.

Lysosomes : Morphology, chemistry, their polymorphism in relation to cytolysis, cell ageing and cell autophagy.

UNIT-III

Nucleus :Nuclear envelope, nuclear permeability, structure of interphase nucleus, structure and cytochemistry of nucleus, structure and biogenesis of ribosomes.

Centrioles : Basal bodies, cilia, flagella, microtubules, amoeboid movement.

UNIT-IV

Golgi complex : Morphology, chemical composition, relationship with other cell components, its function with special reference to cell secretion.

Ultrastructure of typical sperm of insect.

Vitellogenesis in insects.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals based on Theory Paper BZO 3003 (BZO 3053)

1. Carbohydrates : Basics of PAS and staining with PAS.
2. Proteins : Basis of Mercuric-bromophenol blue and staining of proteins with Hg-SPB.
3. Lipids : Basis of Sudan black B and Nile blue sulphate methods and staining of acids and neutral lipids with the help of SPB & HBS techniques.
4. Nucleic acids : Basis of Feulgen's and Methyl green/pyronin G and staining of nucleic acids with Feulgen and MG/PG techniques.
5. Smear preparation of testes of insects or mammalian semen.
6. Study of slides of insect and mammalian testes showing different stages of spermatogenesis.
7. Study of slides of ovaries of insects, birds and mammals showing various stages of Oogenesis.

Books recommended

1. DeRobertis, EDP, De Robertis, E.M.F. Cell Biology and Molecular Biology. Eighth Edition. W.B. Saunders Co., Philadelphia, 1995.
2. Powar, C.B., Cell Biology, 3rd ed., Himalaya Publishing House, Mumbai, 2010.
3. Alberts, B. Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., Molecular Biology of the Cell, 5th ed., Garland Science, Taylor and Francis Group, New York, 2008.
4. Lodish, H., Berk, A. Matsudaira, P. et al., Molecular Cell Biology, 5th ed., WH Freeman & Co., New York, 2004.
5. Karp, G., Cell Biology, 6th ed., John Wiley & Sons, Inc., 2010.
6. Cooper, G.M. and Hausman, R.E., The Cell A Molecular Approach, 4th ed., ASM Press, Washington DC, 2007.

Paper IX: Animal Physiology

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 100
Theory : 75
Internal Ass. : 15
Annual Exam. : 60
Practical : 25
Internal Ass. : 05
Annual Exam : 20

Objectives

To make the students understand the physiological processes going on inside the vertebrates.

UNIT-I

Digestion : Intracellular and extracellular digestion, digestive enzymes, digestion by means of symbionts, coordination of digestive enzymes, intestinal absorption.

UNIT-II

Respiration : Nature of respiratory organs, transport of respiratory gases, respiratory quotient and caloric equivalent of oxygen, control of respiration.

Muscle : Muscle contraction – physiology and chemistry.

Nitrogen excretion : Chemical nature of nitrogenous products, distribution of excretory products of protein metabolism, mechanism and control of excretion.

UNIT-III

Circulatory System : Blood components, functions of components, cardiac output and heart rate, physiology of heart, control of cardiovascular function.

UNIT-IV

Nervous system : Structural elements, nerve impulse, resting and action potentials, conduction of action potential, synaptic transmission.

Reproduction: Structure of gonads and physiology of reproduction.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical based on Theory Paper BZO 3004 (BZO 3054)

Physiology

1. Identification of food stuffs-starch, sucrose, glucose, proteins and fats.
2. Demonstration of osmosis and diffusion.
3. Demonstration of the presence of amylase enzyme in saliva. Effect of pH and temperature on enzyme action.
4. Determination of coagulation and bleeding time of blood.
5. Determination of blood groups of human blood samples.

6. Recording of blood pressure of man.
7. Innumeration of red blood corpuscles and white blood corpuscles of man.
8. Estimation of haemoglobin content in blood.

Books Recommended

1. Guyton, A.X., Text Book of Medical Physiology, 7th edition, Saunders Company, 1986.
2. Best, J.P., Best and Taylor's physiological basis of medical practice, 11th ed., William and Wilkins, 1985.
3. Hoar, W.S., General and comparative physiology, Adaptation and Environment, 3rd ed., Cambridge University Press, 1983.
4. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd ed., Lippincott Williams and Wilkins, 2003.

Paper – X : Taxonomy, Ecology & Palaeontology-I

	Total Marks : 100
Theory hours per week : 4	<u>Theory</u> : 75
Practical hours per week : 3	Internal Ass. : 15
	Annual Exam. : 60
	<u>Practical</u> : 25
	Internal Ass. : 05
	Annual Exam : 20

Objectives

To enable the students to identify, classify and name the organism according to international code of zoological nomenclature. To acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification. To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles. To enable the students understand the adaptations of the animals to their environment. To make the students understand the importance of Palaeontology with special reference to the fossils, dating of fossils and geological time scale. To acquaint the students with origin of different vertebrates and ancestries of some vertebrates.

UNIT-I

Definitions and perspectives of systematics, classification and taxonomy; history, goals and importance of taxonomy; procedures of taxonomy-identification, classification, nomenclature, phena, taxa, category; key and its significance; higher taxa and linnean hierarchy; qualitative and quantitative methods of analysis of variations; history and theories of classification; international code of Zoological nomenclature-principles and objectives and rules for nomenclature, typesystem and priority for different taxa.

UNIT-II

Introduction to Ecology-Definition, subdivision of ecology and scope of ecology.

Ecological Factors-Temperature and light as ecological factors.

Ecosystem - Definition, components of ecosystem, Grazing and detritus type of food chain, Food Web and Trophic levels.

Ecological pyramids-Pyramids of number, biomass and energy.

UNIT-III

Energy flow-Flow of energy through a food chain in relation to laws of thermodynamics.

Biogeochemical cycles – Gaseous and Sedimentary type of biogeochemical cycles.

Principles of limiting factor- Leibigs' law of minimum, Shelfords law of tolerance and concept of limiting factors.

Ecological niche – Concept of ecological niche, and competitive exclusion principle.

UNIT –IV

Introduction to Palaeontology : History, Stratigraphy ; Principles, Importance, Successive stratigraphic steps, fossils, importance and dating of fossils, Geologic time Scale, General account of Palaeo-Meso-and Cenozoic Eras with a mention of important fossil groups in different Eras, periods and epochs.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1½ marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals

1. Study of components of ecosystem and ecological pyramids.
2. Use of keys to various taxas from different orders of animals. Methods of describing animals with particular reference to the recording of taxonomic characters.
3. Study of Fossils and their models.
4. Study of some charts relevant to Palaeontology.
5. Study of models of dinosaurs.
6. Visit to Govt. Museum.

Books Recommended

1. Dobzhansky, T.G., Genetics and the origin of species. Columbia Univ. Press, New York, 1951.
2. Mayr, E., Principles of Systematic Zoology, Tata McGraw-Hill, New Delhi, 1976.
3. Krebs, J.C., Ecology, Harper & Row, Publ., New York, 2009.
4. Odum, E.P. and Barrett G.W., Fundamentals of Ecology, Thomson Brooks/Cole, 2005.
5. Clarke, G. L., Elements of Ecology, John Wiley & Sons, New York, 1954.
6. Kendeigh, S.C., Ecology with special reference to animals and man, Prentice Hall of India, N. Delhi, 1961.
7. Smith, Ecology, Harper & Row Publishers, New York, 1990.
8. Kormondy, E.J., Concepts of Ecology, 2nd ed., Prentice Hall of India, New Delhi, 2005.
9. Stirton, R.A., Time, life and man, C.B.S. Publishers & Distributors, Delhi, 1959.
10. Colbert, E.H., Evolution of Vertebrates, C.B.S. Publishers & Distributors, Delhi, 1989.
11. Kapoor, V.C., Theory and Practice of Animal Taxonomy, 6th ed., Oxford and IBH Publishing Co. Pvt. Ltd., N. Delhi, 2008.

**OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR
B.Sc. (Honours School) - Zoology
THIRD YEAR (SIXTH SEMESTER) EXAMINATION
OUTLINES OF TESTS**

Paper	Title of the Paper	Marks	
Paper-XI	General account of Vertebrates - II	100	} Final Theory: 75 Practicals : 25
Paper-XII	Comparative anatomy of Vertebrates – II & Wildlife	100	
Paper-XIII	Cytogenetics	100	
Paper-XIV	Embryology and Endocrinology	100	
Paper-XV	Taxonomy, Ecology and Palaeontology-II	<u>100</u>	
	Total :	<u>500</u>	

Paper XI: General Account of Vertebrates (Aves and Mammals) –II and Zoogeography

	Total Marks	: 100
Theory hours per week	: 4	<u>Theory</u> : 75
Practical hours per week	: 3	Internal Ass. : 15
		Annual Exam. : 60
		<u>Practical</u> : 25
		Internal Ass. : 05
		Annual Exam : 20

Objectives

To acquaint the students with the classification and general characters including morphology and physiology of different vertebrates from fishes to mammals including their behaviour and physiological adaptations. To educate the students about the importance of wildlife conservation.

UNIT-I

Aves

Classification upto orders, general characters and peculiar features of the class Aves. Detailed account of Ratitae; migration in birds; beaks & feet in birds; aerodynamics of flight in Aves. Adaptive radiations and affinities of class Aves.

UNIT-II

Mammals

A brief classification of class Mammalia upto orders. General and peculiar features of the class Mammalia. General account of Monotremes, Marsupials, insectivorous mammals, flying mammals, carnivorous mammals, toothless mammals, gnawing mammals & Cetacea mammals, Ungulates and Primates. Affinities of class Mammalia.

UNIT – III

Wild Life

Distribution of wildlife in India with particular reference to Himalayan mountains, peninsular India and tropical rain forest regions. Wildlife of Mangrove swamps & Andaman & Nicobar Islands. Water birds of Bharatpur sanctuary.

Wildlife habitat with particular reference to food, shelter and water requirements, Biotic succession and wildlife, successional classification of wildlife.

UNIT-IV

Wild Life

Methods of studying wildlife, Government and non-government organisations of wildlife. Law and legislation regarding wildlife.

Special projects for endangered species (a) Project tiger, (b) Gir Lion Sanctuary Project, (c) Crocodile Breeding Project and (d) Project Hangul.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals

1. Study of the birds of Panjab University Campus alongwith their roosting and nesting sites.
2. Study of the winter migratory birds of Sukhna Lake, Chandigarh.
3. Study of the wild animals both in nature and Captivity of Chhatbir Zoo near Chandigarh.
4. Visit to Pinjore Garden to study wild animals in nature and Captivity.
5. Visit to Kansal Sanctuary to study the wildlife.

Vertebrates

Museum specimens: Study of museum specimens belonging to different groups with classification, morphological characters and ecological notes.

Books Recommended

1. Kent, G.C. and Carr R.K., Comparative anatomy of vertebrates, 9th ed., McGraw Hill, New York, 2001.
2. Liem, K.F., Bemis, W.E., Walker, W.F. and Grandi, L., Functional Anatomy of Vertebrates an evolutionary perspective, 3rd ed., Harcourt College Publishers, Orlando, Florida, 2001.
3. Weichert, C.K., Principles of Chordates , McGraw Hill Book Co. Inc., London, 1970.
4. Walter, H.E. and Slaves, L.P., Biology of vertebrates, McMillan Co., New York, 1959.
5. A text book of Zoology by T.J. Parker and Haswell, Revised by A.J. Marshall, MacMillan & Co. Ltd., New York.
6. Encyclopedia of mammals by Amy-Jane-Bear, Pat Morris Grang Books, 2005.
7. Compete encyclopedia of birds by Bejeek & Stastny Rebo Publishers, 2004.

Paper XII: Comparative Anatomy of Vertebrates - II

Theory hours per week	: 4	Total Marks	: 100
Practical hours per week	: 3	Theory	: 75
		Internal Ass.	: 15
		Annual Exam.	: 60
		Practical	: 25
		Internal Ass.	: 05
		Annual Exam	: 20

Objectives

To enable the students to draw a comparative account of the morphology and general anatomy of the vertebrates and to understand evolution of different system in vertebrates. To enable the students understand the scope and importance of zoogeography.

UNIT-I

Digestive system: Morphology of teeth in vertebrates oral cavity with special reference to dentition in mammals.

Comparative accounts : Pharynx, stomach and intestine in vertebrates.

UNIT-II

Respiratory system: A general account of the respiratory system in vertebrates.

Circulatory system: Formation and evolution of heart, aortic arches and their significance.

UNIT – III

Nervous system: General account of vertebrate brain (Prosencephalon, Mesencephalon, Rhombencephalon, ventricles, brain membranes), comparative account of brain with special reference to cerebral hemispheres (Pallium), mid brain and hind brain. Hypothalamus, Epithalamus, Thalamus. Spinal cord and its variation in vertebrates. Cranial nerves : origin and supply and variations in vertebrates.

Receptor organs: Organs of hearing, sight in vertebrates.

UNIT-IV

Urinogenital system : Types of kidney-Archinephros, Mesonephros, Metanephros, urinary bladder.

Reproductive organs : Gonads, ducts and their modifications in males and females in the vertebrates group.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practical

Histological slides available in museums with respect to different systems.

Dentition of vertebrates.

Dissections : Study of Blood vascular system of *Gallus*; air sacs, muscles of flight and pecten of *Columba* (Through models and charts). Neck nerves, blood vascular and reproductive systems of *Rattus* (Rat).

Books Recommended

1. Kent, G.C. and Carr R.K., Comparative anatomy of vertebrates, 9th ed., McGraw Hill, New York, 2001.
2. Liem, K.F., Bemis, W.E., Walker, W.F. and Grandi, L., Functional Anatomy of Vertebrates an evolutionary perspective, 3rd ed., Harcourt College Publishers, Orlando, Florida, 2001.
3. Weichert, C.K., Principles of Chordates, McGraw Hill Book Co. Inc., London, 1970.
4. Walter, H.E. and Slaves, L.P., Biology of vertebrates, McMillan Co., New York, 1959.

Paper XIII: Cytogenetics

	Total Marks	: 100
Theory hours per week	Theory	: 75
Practical hours per week	Internal Ass.	: 15
	Annual Exam.	: 60
	Practical	: 25
	Internal Ass.	: 05
	Annual Exam	: 20

Objectives

To enable the students to learn various aspects of cell biology. To give an insight into evolution of genetic material, its functional aspects and changes in the environment that bring about evolution.

UNIT-I

Physical basis of heredity – Mendelism, interaction of genes, multiple alleles, chromosome structure and function in Eukaryotes (except in chemistry, models and concepts). Polytene chromosomes, lampbrush chromosomes.

UNIT-II

Cell division _Mitosis & Meiosis.

Sex determination-Sex chromosomes & sex chromatin, different types of sex mechanisms.

UNIT-III

Chromosome changes- Structural aberrations and its significance. Numerical changes, polyploidy and its types.

Nature of genes-Double helix structure of DNA, mechanisms of DNA replication.

Changes in genes-Spontaneous mutations and induced Mutations, physical and chemical mutagens.

UNIT-IV

Linkage of genes, crossing over, sex linkage in *Drosophila* and man, criss-cross inheritance, colour blindness and haemophilia.

Cytoplasmic inheritance.

Human Genetics-Normal and abnormal karyotypes.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals

1. Study of mitosis from onion root tips by making temporary squash preparations and staining with aceto carmine/aceto orcein.
2. Study of chromosomes (meiosis and mitosis) from the testicular tissue of *Chrotogonus* grasshoppers/cockroach etc.
 - (i) By squash method using Aceto-orcein stain.
 - (ii) By air drying technique using acetic acid dissociation technique and staining with Geimsa or Feulgen.
3. Preparation of temporary squash preparations of salivary glands for studying polytene chromosomes of *Chironomus*/mosquito/*Drosophila*.
4. Mammalian blood smear preparation for the study of drum sticks as sex chromatin test (rat or human).
5. Study of sex chromatin from human buccal mucosa.
6. Study of metaphase karyotypes from permanent/temporary slides of invertebrate and vertebrate species such as beetles, mosquitoes, grasshoppers, flies, spiders, man, rat, mice and bat etc. plus numerical or structural aberrations, if any.
7. Study of Mendelian ratios from the study of seed coat colour pattern of bean seeds (Monohybrid and Dihybrid ratios).
8. Survey of human subjects for the demonstration of the frequency of dominant and recessive traits such as free and attached pinna, rolling of tongue, eye colour, hair colour etc.
9. Screening of films of Heredity, gene expression, DNA structure/cell division etc. available in the Department.

Books recommended

1. Goodenough, U., Genetics, IIIrd ed., Philadelphia, Saunders College Pub.,1984.
2. Swanson C.P., Merz T, and Young W.J., Cytogenetics - The Chromosome in Division, Inheritance and Evolution, IInd ed., Prentice Hall of India, New Delhi, 1982.
3. Gardner, E.J. and Snustad , D.P., Principles of Genetics, 7th ed., New York, John Wiley, 1984.
4. Winchester, A.M., Genetics - A survey of the Principles of Heredity, 3rd ed., Calcutta,Oxford and IBH Pub. 1972.
5. Gupta P.K., Genetics, Rastogi Publishers, Meerut, 2011
6. Gupta P.K.,Cell and Molecular Biology, 3rd ed., Rastogi Publishers, Meerut, 2005.
7. Snustad, D.P. and Simmons, M.J., Principles of genetics, 4th ed., John Wiley & Sons Inc. NJ, 2006.

Paper XIV: Embryology and Endocrinology

	Total Marks	: 100
Theory hours per week	Theory	: 75
Practical hours per week	Internal Ass.	: 15
	Annual Exam.	: 60
	Practical	: 25
	Internal Ass.	: 05
	Annual Exam	: 20

Objectives

To enable the students to know about the development of all the vertebrates from an egg to the embryo. To acquaint the students with the functions of various endocrine glands and their secretions i.e. hormones

UNIT I

History, Problems and Scope : Types of eggs; fertilization, early development (cleavage, blastulation, gastrulation and tubulation), presumptive areas, organisers and inductors.

UNIT II

Development of membranes and formation of placenta. Types of placentae in mammals, pregnancy tests. Bio-chemical basis of embryology, regeneration, metamorphosis.

UNIT-III

Introduction to hormones and their mode of action.

Gonadal hormones in Mammals.

Hormonal control of metabolism, development, somatic pigmentation and reproduction in insects.

UNIT-IV

Structure of endocrine glands-pituitary, thyroid, adrenal and pancreas of vertebrates.

Biological actions of hormones of pituitary, thyroid, adrenal and pancreas.

Note: - Examiner will set a total of nine questions comprising two questions from each unit and one compulsory question of short answer type covering the whole syllabus. It will consist of eight short answer type questions of 1^{1/2} marks each. Students will attempt one question from each unit and the compulsory question. All questions carry equal marks.

Practicals

Embryology

1. Study of the development stages of Frog starting from fertilized egg upto tadpole stage.
2. Study of the slides showing the development of frog from zygote upto 7mm embryo.
3. Making stained permanent preparations of the blastodiscs from 18 to 90 hours incubated chick eggs.
4. Study of the whole mounts of the blastodiscs of 18 to 90 hours age.
5. Study of the slides of *Amphioxus* and *Herdmania* larvae.

Endocrinology

1. Localization of endocrine glands in rat.
2. Study of the estrous cycle in mice/rat.
3. Study of the microscopic structure of endocrine glands-thyroid, pancreas, ovary, testes, adrenal and pituitary.

Books Recommended

1. Balliensky B.I.(1981) An Introduction to Embryology, Saunders Company.
2. Turner, C.D. and Bagnars, W.B. (1976) General Endocrinology, Saunders Company.
3. Highnam, K.C. and Hill, L.(1981) Comparative Endocrinology of invertebrates, Enwaral Arnold Ltd., London.
4. Golds Worthy, G.J. Robinson, J. and Mordue, W. 1981. Endocrinology, John Wiley and Sons, New York.
5. Tombes, A.S.(1970) An Introduction to invertebrates endocrinology, Academic Press, New York.

Paper – XV : Taxonomy, Ecology & Palaeontology-II

Theory hours per week: 4
Practical hours per week: 3

Total Marks : 100

Theory : 75
Internal Ass. : 15
Annual Exam. 60
Practical : 25
Internal Ass. : 05
Annual Exam: 20

Objectives

To enable the students to identify, classify and name the organism according to international code of zoological nomenclature. To acquaint the student with different procedures of taxonomy and different methods of analysis of variations and theories of classification. To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles. To enable the students understand the adaptations of the animals to their environment. To make the students understand the importance of Palaeontology with special reference to the fossils, dating of fossils and geological time scale. To acquaint the students with origin of different vertebrates and ancestries of some vertebrates.

UNIT-I

Population structure of species; polytypic species, race, variety, cline, subspecies, semispecies, super species; speciation, species concepts-Typological species concept, nominalistic species concept, biological species concept, evolutionary species concept; difficulties in applying biological species concept.

UNIT-II

Population –Characteristics of a population, interspecific relationships (positive, negative and neutral relationships).
Ecological succession – Definition, types of succession and succession of different animal communities through hydrarch. Brief account of theories of succession. Significance of succession.

UNIT-III

Ecological adaptations – Natatorial, Desert, Volant and Fossorial adaptations.
Mimicry and Protective colouration – Definition, kinds of mimicry. Protective mimicry, Aggressive Mimicry and Conscious mimicry.

UNIT-IV

Origin of vertebrates; Pisces, Amphibia, Reptilia, Aves and Mammalia. Ancestry of man, horse, camel and elephant.

Practicals

1. Phototactic behaviour of an insect.
2. Geotactic behaviour of an insect/annelid.
3. Food preferences in insects/larvae.
4. Habituation response in mosquito larvae.
5. Study of population, association and inter specific relationships.
6. Ecological adaptations through specimens, models and charts.
7. Visit to Museum of Department of Anthropology, P.U., Chandigarh.
8. Study of models of ancestry of Elephant.
9. Study of some charts relevant to Palaeontology.

10. Project work : Study of Animal Behaviour.
11. Visit to Chhatbir Zoological Park.

Books Recommended

1. Dobzhansky, T.G., Genetics and the origin of species. Columbia Univ. Press, New York, 1951.
2. Mayr, E., Principles of Systematic Zoology, Tata McGraw-Hill, New Delhi, 1976.
3. Krebs, J.C., Ecology, Harper & Row, Publ., New York, 2009.
4. Odum, E.P. and Barrett G.W., Fundamentals of Ecology, Thomson Brooks/Cole, 2005.
5. Clarke, G. L., Elements of Ecology, John Wiley & Sons, New York, 1954.
6. Kendeigh, S.C., Ecology with special reference to animals and man, Prentice Hall of India, N. Delhi, 1961.
7. Smith, Ecology, Harper & Row Publishers, New York, 1990.
8. Kormondy, E.J., Concepts of Ecology, 2nd ed., Prentice Hall of India, New Delhi, 2005.
9. Stirton, R.A., Time, life and man, C.B.S. Publishers & Distributors, Delhi, 1959.
10. Colbert, E.H., Evolution of Vertebrates, C.B.S. Publishers & Distributors, Delhi, 1989.
11. Kapoor, V.C., Theory and Practice of Animal Taxonomy, 6th ed., Oxford and IBH Publishing Co. Pvt. Ltd., N. Delhi, 2008.
12. Mayr, E., Systematics and the origin of species, Columbia Univ. Press, New York, 2005.

**PANJAB UNIVERSITY OUTLINE OF TESTS, SYLLABI AND COURSES OF
READING FOR M.SC. (HONS. SCHOOL) IN ZOOLOGY (SEMESTER SYSTEM)
EXAMINATION, 2013-2014.
M.Sc. (H.S.) 1st year (1st semester)**

Paper	Course/Paper	Code				Credits
		Theory		Practical		
		Course No.	Marks	Course No.	Marks	
I	Comparative Animal Physiology & Endocrinology	MZO 6101	100	MZO 6151	40	5.6
II	Cytogenetics & Cell Biology	MZO 6102	100	MZO 6152	40	5.6
III	Biology of Parasites	MZO 6103	100	MZO 6153	40	5.6
IV	Insect Ecology & Insect Physiology	MZO 6104	100	MZO 6154	40	5.6
V	Aquaculture & Fisheries	MZO 6105	100	MZO 6155	40	5.6

Total Credits: 28

Total Marks: 700

M.Sc. (H.S.) 1st year (2nd semester)

Paper	Course/Paper	Code				Credits
		Theory		Practical		
		Course No.	Marks	Course No.	Marks	
VI	Methodology & Instrumentation	MZO 6201	100	MZO 6251	40	5.6
VII	Molecular Biology	MZO 6202	100	MZO 6252	40	5.6
VIII	Biology of Vertebrate Immune System	MZO 6203	100	MZO 6253	40	5.6
IX	Developmental Biology	MZO 6204	100	MZO 6254	40	5.6
X	Environmental & Quantitative Biology	MZO 6205	100	MZO 6255	40	5.6

Total Credits: 28

Total Marks: 700

M.Sc. (H.S.) 2nd year (3rd semester)

Paper XI Animal Biochemistry (MZO 7101)

Marks
: 125

M.Sc. (H.S.) 2nd year (4th semester)

Special Paper (either of these)
Paper XII

Total Marks : 625

Marks

- i. Limnology & Fisheries (MZO 7201)
 - ii. Entomology (MZO 7202)
 - iii. Concepts in Parasitology (MZO 7203)
 - iv. Genetics & Molecular Cytogenetics (MZO 7204)
 - v. Stress & Reproductive Physiology (MZO 7205)
- Dissertation
Seminar
Viva-voce test

100

400

50

75

Note : There will be 4 hours theory per paper per week and 3 hours practical per paper per week.
The total work load will be 35 hours per week.

FIRST SEMESTER

PAPER I: COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY (MZO 6101)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To enable the students know about all the physiological processes going on in the human body. To make the students understand the functions of hormones and their mechanism of action.

UNIT – I

Nutrition: Chemistry, metabolic role, sources and deficiency diseases of vitamin; Biological significance and regulation and deficiency diseases of minerals.

Circulation: Chemistry of blood components and their functional significance; origin, formation, molecular regulation and maturation of RBCs and WBCs; biochemistry of haemoglobin and myoglobin; biochemical interconversions during blood coagulation and homeostasis. Cardiac cycle and its regulatory mechanisms. Cardiac output and the factors that effect cardiac output, micro circulation, blood pressure, factors influencing blood pressure and its regulation.

Respiration: Concept of respiration, mechanism of breathing; biochemistry of respiratory exchange; Transport of respiratory gases; Regulatory mechanisms (humoral and neural) of respiration. Respiratory acidosis, alkalosis and regulation of pH.

Environmental Physiology : Endothermy and physiological mechanism of regulation of body temperature. Physiological adaptations in response to high and low ambient temperature. Solvent and solute regulation and physiological adoptions in response to stenohaline, euryohaline and terrestrial environment, physiological adaptation at high altitude and deep sea environment.

UNIT – II

Excretion: Concept of excretion and nitrogenous wastes; functional anatomy of renal unit; biophysical and chemical mechanisms of ultrafiltration, reabsorption and secretion, transport mechanisms, urine formation & regulatory control of sugar, urea, Na⁺ K⁺, and H⁺; Role of kidneys in regulation of acid-base balance and osmoregulation.

Physiology of Muscles : Types of muscles and their components; Molecular organization of myosin, role of heavy and light meromyosin, molecular organization of actin; interaction of actin and myosin, ATPase activity of myosin, power-stroke, ATP binding and hydrolysis; Role of troponin and tropomyosin and Ca⁺⁺ in regulation of muscle contraction. Contraction of smooth muscles, role of phosphorylation, Ca⁺⁺ and kinases; Role of actin (microfilaments) and myosin in eukaryotic cells.

Nervous system and sense organs : Neuron as the basic unit of nerve physiology; Methyl-accepting chemotaxis proteins and chemotactic signals of the plasma membrane; Na⁺ and K⁺ permeability and action potentials, structure of Na⁺ and K⁺ channels. Neurotransmitters : Molecular mechanism of acetylcholine, catecholamine, serotonin - amino butyric and glycine

neurotransmitters, acetylcholine receptor channel and their inhibitors; Retinal rod cell excitation and molecular biology of visual cycle, colour vision. Molecular mechanisms of auditory and olfactory responses.

UNIT – III

Reproductive Physiology : Structure and functions of vertebrate testis; spermatogenesis and its hormonal control; structure and functions of leydig cells; steroidogenesis in testis; role of accessory reproductive secretions; structure and functions of vertebrate ovary; folliculogenesis and oogenesis and their hormonal control; ovulation and luteinization and their regulatory mechanisms; corpus luteum formation, its hormonal and neural maintenance and regression.

Endocrinology : Chemical nature of hormones, steroid hormones, amino acid derived hormones, catecholamines and peptide hormones.

Mechanism of hormone action, steroid hormone-receptor interactions and signal transduction.

Secondary messengers in hormone action, role of cAMP, Ca⁺⁺, GTP, phosphoinositides, nitric oxide.

UNIT – IV

Autocrine, paracrine and Juxtacrine regulation of hormones.

Pineal-hypothalmo-hypophyseal-gonadal axis.

Pineal gland, its elaborations and circadian rhythms.

Hormonal elaborations of pancreas, adrenals, thyroid, parathyroid and their role in regulation of carbohydrate, lipid, protein, calcium and phosphorus metabolism.

Stress physiology and adaptation.

Hormones of gastro-intestinal tract.

Prostaglandins, their synthesis and biological functions.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6101 (MZO 6151)

1. To demonstrate that the optimum activity of salivary amylase is pH dependent.
2. To study the effects of various osmolarities on erythrocytes.
3. To study the effect of exercise on cardiovascular and respiratory system.
4. To perform the tuning fork tests of hearing.
5. To find out the physiological blind spot of human eye.
6. To estimate the glucose level in blood of rat.
7. To study the effect of insulin on blood glucose level of rat.
8. To prepare the vaginal smears of mice and identify the stage of estrous cycle.
9. To locate the endocrine glands in rat.
10. To study the histology of endocrine glands.

BOOKS RECOMMENDED

1. Hall, J. E., Guyton and Hall Text Book of Medical Physiology, 12th edition, Saunders Company (2010).
2. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd edition, Lippincott Williams and Wilkins (2003).
3. Hoar, W.S., General and Comparative Physiology, Adaptation and Environment, 3rd edition, Cambridge University, Press (1985).
4. Turner, C.D. and Bagnars, W.B., General Endocrinology, Saunders Company (1976).
5. Golds Worthy, G.J. Robinson, J. and Mordue, W., Endocrinology, John Wiley and Sons, New York (1981).
6. Bentley, P.J., Comparative Vertebrate Endocrinology, Cambridge Univ. Press (1998).
7. Vander, A.J., Sherman, J.H. and Luciana, D.S., Human Physiology, McGraw Hill Publ. Co. (1990).

PAPER II : CYTOGENETICS AND CELL BIOLOGY (MZO 6102)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To enable the students to learn various aspects of cell biology. It will also give an insight into evolution of genetic material, genetic code, regulation of gene, gene therapy and human genome project.

UNIT – I

Evolution: Evolution of biomolecules and pattern of genome evolution.

Cell Division: Molecular basis of cell division. Mitotic apparatus. Forces of cell division (chromosome movement).

Molecular Mutations: Molecular basis of mutations. Site directed mutagenesis. Target theory.

The Genetic Code : Properties of genetic code. Mutations in genetic code. Bobble's hypothesis. Overlapping and split genes.

UNIT – II

Regulation of Gene : Operon hypothesis. Pro and eukaryotic operons. Induction and repression. Complex gene clusters.

Genes in Populations : Hardy Weinberg Law and calculation of gene frequencies.

Human Genome Project and gene therapy.

UNIT - III

Fixation : Non-chemical and chemical fixation, fixatives for electron microscopy.

Oogenesis : Premeiotic phase, meiotic phase, vegetative growth phase (storage of developmental information), role of oocyte nucleus, other organelles and accessory glands, vitellogenesis and oocyte growth in non-mammalian vertebrates. Ultra structure of mature oocyte of mammal.

Spermatogenesis with examples of insects and mammals. Ultra structure of spermatozoan of mammal

UNIT – IV

Fertilization in sea-urchin and mammals : Capacitation, acrosomal reaction, sperm-egg adhesion, egg activation, blockage of polyspermy, fusion of sperm and egg pronuclei.

Internalization of macromolecules and particles, Sorting and maturation of proteins : Role of endoplasmic reticulum and Golgi apparatus, Membrane dynamics, Synthesis and assembly of collagen.

Mitochondria : Bioenergetics.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6102 (MZO 6152)

1. Histochemical study of slides of ovaries of insects, crustaceans, fish, amphibian, bird and mammal.
2. Preparation of permanent histological slides of ovaries of insects, frog, mice/rat.
3. Basis of reactions and demonstration of the sites of proteins, nucleic acids, lipids and carbohydrates in ovaries of insects/frog/mice/rat.
4. Demonstration of the sites of some enzymes in liver/ovary of rat.
5. Preparation of permanent histological slide of testis of insect.
6. Feulgen staining of testis of insect and quantitative estimation of DNA with microdensitometer.
7. Preparation of smear of testes of insect/rat, Smear of mature spermatozoa of rat and staining with giemsa stain/haematoxylin/ eosin.
8. Karyotyping idiograms of Grasshopper, mosquito and human chromosomes.
9. Genic/allelic frequency in population studies.
10. *Drosophila* eye colour variations.
11. Demonstration of drum sticks in blood smear.
12. Abnormalities of mitotic/meiotic divisions.
13. Air drying technique for preparing mice chromosomes.
14. Insect chromosome preparations by acetic acid dissociation technique.
15. Preparation of polytene chromosomes from *Chironomus* larvae.
16. Micronucleus/comet assay study.
17. Study of chromosomal slides of different groups of vertebrates/invertebrates (Grasshopper, cockroach, Gryllid, Mosquito, Flies and Fishes).
18. Study of chemical induced chromosomal changes in mice, through slides.

BOOKS RECOMMENDED

1. Snustad, D. P. and Simmons, M. J., Principles of Genetics, 6th ed., John Wiley, New York (2011).
2. Karp, G., Cell Biology, 6th ed., John Wiley and Sons (Asia) Pvt Ltd (2010).
3. Pierce, B. A., Genetics: A Conceptual Approach, WH Freeman (2010).
4. Gupta, P.K., Genetics, 4th ed., Rastogi Publications, Meerut (2009).
5. Cooper, G. M., The Cell A Molecular Approach, 4th ed., Sinauer Associates, Inc, Massachusetts (2007).
6. Lewin, B., Cassimeris, L., Lingappa, V. R., Plopper, G., Cells, Jones and Bartlett publishers, Inc., Massachusetts (2007)
7. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H. and Matsudaira, P., Molecular Cell Biology, 6th ed., WH Freeman Company, New York (2007)
8. Brown, T.A., Genomes 3, Garland Science (2006).
9. Gardner, E.J., Simmons, M. J. and Snustad , D.P., Principles of Genetics, 8th ed., John Wiley, New York (2006).
10. Primrose, S. B. and Twyman, R., Principles of Gene Manipulation and Genomics, 7th ed., John Wiley, New York (2006).
11. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., Molecular Biology of the Cell, 4th ed., Garland Science, New York (2002).

PAPER III: BIOLOGY OF PARASITES (MZO 6103)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To enable the students to classify and study the variation in morphology, life cycle and pathogenesis of important parasites causing diseases in animals and human beings .

UNIT – I

Introduction about parasitic protozoa.

General account of medically important parasites in Kinetoplastida, Coccidia, Piroplasmia and Microspora (for example *Leishmania*, *Trypanosoma* , *Encephalitozoon*, *Babesia*, *Theileria*, *Sarcocystis*, *Isospora*, *Cryptosporidium* etc.).

Invitro culture of protozoan parasites e.g. *Plasmodium*, *Entamoeba*, *Giardia*, *Leishmania*, *Trypanosoma* etc.

UNIT – II

Outline classification of trematodes with general account of important parasites in fasciolidae paramphistomidae, dicrocoelidae, troglotrematidae, opisthorchidae and schistosomatidae.

Ultrastructure of the body wall of digenetic trematodes.

Variation in the life cycle in Digenea.

UNIT - III

Outline classification of cestodes with general account of important parasites in diphyllbothridae, taeniidae and anoplocephalidae.

Ultrastructure of the body wall of cestodes.

Variation in the life cycles of cestodes.

UNIT – IV

General organization and Outline classification of nematodes with general account of important parasites in strongyloidea, ascaridoidea, oxyuroidea, dracunculoidea, filarioidea and trichinelloidea.

Ultrastructure of nematode sense organs like amphids, phasmids and Papillae.

Variation in life cycle of nematodes.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6103 (MZO 6153)

1. Study of the cestodes belonging to the family Anoplocephalidae.
2. Study of the trematodes belonging to the family Paramphistomidae.
3. Study of the digenetic trematode larvae from the snails.
4. Study of the nematodes infecting sheep, goat, fowl and cockroaches.
5. Detailed morphological and histological studies of Ascaris.
6. Study of the protozoan parasites infecting cockroaches and mice.
7. Study of *invitro* culture of *Leishmania*.

BOOKS RECOMMENDED

1. Ichchpujani R.L. & Rajesh Bhatia, Medical Parasitology, 3rd Ed. Jaypee Brothers Medical Publishers, New Delhi (2002).
2. Lynne Shore Garcia, Diagnostic Medical Parasitology 4th Ed. ASM Press, Washington DC, (2001).
3. Parija, S. C. Textbook of Medical Parasitology, All India Publishers and Distributors (2001)
4. Smyth, J.D., Introduction to Animal Parasitology, Hodder & Stoughton, London (2005).
5. Chatterjee, K. D., Parasitology: Protozoology and Helminthology, 13th ed., CBS publishers and distributors Pvt Ltd (2009)
6. Cheng, T.C., General Parasitology, 2nd ed., Academic Press, London (1986).
7. Noble, E.R. & Noble, G.A., Parasitology : The biology of animal parasites 5th edition, Lea & Febiger, Philadelphia (1982).
8. Larry S. Roberts & John Janovy Jr., Foundations of Parasitology Mc. Graw Hill Book Co., (2000).
9. Ramnik Sood, Parasitology (Protozoology & Helminthology) CBS Publishers & Distributors, (1993).
10. Urquhart, Armour, Duncan, Dunn & Jennings, Veterinary Parasitology Blackwell Publishing, (2003).
11. Bernard E. Mathews, An introduction to Parasitology Cambridge University Press, (1998).

PAPER IV : INSECT ECOLOGY & INSECT PHYSIOLOGY (MZO 6104)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To impart knowledge to students on ecological and physiological aspects of Arthropods, which dominate in number among all living organisms. To make the students understand the adaptations of these animals to their environment and the concept of insect societies.

UNIT – I

Salient features of different orders of insects.

Insect and its environment : Interrelations with living and non-living environment, fluctuations in populations of insects.

Extreme environments and insects : Desert insects, cave insects, high altitude insects, insects of torrential streams.

Insects dispersal : Means and limiting factors.

Insect - Plant interaction : Mechanism of host plant selection, receptors systems and sensory perception in phytophagous insects, resistance of host plants to insect attack, Insect-Weed-Crop interactions, insect – pollinator interactions, insect – plant gall interactions.

UNIT – II

Insect Societies : honey bees, termites, ants with reference to general habits including

- caste system
- nest construction
- communication
- brood care
- thermoregulation
- swarming
- feeding and foraging
- defense

UNIT – III

Physiology of digestion in insects including digestion of various types of food.

Gaseous exchange in terrestrial insects.

Physiology of excretion, salt and water metabolism and conservation of water in insects.

UNIT – IV

Neuro-endocrine organs, hormones and their role in development and metamorphosis.

Parthenogenesis and other atypical methods of reproduction in insects viz: paedogenesis, polyembryony, viviparity.

Effect of temperature and photoperiod on the lives of insects, details of onset, termination and significance of diapause.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the

remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6104 (MZO 6154)

1. Study of representatives from different insect orders in order to understand the salient features and diversity in insect groups.
2. Dissection of various insects to study the alimentary canal and glands associated with the digestion of different types of food.
3. Dissection of an insect to study tracheation and spiracles.
4. Dissection of various insects to demonstrate number, arrangement and associations of malpighian tubules.
5. Dissection of an insect (cockroach/grasshopper) to expose neuroendocrine organs.
6. To study the effect of temperature and photoperiod on the development of insects.
7. To study of nest, castes and life stages of honey-bee.
8. To study of nest, castes and life stages of termites.
9. To study of nest, castes and life stages of ants.
10. Visit to apiary
11. Project work

BOOKS RECOMMENDED

1. Mani, M.S., General Entomology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Calcutta, Bombay, (1990).
2. Frisch K. V., The Dance Language and Orientation of Bees, Harvard University Press (1993).
3. Chapman, R.F., The Insects, Structure & Function (eds; Simpson, S.J. and Douglass, A. E.) 5th ed., Cambridge University Press (2013).
4. Richards, O. W. & Davies R. G. Imms General Text Book of Entomology, 10th ed., (reprint) B.I. Publications Pvt Ltd. N. Delhi (1997).
5. Wigglesworth, V.B., Insect Physiology, BiblioBazaar (2011).
6. Mishra, R.C., Honey bees and their management in India, ICAR Publications, (1995).
7. Winston, M. L., The Biology of Honey Bee, Harvard University Press (1991).

PAPER V : AQUACULTURE & FISHERIES (MZO 6105)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To enable the students understand the different fresh water habitats, the classification of water bodies based on various physicochemical and biological parameters and the importance of fishery science.

UNIT - I

Freshwater habitat :

Types of Freshwater habitats – Lotic and Lentic Waters.

Zonation in Lentic habitat

Hydrobiological characteristics – Temperature, penetration of light, turbidity, dissolved gases, pH, biogenic salts etc.

Water problems in aquatic and amphibious situations.

Ecological classifications of freshwater organisms other than fishes :

On the basis of trophic status

On the basis of mode of life – Benthos, Periphyton, Plankton, Nekton and Neuston

On the basis of zonation in lentic and lotic habitats.

Classification of lakes :

Trophic classification of lakes – Oligotrophic, eutrophic and dystrophic lakes.

Thermal classification of lakes – Forel's and Yoshimura's classifications of lakes.

Hutchinson's classification of lakes – Amictic, cold monomictic, dimictic, warm monomictic, oligomictic and polymictic lakes.

Ecological succession:

Definitions and types of ecological succession

Succession of animal communities through Hydrarch

Productivity:

Concepts of productivity – Biomass, biotic potential, standing crop, carrying capacity, yield, productivity, primary and secondary productivity.

Estimation of Primary production – Harvest method, oxygen production method, carbon dioxide assimilation method, radioisotope method, chlorophyll method, disappearance of raw materials and pH method.

UNIT - II

Eutrophication :

Definitions and types - natural and cultural eutrophication.

Causes and impact of eutrophication.

Control of eutrophication – Mechanical, Chemical and Biological control.

Bioassay – Terminology, methodology, calculation of LC 50 and EC 50 values and threshold concentrations.

Methods in Field Biology : Methods of estimating population density of animals.

Estuarine Habitat :

Characteristics of estuarine habitat.

Classification of estuaries.

Estuarine fauna – Temporary and permanent.

Adaptations of estuarine fauna.

Special Aquatic Habitats :

Polar and alpine lakes.

Salt lakes.

Special stream environment.

UNIT - III

Fishery Science : Its importance and application.

Morphological variations in the body form- in deep – sea and hillstream fishes.

General information about the fishes of Punjab, Haryana and Himachal Pradesh :
Brief account of the following orders with ecological notes on the fishes mentioned in brackets:

Clupeiformes (*Gadusia chapra*) - *Notopterus*.

Cypriniformes - *Schizothorax richardsonii*, *Hypophthalmichthys molitrix*,

Cyprinus carpio, *Puntius*, *Labeo*, *Catla*, *Cirrhinus*, *Tor*, *Garra*, *Noemacheilus*, *Botia*.

Siluriformes : (*Mystus*, *Aorichthys*, *Wallago/Heteropneustes fossilis*)

Channiformes : (*Channa punctatus*)

Perciformes : *Colisa fasciatus*

Mastacembeliformes : (*Mastacembelus armatus*)

UNIT - IV

Age and growth studies using scales, vertebrae, opercular bones. Method of calculating the back-calculations using Fraser Lee, equation, growth parameters e.g., specific rate of linear growth, index of species average size, growth characteristic, growth constant, survival, mortality rate and their application in fishery management.

Exotic fishes : Different fishes introduced in India, history, causes, impacts, usefulness to fish culture.

Pearl culture in India: species involved, implantation procedure, water quality, economics.

Fish : biodiversity, loss of fish biodiversity, enhancement, role of genetics in aquaculture and fisheries.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6105 (MZO 6155)

1. Qualitative study of biotic components of aquatic ecosystem.
2. Quantitative study of biotic components of aquatic ecosystem.
3. Study of different types of Phytoplankton (Bacillariophyceae, Chlorophyceae, Euglenophyceae & Cyanophyceae).
4. Study of different types of Zooplankton (Protozoa, Rotifera, Cladocera, Copepoda).
5. Study of Benthic fauna.
6. Study of Neuston.
7. Study of Nekton.
8. Study of Macrophytes.
9. Estimation of Nitrates in water.
10. Estimation of Phosphates in water.
11. Estimation of dissolved oxygen by modified **winklen method** in water.
12. Determination of Primary productivity in an aquatic habitat.
13. Study of impact of Heavy metals on productivity.
14. Identification of the following fishes up to species level of Punjab, Haryana and Himachal Pradesh using already prepared field keys. Noting down their important characters, making sketches, and economic importance of each fish species along with ecological notes: *Notopterus notopterus*, *N.chitala*, *Schizothorax richardsonii*, *plagiostomus*, *Hypophthalmichthys molitrix*, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Puntius Labeo rohita*, *Catla catla*, *Cirrhinus*

mrigala, Tor putitora, Garra gotyla gotyla, Noemecheilus botia, Botia berdi., Mystus seenghala, Aorichthys spp., Wallago attu, Heteropneustes fossilis, Channa, Mastacembelus armatus.

15. Study of important deep-sea and hills stream fishes with special reference to various adaptations.
16. Study of hard parts e.g., scales, vertebrae, otoliths and opercular bones for age determination, Calculations of back-calculated lengths using Fraser-Lee. equation. On the basis of available growth data calculation of various growth parameters e.g., annual increment, specific rate of linear growth, growth characteristic, growth constant, calculation of harvestable size and maximum size to be attained by the fish.
17. Study of various exotic fishes introduced in India and their characteristic features.
18. Study of different bivalves involved in Pearl Culture.

BOOKS RECOMMENDED

1. Jhingran, V.G., *Fish and Fisheries of India*, Hindustan Publishing House (India), New Delhi (1991).
2. *Aquaculture Production*. FAO. Fisheries Circular No.815, No.4, Rev.FAO Rome (1998).
3. Mohan Joseph, M, *Aquaculture in Asia*, Asian Fisheries Society, Manglore (1990).
4. Talwar, P.K., & Jhingran, A.G., *Inland Fishes of India*, Vols.I & II, P.K. Talwar & Jhingran, A.G., Oxford & IBH, New Delhi (1991).
5. Lagler Karl F., *Freshwater Fishery Biology*, Wm.C.Brown Company Publ., Dubuque, Iowa (1969).
6. Bangenal, T., *Methods for Assessment of Fish Production in Freshwaters* 3rd Ed , IBH Handbook No.3 Blackwell Scientific Publication, Oxford (1970).
7. Johal, M.S., and Tandon, K.K., *Monograph on the Fishes of reorganized Punjab*, Parts I & II. Punjab Fisheries Bulletin (1979, 1980).
8. Odum, E.P., *Fundamentals of ecology*, W.B. Saunders Co. Philadelphia (1971).
9. Welch, P.S., *Limnology*, Mcgraw Hill Book Co. New York (1952)
10. Wetzel, R.G., *Limnology*, W.B.Saunders Co. Philadelphia (1983).
11. Hynes, H.B.N., *The Biology of Polluted Waters*, Liverpool Univ. Press, Liverpool (1978).
12. Ruttner, F., *Fundamentals of Limnology*, Univ. Press, Toronto (1975).
13. Tandon, K.K. & Johal, M.S., *Age and growth in Indian Freshwater Fishes*, Narendra Publishing House, Delhi (1995).
14. Johal, M.S., Aggarwal, S.C., *Fishery Development*, Narendra Publishing House, Delhi (1997).
15. Peter B. Moyle & Joseph J. Cedh, *Fishes :An Introduction to Ichthyology*, Prentice – Hall, Inc. Jersey, U.S.A. (1986).

SECOND SEMESTER

PAPER VI: METHODOLOGY AND INSTRUMENTATION (MZO 6201)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To acquaint the students with various instruments used in scientific laboratories and to make them understand the basic principles involved in the important techniques used in scientific research.

UNIT - I

Microscopy : Principle, structural parts and applications of compound microscope, phase - contrast microscope, Differences of Phase Contrast and interference microscope, fluorescent microscope, transmission electron microscope and its differences with scanning electron microscope.

Cell fractionation method : Different mechanical and chemical procedures. Principle of centrifugation and ultracentrifugation, different methods of ultracentrifugations (in brief) and their applications, structural parts of an analytical ultracentrifuge.

UNIT – II

Spectrophotometry ; Principle of Colorimetry and its applications.

Chromatography : Principles of chromatography, paper chromatography, thin layer chromatography, gas chromatography, gel permeation chromatography, ion exchange chromatography, high pressure liquid chromatography, affinity chromatography.

UNIT – III

Electrophoresis : Principle of electrophoresis, paper electrophoresis, polyacrylamide gel electrophoresis, Disc gel electrophoresis, and SDS-PAGE, agarose gel electrophoresis, isoelectric focusing, applications of electrophoresis - distinguishing of Phage DNA, detection of plasmids, separation of DNA molecules, Southern transfer, Northern transfer and Western transfer.

Tissue culture techniques : Aseptic and sterilisation techniques, factors effecting cell growth *in vitro*. Specialized Cell Culture Techniques.

UNIT – IV

Principles and Applications of Flow cytometry, Cell sorting.

Radioisotopes : Radioactive isotopes, half life of isotopes, detection and measurement of radioactivity (Gas ionization, scintillation and autoradiography), applications of radioisotopes in biological sciences.

Immunocytochemistry and Enzyme linked immunosorbent assay

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6201 (MZO 6251)

1. To study the parts of the compound microscope fluorescent microscope and phase-contrast microscope and their maintenance.
2. To study the living material under the phase contrast microscope.
3. To Find out the diameter, area and circumference with the help of stage micrometer and oculometer.
4. To sketch the diagram of any tissue with the help of camera lucida and to draw its magnification line.
5. Demonstration of section cutting and mounting of sections on the grid for SEM and TEM. Demonstration of SEM & TEM in the CIL lab.
6. Demonstration of working of ultracentrifuge.
7. To separate a sample of amino acids with the help of paper chromatography and TLC.
8. To find out pH with a pH meter and weight with electrical balance.
9. To do a short term in vitro culture of a parasite.
10. Demonstration of SDS-PAGE and western blotting to students.
11. To demonstrate ELISA to students.

BOOKS RECOMMENDED:

1. Gurumani, N., Research methodology for Biological Sciences, MJP Publishers, Chennai (2007).
2. Kuby, J., Immunology, 6th ed., W.H. Freeman and Company (2007).
3. Freshney, R.I., Culture of Animal Cells : A manual of basic technique, 5th Ed., Wiley Liss Inc., New York. (2006).
4. Boyer, R., Modern Experimental Biochemistry, 3rd ed., Pearson Education (2004).
5. Wilson, Keith and Walker, John, Practical Biochemistry : Principles and techniques, 5th Edition Edited, Cambridge University Press (2000).
6. Michael G, Flow Cytometry : A Practical Approach, 3rd Edition Edited Michael G. Ormerod Oxford University Press (2000).
7. Beckatt, A.H. and Stenlake, J.B., Practical Biochemistry, the Athlone Press, London (1988).
8. Bacq, Z.M. and Alexander, P, Fundamentals of Radiography, Pergamon Press, London (1989).
9. Bennett, A.H. and Usterbere, H, Phase Microscopy: Principle and applications, John Wiley and Sons, London (1951).
10. Dawes, C.J., Techniques for Transmission and Scanning Electron Microscopy, Ladd Rew. Ind., Inc., Publishers (1981).
11. Freefelder, D, Practical Biochemistry : Application to Biochemistry and Molecular Biology, W.H. Freeman, (1982).
12. Watt, J.M., The Principles and Practice of Electron Microscopy, Watt (1985).

PAPER VII: MOLECULAR BIOLOGY (MZO 6202)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To enable the students to understand the molecular basis of cell signalling, cell division and transport of ions across membranes. To acquaint students with various techniques used in molecular biology. To make the students understand the role of different factors causing cancer.

UNIT - I

Structure and function of pro-and eukaryotic membranes, molecular structure of membranes, transport proteins, signalling molecules and cell surface receptors, pathways of intracellular signal transduction.

Cytoskeletal elements and their role in cell shape and cell movements.

UNIT – II

Restriction enzymes, recombinant vectors (plasmid, phage, cosmid, p1, YAC) and their role, genomic and DNA libraries, DNA amplification techniques (PCR and LCR), chromosome walking and DNA sequencing.

Nucleic acid hybridization (Southern and western blotting), DNA finger printing, RFLP markers, RAPD and AFLP, uses of recombinant DNA technology in medicine and health, transgenic animals and knockout mice.

UNIT – III

Extracellular matrix, adhesive proteins: Cell-cell adhesive proteins, cell matrix interaction.

Cell cycle-Eukaryotic cell cycle, regulators and cell cycle progression.

UNIT – IV

Cell proliferation and programmed cell death.

Cancer : Development of cancer, characteristics of cancer cells, causes of cancer: chemicals, viruses and radiations, human tumour viruses. Oncogenes and their proteins (characteristics and classification), tumour suppressor genes (antioncogenes) and the functions of their proteins.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6202 (MZO 6252)

1. Introduction to instruments in Biology experiments (i) Oven incubator (ii) Centrifuge (iii) Double distillation plant (water) (iv) Homogenizer (manual & electric)

- (v) water bath (vi) Cooling centrifuge (temperature regulated centrifuge)
 (vii) Autoclave (viii) Laminar flow (ix) Electronic balance
2. To stain the bacterial sample provided using gram staining technology.
 3. Cell fractionation of rat liver.
 4. Estimation of Glucose-6-Phosphatase in various cell fractions compared with homogenate and calculate specific activity.
 5. Estimation of Acid phosphatase in various cell fractions compared with homogenate and calculate specific activity of acid phosphatase in various cell fractions.
 6. Extraction of nucleic acid from any tissue. Estimation of DNA and RNA.
 7. How to culture *E. coli* in the laboratory.
 8. Separation of genomic DNA.
 9. Preparation of the polytene chromosomes of *Chironomus* for the study of gene amplification (Puffs).
 10. Demonstration of the procedure of “Polymerase Chain Reaction” (PCR) for amplification of DNA fragments.
 11. Preparation of polytene chromosomes of *Chironomus* for locating the repetitive DNA sequences in the form of ectopic pairings.
 12. Demonstration of western blotting technique for the detection of proteins.

BOOKS RECOMMENDED

1. Benjamin, L., Genes IX, Jones and Bartlett Publishers (2013).
2. Clark, D. P., Molecular Biology, AP Cell Press (2010)
3. Cooper, G. M., The Cell A Molecular Approach, 4th ed., Sinauer Associates, Inc, Massachusetts (2007).
4. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H. and Matsudaira, P., Molecular Cell Biology, 6th ed., WH Freeman Company, New York (2007)
5. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P., Molecular Biology of the Cell, 4th ed., Garland Science, New York (2002).

PAPER VIII: BIOLOGY OF THE VERTEBRATE IMMUNE SYSTEM (MZO 6203)

Theory hours per week : 4
 Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To acquaint the students with the basic concepts of immunology and the immune effector mechanisms. To make the student understand the role of immunity in controlling the pathogenic infection.

UNIT – I

Introduction to immunology.

Immune response and host defense mechanisms, Cell mediated effector responses (CTL's & NK cells)

Cells and tissues of the immune system : haematopoiesis (Origin and differentiation of the lymphoid cells), blood composition with special reference to globulins and leucocytes, structure and function of primary and secondary lymphoid organs.

Antigens : definitions, properties of immunogens, adjuvants.

Antigen-antibody interaction : Serodiagnostic assays.

UNIT – II

Immunoglobulins : Basic structure, Fine structure, Immunoglobulin Classes their structure and functions, Effector functions of Immunoglobulins, B cell receptor.

Complement system : Complement pathways, deficiencies

Hypersensitivity : Mechanisms and causes of anaphylactic shock, Arthus-type and cell mediated delayed hypersensitivity.

UNIT - III

Monoclonal antibodies : Basic steps involved is the production of monoclonal antibodies characterization and uses of monoclonal antibodies.

Immunity to parasites : Brief account of immunity to protozoan (*Plasmodium, Leishmania, Trypanosoma*) and helminth parasites of man.

Cytokines : Properties, Structure, Receptors, Antagonists.

UNIT – IV

The Major Histocompatibility complex : Distinguishing features of MHC, H2 complex, HLA complex, transplantation, T cell receptor.

Autoimmunity : Immunological tolerance and autoimmunity, major autoimmune diseases and immunosurveillance.

Vaccines : Active and passive immunisation, types of vaccines.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6203 (MZO 6253)

1. To study the histology of lymphoid organs.
2. Preparation of blood film and identification of white blood cells from normal and infected animals.
3. To perform agglutination reaction by using blood group typing kit.
4. To perform antigen – antibody interaction by Ouchterlony method.
5. To isolate W.B.C. from blood using density gradient centrifugation.
6. Detection of live/dead white blood cells using Acridine Orange/Ethidium bromide staining under U.V. light.
7. To perform indirect fluorescent antibody test.
8. To demonstrate antigen-antibody reaction by ELISA to students.
9. To perform DOT- ELISA by using kit.

BOOKS RECOMMENDED

1. Benjamini, Immunology, 5th ed., Coico & Sunshine, Wiley-Liss Publication, New York (2003).
2. Roitt, I.M., Brostoff, J. and Male, D., Immunology, 8th ed., Mosby Publications, Edinburgh, Mosby (2012).
3. Paul, W.E., Fundamental Immunology, 7th ed., Lippincott Raven Publication, Philadelphia, New York (2012).
4. Kuby J., Immunology, 6th ed., W.H. Freeman & Company, New York. (2007).
5. Janeway, C.A., Travers, P., Walport, M. and Shlomchik, M.J., Immunobiology: The System in Health and Disease, Garland Science Publishers, (2005).

PAPER IX: DEVELOPMENTAL BIOLOGY (MZO 6204)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To enable the students understand the process of development in various animals and the phenomena associated with that. It also includes the genetic involvement and the role of maternal environment on fetal development. It will enable the students understand the environmental influences on development and factors responsible for ageing.

UNIT – I

Cytoplasmic determinants and autonomous cell specification – Cell commitment and differentiation, cell specification in nematodes, germ cell determinants, germ cell migration. Progressive cell-cell Interaction and cell specification fate.

Induction : Cell-cell interactions, primary embryonic induction, role of endoderm in mesodermal specificity, mesodermal inducers, neural induction, secondary induction, instructive and permissive interactions, chemical nature of evocators, concept of competence, epitheliomesenchymal interaction.

UNIT – II

Molecular basis of differentiation, transdifferentiation and dedifferentiation.

Eukaryotic regulatory proteins and their interaction, transcription regulators in tissue and stage specific gene expression, DNA methylation, tissue specific enhancers, regulation of transcription by vertebrate steroid hormones.

Globin gene switching.

UNIT – III

Hormones as mediators of development. Amphibian metamorphosis, Insect metamorphosis, Ovarian luteinization and mammary gland differentiation.

Limb development and pattern formation - limb generation and position effect, role of mesoderm and ectoderm in development of limb, changes in the polarity of limb, Regeneration.

UNIT – IV

Teratogenesis - Critical period, dose, classes of cytotoxic teratogens, human teratogenesis.

Gene regulation in development - Maternal genes, maternal and zygotic control during initiation of development.

Ageing : Consequences, causes, control by genes, ageing of cells in vitro.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6204 (MZO 6254)

1. To study the different larvae in the invertebrates.
2. To study the different stages of development in frog and chick.
3. To prepare permanent stained slides of developing stage from fertilized egg of hen.
4. To study the RNA activity in the polytene chromosomes in dipterans.
5. To prepare permanent slides of larvae of invertebrates.

BOOKS RECOMMENDED

1. Balinsky, B.I. and Fabian, B. C., An Introduction to Embryology, 5th ed., Saunders, Philadelphia (2012).
2. Gilbert, S. F., Developmental Biology, 9th ed., Sinauer Associates Inc Publishers (2010).
3. Browder, L.W., Developmental Biology, 3rd ed., Saunders College Publishing (1991).
4. Muller, W. A., Developmental Biology, Springer (1997).
5. Rastogi, V. B. and Jayaraj M. S., Developmental Biology, Kedar Nath Ram Nath, Meerut (2009)
6. Wolpert, L. et al., Principles of Development, 2nd ed., Oxford (2001)
7. Wright, S. J., A Photographic Atlas of Developmental Biology, Morton Publishing Company (2005).

PAPER X : ENVIRONMENTAL & QUANTITATIVE BIOLOGY (MZO 6205)

Theory hours per week : 4
Practical hours per week : 3

Total Marks : 140

Theory

Sem. Exam. : 80

Int. Ass. : 20

Practical

Practical : 32

Int. Ass. : 8

Objectives

To impart environmental education to students on the important environmental issues such as pollution, global warming, ozone depletion and management of solid waste. To enable the students to understand the importance of epidemiology and biostatistics in scientific research.

UNIT I

Environmental education : Objectives, guiding principles, major areas and scope of environmental education.

Environmental challenges in India: Population explosion and poverty, land degradation, human settlement, increase in agricultural growth, energy crises, biodiversity, environmental pollution, water management etc.

Biomonitoring of Environment : Microbial system, lower plants, higher plants, animal systems, human system, cell biology & genetics, aeroallergens etc.

Control of Environmental Pollution through Law : Environmental Protection Act 1986 and amendments in Air and Water Acts.

Atmospheric Pollution : Sources, hazards of air pollutants on plants, animals, human beings and climate.

Water Pollution : Impact of pollution due to sewage, industries, thermal power plants, silt, pesticides, fertilizers, detergents, etc.

Management of Solid municipal wastes – composting, incineration, sanitary landfills,

Management of Hazardous wastes – deep well injection, land application, secure land fill, source reduction, treatment, incineration etc.

Recycling and reclamation of wastes – anaerobic bacterial digestion, pyrolysis, as fuel, composting, recycling, etc.

Environment and Global issues:

Global Warming – Green house effect, changes in green house gases, impact of green house.

Ozone depletion – Ozone depletion and CFC, Global efforts and management issues.

Biodiversity – Concept, human activity as a major threat to biodiversity.

UNIT II

Epidemiology : Definition, meaning, history, concept and scope. Descriptive epidemiology : Factors: Physical factors (Geological, geographical, climatic), Biological factors (Flora and fauna, nutrition, allergens etc.) socio-economic factors (population distribution, social and political structure). Epidemiological procedures – Investigations with reference to time (fluctuations, types of epidemics), place (national and international variations), person (sex, age, profession).

Demographic Studies : fertility, mortality, population size. Methods: tables, comparative tables, city maps, graphs etc., Periodic monitoring through maps.

Detection of epidemics : Verification, confirmation, identification of cases, data analysis & Hypothesis.

UNIT III

Quantitative Biology - Study of the following Statistical methods with special reference to biological problems. Only application part is included derivations excluded.

Measures of central tendency : Mean, mode and median.

Measures of dispersion : Standard deviation.

Correlation analysis : Karl Pearson, ranking and concurrent methods.

Regression analysis : Construction of regression equation on the basis of biological data and calculation of X value when Y is given.

UNIT IV

Graph : Construction of graph when different types of biological data is given.

Normal distribution : Normal distribution curve and its properties, Z-score.

Test of significance : t-test, F-test, chi-square test.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, two to be set from each unit, each carrying 15 marks. The candidate will be required to attempt one question from each unit.

Practicals based on theory paper MZO 6205 (MZO 6255)

1. Estimation of percentage saturation of dissolved oxygen by modified Winkler's method.
2. Estimation of free carbon dioxide content in a water sample.
3. Determination of total hardness and % age of temporary hardness in given polluted water sample.
4. Determination of % age of different ions imparting alkalinity in a water sample.
5. Determination of organic pollution load in a water sample.
6. Estimation of suspended solids in a water sample.
7. Determination of dissolved solids.
8. Determination of pH of water sample.
9. Determination of Shannon's Diversity index of a community.
10. Study of the following with the help of atlas/maps/charts:
 - a) Hydroelectric projects
 - b) Nuclear Power Projects
 - c) Thermal Power Projects.
11. Study of the following with the help of atlas/maps/charts: :
 - a) Coal fields
 - b) Oil wells
 - c) Oil refineries
12. Study of Indian Wild life Sanctuaries/ National Parks and their fauna with the help of atlas/maps/charts.
13. Study of different types of forests in India with the help of atlas/maps/charts.
14. Recording of data by using any material such as fish or mollusks or insect.
15. Calculation of standard deviation on the basis of recorded data.
16. Calculation of correlation coefficient (between X & Y variables) on the basis of material provided.
17. Setting up of regression equation and the calculation of the value of Y of unknown X on the basis of equation $Y = a+bX$.
18. Construction of graphs.

BOOKS RECOMMENDED

1. Timmreck T. C., An Introduction to Epidemiology, 3rd ed., Jones and Bartlett Publishers, Sudbury (2002).
2. Beaglehole R., Bonita R. & Kjellstrom T., Basic Epidemiology, (reprint) Orient Longman Limited (1994).
3. Odum, E.P., Fundamental of Ecology, Saunders College Publishing Company, Philadelphia (1971).
4. Hynes, H.B.N., The Biology of Polluted Waters, Liverpool University Press, (1978).
5. Dix, H.M., John, Environmental Pollution, John Wiley Public, N.T., (1984).

6. Varshaney, C.C., Water Pollution and Management Reviews, South Asian Publications Pvt.Ltd., New Delhi, (1983).
7. Wilson, Handbook of Solid Waste Management, Van Nostrand Reinhold, (1984).
8. Stren, S.C., Air Pollution, Academic Press, (1986).
9. Owem, O.S., , Natural Resources Conservation: An Ecological Approach, MacMillan Publishing Company,N.Y.,(1994).
10. Botkin, D.B., & Keller, E.A., Environmental Science, 3rd ed., John Wiley & Sons, Inc., New York (2000).
11. Barker C., & Churche, R. ,Epidemiology practice Livingstone.
12. Barker D. J. P., Cooper, C. & Rose, G. A., Epidimiology in medical practice, 5th ed. Churchill Livingstone, 1998.
13. Snedecor, GW & Coohran, WC, Statistical Method, Oxford IBH, 1989.
14. George W. Snedecer and Willian G.Cochran, Statistical Methods, Oxford & IBH, 1967.
15. Gupta, S.P., Practical Statistics, S. Chand & Company Ltd., Delhi, 1982.
16. Pardine, C.G. and Rivett, B.H.P., Statistical Methods for Technologists, English University Press, 1969.
17. Wilks,S.S., Elementary Statistical Analysis, Princeton University Press, 1967.
18. Fisher, R.A., Statistical Methods for Research Worben, Oliver & Proyl, 1970.

SEMESTER - III

PAPER XI: ANIMAL BIOCHEMISTRY (MZO 7101)

Theory hours per week : 4
Practical hours per week : 3

Time : 3 hrs.
Total Marks : 125
Theory
Sem. Exam. : 80
Int. Ass. : 20
Practical
Practical : 20
Int. Ass. : 5

Objectives

To acquaint the students with the biochemical events that occur at the molecular level including structure, chemical properties and biological significance of macromolecules of physiological importance.

UNIT - I

Introduction : Importance of Biochemistry in Animal Sciences

Carbohydrates : General structure, classification and chemical properties of carbohydrates.

Homo and heteropolysaccharide : Structure of starch, insulin, pectins, dextrans, glycogen, cellulose and chitin. Bacterial polysaccharides. Mucopolysaccharides. Blood group substances. Biological functions of important polysaccharides.

Lipids : Simple lipids, general structure and chemical properties of simple lipids.

Compound lipids: Structure of phospholipids like lecithins, lysolecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, cardiolipids, sphingomyelins, glycolipids, cerebrosides, gangliosides, properties and functions of phospholipids.

Derived lipids : Cholesterol and steroid hormones (chemistry), biological functions of lipids.

Proteins : Amino acids as monomers of proteins and their properties, types of proteins and their classification, levels of protein structure and forces stabilizing protein structure and shape, the conformation of proteins, subcellular assemblies of protein, functions and their denaturation.

Conjugated proteins: Lipoproteins, glycoproteins, nucleoproteins, metalloproteins and chromoproteins, biological functions of proteins.

Nucleic acids : Molecular structure and biological functions of DNA & RNA molecules, Z-DNA and its biological significance, physical properties of nucleic acid - denaturation of DNA, hydrolysis of nucleic acids, nucleic acids and protein interaction.

Porphyryns: Porphyryns and their classification, important metalloporphyryns occurring in nature, bile pigments - chemical nature and their physiological significance.

UNIT - II

Enzymes: Enzyme kinetics, mode of action of enzymes and biochemical role of coenzymes and isoenzymes, effect of enzyme concentration, substrate concentration and pH on enzyme activity, mechanism of enzyme action - a brief description, allosteric enzymes, concentration of effector, feed back inhibition - various mechanisms, covalent modifications Irreversible and Reversible.

Metabolism: ATP - cycle, energy rich phosphate compounds, major pathways of catabolism of carbohydrates, glycolysis, tricarboxylic acid cycle, phosphogluconate pathway, glycogenolysis.

Oxidation of fatty acids: Oxidation, biosynthesis of saturated and unsaturated fatty acids.

Mitochondrial-electron transport chain, mechanism of mitochondrial oxidative phosphorylation, inhibitors of electron transport chain, inhibitors and uncouplers of mitochondrial oxidative phosphorylation.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

Books Recommended

1. Outline of Biochemistry by : Eric E. Conn, Paul K. Stump, George Bruening, Roy, H. Qoi, John Wiley and Sons, New York, (1987).
2. Harper's Biochemistry 22nd edition) by: Robert K.Murray, Peter, A. Mayes, Daryl K. Granner, Victor W. Wodwell, Prentice-Hall International Inc., (1990).
3. Biochemistry IIIrd edition, Lubert Stryer, W.H. Freeman and Company, New York, (1988).
4. Principles of Biochemistry by Albert Lehninger ,Worth Publishers Inc., USA., (1982).

Practicals based on Paper – XI MZO 7101 (MZO 7151)

1. Qualitative estimation of Carbohydrates.
2. Quantitative estimation of Glucose in RBCs
3. Quantitative estimation of Glycogen in tissues.
4. Qualitative estimation of proteins
5. Quantitative estimation of proteins by Lowry's Method.
6. Quantitative estimation of proteins by Bradford assay.
7. Qualitative estimation of fats.
8. Quantitative estimation of cholesterol in serum.
9. Quantitative estimation of DNA.
10. Quantitative estimation of RNA.
11. Determination of acid phosphatase activity in tissues.
12. Effect of different substrate concentration on enzyme activity.

SEMESTER IV

Special Paper (either of these)
Paper XII

Total Marks : 625
Marks

i. Limnology & Fisheries (MZO 7201)	}	100
ii. Entomology (MZO 7202)		
iii. Concepts in Parasitology (MZO 7203)		
iv. Genetics & Molecular Cytogenetics (MZO 7204)		
v. Stress & Reproductive Physiology (MZO 7205)		
Dissertation		400
Seminar		50
Viva-voce test		75

(i) LIMNOLOGY & FISHERIES (MZO 7201)

Time : 3 hrs.
Total Marks : 100
Sem. Exam. : 80
Int. Ass. : 20

Theory hours per week : 4

UNIT - I (LIMNOLOGY)

Physico-chemical characteristics of water in relation to biota : temperature, light and turbidity, dissolved oxygen, carbon dioxide, pH, nitrogen, phosphorus.

Plankton : classification, distribution , diurnal movements of plankton.

Benthos : zonation, phyto and zoo-benthos.

Lotic Waters : characteristics and adaptations of organisms.

Thermal stratification in lakes.

Aquatic ecosystem : components, food chain, ecological energetics.

Origin of lakes : land slides, glacial action, volcanic action, wind action, river activity, solution lakes, tectonic lakes.

Bog Lakes : physico-chemical conditions, biotic conditions - nature and quantity of plankton, faunal characteristics.

Aquatic pollution : aquatic pollution in relation to biota, thermal pollution, treatment of waste waters -primary, secondary and tertiary, BOD and saprotic classification of waters, bioindicators of water pollution.

Role of limnology in the management of fish ponds.

UNIT - II (FISHERIES)

History of Indian fisheries.

Morphology of the following category of fishes : carp, cat-fish, perch, eel.

Riverine fisheries of the following major river systems of India, their physico-chemical characteristics and important fishes: Indus river system, Ganga river system.

Fishery, location, physico-chemical characteristics, management and present status of the following reservoirs: Gobindsagar, Pong.

Fish culture in freshwater ponds : kinds of ponds (contour, barrage, paddy), parts of ponds (walls, pond inlet, pond outlet, overflow, shape, size & depth), soil type, water quality, nursery pond, rearing pond, stocking pond, feeding pits, hatching pits, marketable tanks, hospital tanks.

Culturable fishes : Indian major carps, salt-water fishes, exotic fishes, air-breathing fishes.

Fish breeding: types of breeding (natural and bundh breeding), fish seed collection from natural resources.

Types of fish culture : composite-culture (fish-cum-paddy, fish-cum-duck, fish-cum-dairy), monoculture, sewage fish farming.

Induced breeding : history, technique, P.G. injection, use of synthetic chemicals for induced breeding.

Fish diseases and their control : protozoan, viral, bacterial fungal, crustacean, helminthes nematodes, environmental stress (temperature, light, DO, pH, ammonia, bicarbonates, acidity, nutritional deficiency diseases).

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

BOOKS RECOMMENDED

1. Fish and Fisheries of India. V.C. Jhingran, Hindustan Publishing House (India), New Delhi (1991).
2. Aquaculture production. FAO Fisheries Circular No.815, Psv. No.4, (1992).
3. Aquaculture in Asia, M.Mohan Joseph. Asian Fisheries Society, Manglore, (1990).
4. Inland Fishes of India. Vols.I & II P.K. Talwar & A.G. Jhingran. Oxford & IBH, New Delhi, (1991).
5. Freshwater Fishery Biology. Karl F.Lagler, Wm.C.Brown Company Publis. Dubuque. Iowa (1969).
6. Methods for Assessment of Fish Production in Freshwaters 3rd Ed. t. Bangenal. IBH Handbook No.3. Blackwell Scientific Publication, Oxford (1978).
7. Monograph on the Fishes of reorganised Punjab. Parts I & II. M.S. Johal and K.K. Tandon. Punjab Fisheries Bulletin, (1979).
8. Fundamentals of Ecology, The Eology of Pumnis Watas, Univ. of Toronto Press, Toronto (1970).
9. Limnology : P.S. Welch. McGraw Hill Book Co. New York (1952).
10. Limnology : R.G. Wetzel., Academic Press, New York, (2001).
11. The Biology of polluted waters. H.B.N. Hynes. Liverpool Uni. Press, Liverpool (1978).
12. Fundamentals of Limnology : F. Ruttner. Univ. of Toronto, Univ. Press, Toronto(1975).

13. Age and growth in Indian Freshwater Fishes; K.K. Tandon & M.S. Johal, Narendra Pub. Home. New Delhi (1996).
14. Fundamentals of Ecology, 5th ed by E.P. Odum and Barrett, G.W. Thomson, Braats/ Cole, USA (2005).

(ii) ENTOMOLOGY (MZO 7202)

Theory hours per week : 4

Time : 3 hrs.

Total Marks : 100

Sem. Exam. : 80

Int. Ass. : 20

UNIT - I

Systematic position, host plants, nature of damage and outlines of the life cycle of the following pests of crops, vegetables and fruits :

A. Crops:

Cotton : *Pectinophora gossypiella* (Pink bollworm), *Empoasca devastans* (cotton jassid), *Bemisia tabaci* (cotton white fly), *Dysdercus cingulatus* (Red cotton bug), *Mylocherus maculosus* (Cotton grey weevil).

Sugarcane : *Pyrilla perpusilla* (Sugarcane leaf hopper), *Aleurolobus barodensis* (Sugarcane white fly), *Scirpophaga nivella* (Sugarcane top borer), *Chilo infuscatellus* (Sugarcane shoot borer).

Paddy : *Hieroglyphus banian* (Rice grass hopper), *Dicladispa armigera* (Rice Hispa), *Leptocorisa varicornis* (Gundhi bug).

Wheat : *Tanymecus indicus* (Ghujhia weevil), *Mythimna separata* (Army worm), *Sesamia inferens* (Wheat stem borer).

B. Vegetables : *Pieris brassicae* (Cabbage caterpillar), *Plutella xylostella* (Diamond-black moth), *Urentius sentis* (Brinjal lace wing bug), *Epilachna vigintioctopunctata* (Hadda beetle), *Raphidopalpa foveicollis* (Red Pumpkin beetle).

C. Fruits : *Drosicha mangiferae* (Mango mealy bug), *Dacus dorsalis* (Mango fruit fly), *Diaphorina citri* (Citrus psylla).

Pests of stored food products with particular reference to their habits, nature of damage caused by them and outlines of their life cycles :

Callosobruchus maculatus (Pulse beetle), *Sitophilus oryzae* (Rice weevil), *Rhizopertha dominica* (Lesser grain borer), *Trogoderma granarium* (Khapra beetle), *Tribolium castaneum* (Rust-red flour beetle), *Sitotroga cerealella* (Angoumois grain moth).

Insects of medical and veterinary importance : (Mosquito, house fly, tsetse fly, sand fly, horse fly, blow fly, bot fly, warble fly, poultry louse, sucking louse, fleas, with particular reference to their systematic position, mode of infection and diseases caused by them.

UNIT - II

History of insect pest control, simple devices such as mechanical and cultural control.

Biological control of insect pests with reference to principles, strategies, use of parasites, predators and pathogens.

Chemical control of insect pests including classification of insecticides : stomach poisons, contact poisons, botanicals, systemics, fumigants, common examples from each class and their mode of action, synergistic substances, resistance to pesticides.

Physical methods of pest control : use of radiations and chemosterilants, history and principle of sterile insect release method (SIRM).

Integrated pest management (IPM).

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

BOOKS RECOMMENDED

1. Attwal, A.S., Agricultural pests of India and South East Asia, Kalyani Publishers, New Delhi (1991).
2. Nair, M.R.G.K., Insects and Mites of Crops in India, ICAR, New Delhi (1975).
3. Kumar & Nigam, Economic and Applied Entomology, Emkay Publications (1991).
4. Matheson, R., Medical Entomology, Comstock Publishing Company, Inc. (1950).
5. Mctcalf & Mctcalf, Destructive and Useful Insects McGraw Hill Book Company, Inc. New York, Toronto, London (1951).
6. David Dent, Integrated Pest Management, Chapman & Hall, London, New York, Tokyo, Madras (1995).
7. House, Stevens, Jones, Insect Pheromones and their use in pest management Chapman & Hall, London, New York, Tokyo, Madras (1998).

(iii) : CONCEPTS IN PARASITOLOGY (MZO 7203)

Theory hours per week : 4

Time : 3 hrs.

Total Marks : 100

Sem. Exam. : 80

Int. Ass. : 20

UNIT - I

Different types of animal associations; Definitions; Phoresis, Commensalism, Parasitism, mutualism, Hyperparasitism.

Evolution of parasites : Origin of parasitism, possible evolutionary pathways, adaptation to multiple hosts, some evolutionary patterns.

Parasite host specificity : Kinds of parasite - host specificity, specificity factors related to infection and growth: host specificity of protozoa and helminth parasites.

Host parasite relationships in Protozoa; Trematode, Cestode and Nematode parasites.

UNIT - II

Immunity to parasites : Brief account of immunity to malaria, trypanosomiasis, leishmaniasis, schistosomiasis and ascariasis.

Vectors : Brief account of various insect vectors of human parasitic infections.

Parasite transmission : Introduction, mechanism for location of host mechanism for penetrating the host, circadian rhythm associated with transmission.

Ecology of parasites : Ecological niche, host size, age and parasite numbers, biologic control, role of metazoan parasites in transmission of microbial infections.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

Books Recommended

1. Chandler A.C. & Read, C.P., Introduction to Parasitology, John Wiley, London (1961).
2. Smyth, J.D., Introduction to Animal Parasitology, Hodder & Stoughton, London (1976).
3. Chappell, L.H., Physiology of Parasites, Blackie, Glasgow & London (1979).
4. Cheng, T.C., General Parasitology, Academic Press, London (1973).
5. Noble, E.R. & Noble, G.A., Parasitology : The biology of animal parasites V-edition, Lea & Febiger, Philadelphia (1982).
6. Chatterjee, K.D., General Parasitology Medical Publishers, Calcutta (1982).

(iv) GENETICS & MOLECULAR CYTOGENETICS (MZO 7204)

Time : 3 hrs.

Total Marks : 100

Sem. Exam. : 80

Int. Ass. : 20

Theory hours per week : 4

UNIT - I

1. **Organization of the genetic material :**

Fine structure of eukaryotic chromosomes, chromosome models, chromosomal proteins, nucleosome concept, various types of DNAs-Satellite DNA, Pallindromic DNA, Promiscuous DNA, Mitochondrial DNA.

2. Split genes, Overlapping genes, Plasmids, IS Elements, Transposons and Retroposons.

3. **Specialized chromosomes:**

Lampbrush chromosomes - Methods of preparation, distribution of lampbrush chromosomes, structure in detail of the chromosomes in amphibians, in *Drosophila* spermatocytes and other organisms, significance of the studies of the lampbrush chromosomes.

4. Polytene chromosomes - Distribution of the polytene chromosomes, organization and structure, relationship between the bands and genes, the puffing

mechanism, DNA replication in polytene chromosomes, polytene chromosomes in the hypotrichous ciliates.

5. **Mechanism of chromosome pairing :**
Synapsis and synaptonemal complex-Structure and composition, attachment, biochemical process of pairing and synapsis. Synaptonemal complex in achiasmatic meiosis, synaptonemal complex in non-homologous pairing, recombination nodules and their role in meiotic pairing, polycomplexes.

UNIT - II

6. **Chromosome banding :**
Chromosome bands - What do they represent, techniques and their mechanisms, classification of bands, importance of banding, differences between banding of metaphase chromosomes and polytene chromosomes.
7. **Gene expression :**
Transcription - In prokaryotes-RNA polymerase in *E.coli*, initiation, elongation and termination of RNA synthesis in prokaryotes. In eukaryotes : RNA polymerases in eukaryotes, transcription factors and initiation of RNA synthesis, transcription factors for elongation of RNA chain, termination of RNA synthesis. RNA processing - capping, polyadenylation, splicing, introns and exons.
8. Translation - Activation of amino acids, transfer of amino acids to tRNA, initiation of synthesis, elongation of the polypeptide chain and chain termination.
Genetics of prokaryotes.
9. Sexuality and recombination in bacteria and viruses - Transfer of genetic material-transformation, transduction and conjugation.
10. **Applied genetics :**
Recombinant DNA, molecular probes, gene libraries and PCR.

Note : In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

BOOKS RECOMMENDED

1. Genetics - U. Goodenough, IIIrd ed., Saunders College Pub., Philadelphia, (1984).
2. Cytogenetics - The Chromosome in Division, Inheritance and Evolution by C.P. Swanson, T.Merz, and W.J. Young, IIrd ed., Prentice Hall of India, New Delhi, (1982).
3. Principles of genetics by E.J. Gardner and D.P. Snustad, 7th ed., John Wiley, New York (1984).
4. Genetics - A survey of the Principles of heredity by A.M. Winchesteer, 3rd ed., Oxford and IBH Pub., Calcutta (1972).
5. Cell Biology and Molecular Biology by D. Robertis, EDP & De Robertis E.M.F., 8th ed., Saunders & Co. Philadelphia (1995).
6. Genetics: A textbook for University students by P.K. Gupta, 3rd ed., Rastogi Pub., Meerut (1996).
7. Cytology, Genetics and Molecular Biology by P.K. Gupta, Rastogi Pub., Meerut (1991).
8. Cell Biology by C.B. Powar, 3rd ed., Himalaya Pub., Bombay (1984).
9. Genetics by Strickberger, Monroe W., 3rd ed., Macmillan Pub., New York, (1985).
10. Eukaryotic chromosomes by Bostock, C.J. & Sumner, A.T., Amsterdam, North Holland (1978).
11. Advances in Cell and Molecular Biology by Dupraw, E.J. eds. Academic Press, New York & London, (1971).

12. Principles of genetics by Sinnott, E.W. & Dunn, L.C., 3rd ed., McGraw-Hill, New York (1939).
13. Science of genetics by Hexter, William and Yost, Henry T., Prentice Hall of India, New Delhi, (1977).
14. Handbook of Molecular Cytology by Lima-De-Faria, A. ed. North Holland Publishing Company, Amsterdam, London, (1969).

(v) : STRESS & REPRODUCTIVE PHYSIOLOGY (MZO 7205)

Time : 3 hrs.

Total Marks : 100

Sem. Exam. : 80

Int. Ass. : 20

Theory hours per week : 4

UNIT – I

Introduction: Physical and biological concept of stress and strain, stress tolerance (conformity) and avoidance, (retaliation), type of strain, injuries and homeostasis.

Thermal Stress : Ranges of environmental temperatures, heat exchange between organisms and environment. Body temperature in aquatic amphibious and terrestrial animals to high and low temperature.

Solvent and Solute Stress ; Osmotic and solute requirement of living organisms. Principles of Water and solute movement. Patterns of body fluid, regulation in aquatic, amphibians and terrestrial animals. Adaptive mechanism of body fluid balance under solvent and solute stress.

Atmosphere Pressure Stress : Structural and rate effects of pressure stress. Mechanisms of adaptation in animals to high altitude and during prolonged diving.

UNIT - II

Aviation and Space Stress ; Effects of centrifugal and linear acceleratory forces, perception of equilibrium and turning in blind flying, radiation at high altitude and in space, weightlessness in space.

Structure and physiology of mammalian ovary, folliculogenesis, corpus luteum and its functions.

Vertebrate reproductive cycles and factors regulating them.

Physiology of mammalian testis, Sertoli cell-germ cell interaction, functions of Leydig cells, Sperm maturation and capacitation.

Hypothalamic - pituitary - gonadal interaction.

Fertilization in mammals, and *in vitro* fertilization. Parturition, lactation.

Note: In all, **nine** questions to be set and **five** to be attempted. Q.No.I is compulsory covering entire syllabus. It will consist of **ten** short answer questions of 2 marks each. For the remaining eight questions, four to be set from Unit I and four from Unit II, each carrying 15 marks. The candidate will be required to attempt two questions from each Unit.

Books Recommended

1. Richards, W. Hill, Comparative Physiology of animals : An Environmental approach (Harper and Row) Pub. New York (1986).
2. F. Read Hausworth, Animal Physiology : Adaption and Function (Addision Wesley Pub. Co. California) (1981).
3. Knut Schmidt Nielsen, Animal Physiology : Adaption and Environmental (Cambridge Univ.Press, London) (1985).
4. A.C. Guyton, Textbook of Medical Physiology 7th ed. Saunders Publication (1984).
5. Turner, C.D. & Bagnara, W.D : General Endocrinology W.B. Saunders Co. Philadelphia, U.S.A. (1976).
6. Text Book of Biochemistry and Human Biology by Talwar, O.P. Prentice Hall of India Pvt. Ltd., New Delhi.
7. B.I. Balinsky, An Introduction to Embryology Saunders Company (1981).
8. Balian and Glasser, Reproductive Biology by Excerpta Media Amsterdam (1984).
9. Knobil and Jimmy D. Neill (eds). The Physiology of Reproduction Vol.I & II, Ernst Raven Press.
10. Robert, H. Williams, Text Book of Endocrinology Saunder Company (1981).
