SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

Three Year B. Sc. Degree Course in

Zoology

Principal Dr. D. K. Mhaske
Chairman,
Board of Studies in Zoology,
Savitribai Phule Pune University, Pune. 411 007

1) Title of the Course: B. Sc. Zoology

F. Y. B. Sc. Zoology

(To be implemented from Academic Year 2013-14)

2) Preamble:

The well organized curricula including basic as well as advanced concepts in Zoology from first year to third year shall inspire the students for pursuing higher studies in Zoology and for becoming an entrepreneur and also enable students to get employed in the Biological research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government based on subject Zoology.

3) Introduction:

At **first year of under-graduation** the topics related to the fundamentals of zoology, including exposure to diversity in animal groups and industries based on the zoological areas are covered. The practical course is aimed at to equip the students with skills required for animal identification, morphological, anatomical, technical description, classification and also applications of zoology in the various industries.

At **second year under-graduation**: The level of the theory and practical courses shall be one step ahead of the first year B.Sc. courses based on the content of first year shall be introduced.

At **third year under-graduation:** Theory and practical courses in each semester shall deal with the further detailed studies of the various disciplines of the Zoology subject and other branches of Zoology such as Genetics, Animal Physiology, Molecular Biology, Biochemistry, Microtechnique, Non-chordate and Chordate, Developmental Biology, Histology, Cell Biology, Biodiversity, Public health and hygiene, Pathology, Entomology, Biotechnology, etc. The students will also learn about use of various technical skills in the biological sciences to be helpful during research in the Zoology subject.

Objectives:

- To provide thorough knowledge about various animal sciences from primitive to highly evolved animal groups.
- To make the students aware of applications of Zoology subject in various industries.
- To highlight the potential of various branches of Zoology to become an entrepreneur.

- To equip the students with skills related to laboratory as well as field based studies.
- To make the students aware about conservation and sustainable use of biodiversity.
- To inculcate interest and foundation for further studies in Zoology.
- To address the socio-economical challenges related to animal sciences.
- To facilitate students for taking up and shaping a successful career in Zoology.

4) Eligibility:

1. **First Year B.Sc.:** A student who has passed the Higher Secondary School Certificate (10+2) Science stream with Biology or its equivalent examination as per the Savitribai Phule Pune University, Pune eligibility norms.
2. **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with zoology as one of the subjects. Other students if they fulfill the conditions approved by the equivalence committee by Faculty of Science of the Savitribai Phule Pune University, Pune are also eligible.
3. **Third Year B.Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with zoology as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with terms and conditions laid down by the Savitribai Phule University of Pune. Reservation and relaxation will be as per the Government rules.

5 A) Examination Pattern:

First Year B. Sc. Zoology

Pattern of Examination : Annual

Theory courses	Zoology Theory Paper I : Annual
	Zoology Theory Paper II : Annual
Practical Course	Annual

Paper/ Course No.	Title	Total Number of lectures/practicals per Term	Standard of passing		
			Internal marks out of **20**	External marks out of **80**	Total marks out of **100**
Theory Paper I ZY-101 (First term)	Animal Systematics and Diversity -I	Three lectures/Week (Total 36 lectures per term)	8	32	40*
Theory Paper I ZY-101 (Second term)	Animal Systematics and Diversity -II	Three lectures/Week (Total 36 lectures per term)			
Theory Paper II ZY-102 (First term)	Fundamentals of Cell Biology	Three lectures/Week (Total 36 lectures per term)	8	32	40*
Theory Paper II ZY-102 (Second term)	Genetics	Three lectures/Week (Total 36 lectures per term)			
Practical Paper III ZY-103 (First & Second Term)	Practical	9 Practicals of 4 lectures in each term (18 practicals / year)	8	32	40*

* Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory (100 + 100) = 200 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers be given on the basis of internal assessment, tests etc.

Theory examination will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	8 sub-questions, each of 2 marks; answerable in 2 -3 lines and based On entire syllabus
Question 2 and 3	4 out of 6 - short answer type questions; answerable in 8 – 10 lines
Question 4	2 out of 4 – Descriptive answer type questions, answerable in 15 – 20 lines
Question 5	1 out of 2 – Descriptive answer type questions, answerable in 35 – 40 lines

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks in each term. The written test shall comprise objective type questions – Multiple choice questions, True / False, Definitions, Answer in one or two line questions. There shall be 20 questions.

Practical: Regular assessment of each practical for 20 marks each: Marks for journal: 10, Marks for attendance: 05, Marks for experimental skills: 05.

Practical Examination: Practical examination shall be conducted by the respective college at the end of the academic year. Practical examination will be of more than 4 hours duration. Certified journal is compulsory for appearing in practical examination. There shall be two expert and two examiners per batch for the practical examination.

Second Year B. Sc. Zoology

(To be implemented from academic year 2014-2015)

Pattern of examination: Semester

Theory courses: Sem I: ZY- 211 and ZY- 212: Semester

Sem II: ZY-221 and ZY-222: Semester

Practical Course: Annual

Paper/ Course No.	**Title**	**Total Number of lectures/practicals per Term**	**Standard of passing**		
			Internal marks out of **10** (Theory) out of **20** (Practical)	External marks out of **40** (Theory) out of **80** (Practical)	Total passing marks out of **50** (Theory) out of **100** (Practical)
ZY- 211	Animal Systematics and Diversity -III	Four lectures/Week (Total 48 per semester)	4	16	20*
ZY- 212	Applied Zoology I	Four lectures/Week (Total 48 per Semester)	4	16	20*
ZY-211	Animal Systematics and Diversity -IV	Four lectures/Week (Total 48 per Semester)	4	16	20*
ZY- 212	Applied Zoology II	Four lectures/Week (Total 48 per Semester)	4	16	20*
ZY-223 (Semester- I and II)	Paper III Practical course	12 Practicals of 4 lectures in each Semester (24 practicals / year)	8	32	40**

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

** Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 + 50) = 100 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers be given on the basis of internal assessment tests.
4. Internal marks for Practical Course should be a regular assessment of each practical for 20 marks each : Marks for journal : 10, Marks for attendance : 05, Marks for experimental skills : 05.

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks as follows: The pattern of question papers shall be:

Question 1	10 sub-questions, each of 1 marks based on entire syllabus	10 marks
Question 2 and 3	2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10-15 lines	10 marks each
Question 4	1 out of 2 sub-questions, each of 10 marks; long answer type questions (20-25lines)	10 marks

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple choice Questions, True / False, Definitions and Answer in Two or three lines.There shall be 20 questions.

Practicals: Regular assessment of each practical for 20 marks each: Marks for journal:10, Marks for attendance: 05, Marks for experimental skills: 05

Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of more than 4 hours duration. Certified journal is compulsory for appearing in practical examination. There shall be two expert and two examiners per batch for the practical examination. One of the examiners will be external.

Third Year B. Sc. Zoology

(To be implemented from academic year 2015-2016)

Pattern of examination: Semester

Theory courses: (Sem III: ZY-331 to ZY-336) : Semester

(Sem IV: ZY- 341 to ZY-346) : Semester

Practical Course:(ZY-347-349) : Annual

Theory Papers					
Paper/Course No.	Title	Total Number of lectures Per Semester	Standard of passing		
			Internal marks out of **10** (Theory) out of **20** (Practical)	External marks out of **40** (Theory) out of **80** (Practical)	Total passing marks out of **50** (Theory) out of **100** (Practical)
SEM III					
ZY-331	Animal Systematics and Diversity V	48	4	16	20*
ZY-332	Mammalian Histology	48	4	16	20*
ZY-333	Biological Chemistry	48	4	16	20*
ZY-334	Environmental Biology and Toxicology	48	4	16	20*
ZY-335	Parasitology	48	4	16	20*
ZY-336	General Pathology or Cell Biology	48	4	16	20*
SEM IV					
ZY-341	Biological Techniques	48	4	16	20*
ZY-342	Mammalian Physiology and Endocrinology	48	4	16	20*
ZY-343	Genetics and Molecular Biology	48	4	16	20*
ZY-344	Organic Evolution	48	4	16	20*
ZY-345	General Embryology	48	4	16	20*
ZY-346	Public Health and Hygiene or Medical Entomology	48	4	16	20*

Practical Papers					
ZY- 347 (Semester III & IV)	Practical Paper I	Practicals related to ZY-331, ZY-332, ZY-341, ZY-342. 12 Practicals of 4 lectures in each Semester (24 Practicals / year)	8	32	40**
ZY- 348 (Semester III & IV)	Practical Paper II	Practicals related to ZY-333, ZY-334, ZY-343, ZY-344. 12 Practicals of 4 lectures in each Semester (24 Practicals / year)	8	32	40**
ZY- 349 (Semester III & IV)	Practical Paper III	Practicals related to ZY-335, ZY-336, ZY-345, ZY-346. 12 Practicals of 4 lectures in each Semester (24 Practicals / year)	8	32	40**

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

** Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50× 6) = 300 marks
2. Total marks per year 600 (Theory) + 300 marks (practicals) = 900 marks
3. Internal marks for theory papers be given on the basis of internal assessment tests.
4. Practicals: Regular assessment of each practical for 20 marks each: Marks for journal: 10, Marks for attendance: 05, Marks for experimental skills: 05.

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying 10 marks. The pattern of question papers shall be:

Question 1	10 sub-questions, each of 1 marks based on entire syllabus	10 marks
Question 2 and 3	2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10 – 15 lines	10 marks each
Question 4	1 out of 2 sub-questions, each of 10 marks; long answer type questions (20 – 25 lines)	10 marks

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple choice questions, True / False, Definitions, Answer in Two or three line questions. There shall be 20 questions.

Practicals: Regular assessment of each practical for 20 marks each: Marks for journal: 10, Marks for attendance: 05, Marks for experimental skills: 05.

Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of more than 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be two expert and two examiners per batch for the practical examination. One of the examiners will be external.

5 B) Standard of Passing:

i) In order to pass in the first year theory examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Theory Examination.)

ii) In order to pass in the Second Year and Third Year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 16 marks out of 40 must be obtained in the University Theory Examination.)

iii) In order to pass in practical examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Examination.)

5 C) ATKT Rules:

While going from F.Y.B.Sc. to S.Y.B.Sc. at least 8 courses (out of total 12) should be passed; however all F.Y.B.Sc. courses should be passed while going to T.Y.B.Sc.

While going from S.Y.B.Sc. to T.Y.B.Sc., at least 12 courses (out of 20) should be passed (Practical Course at S.Y.B.Sc. is equivalent to 2 courses).

5 D) Award of Class:

The class will be awarded to the student on the aggregate marks obtained during the second and third year in the principal subject only. The award of the class shall be as follows:

1	Aggregate 70% and above	First Class with Distinction
2	Aggregate 60% and more but less than 69%	First Class
3	Aggregate 55% and more but less than 59%	Higher Second Class
4	Aggregate 50% and more but less than 54%	Second Class
5	Aggregate 40% and more but less than 49%	Pass Class
6	Below 40%	Fail

5 E) External Students:

There shall be no external students.

5 F) Setting of question papers:

F. Y. B. Sc.: For theory papers I and II annual question papers shall be set by the University of Pune and assessment shall be done at the respective colleges. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Paper III, papers shall be set by the University of Pune and assessment done at the respective colleges.

S. Y. B. Sc. and T. Y. B. Sc.: For theory papers for each semester and also for the annual practical examination, question papers shall be set by the University of Pune. Centralized assessment for theory papers shall be done as per the University instructions. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Papers, papers shall be set by the University of Pune and assessment shall be done by the internal examiner and external examiner appointed by University of Pune.

5 G) Verification and Revaluation Rules:

As per University Statues and Rules for verification and revaluation of marks in stipulated time after declaration of the semester examination result.

6 Course Structure:

Duration: The duration of B.Sc. Zoology Degree Program shall be three years.

a) Compulsory Papers:

F. Y. B. Sc.: 2 Theory + 1 Practical (Annual)

S. Y. B. Sc.: 2 Theory per semester + 1 Practical (Annual)

T. Y. B. Sc.: 6 Theory per semester + 3 Practical (Annual)

b) Question Papers :

F. Y. B. Sc. Theory paper:

University Examination – 80 marks (at the end of 2 nd term)

Internal Examination – 20 marks

S. Y. / T. Y. - B. Sc. Theory paper:

University Examination – 40 marks (at the end of each term)

Internal Examination – 10 marks

F. Y. / S. Y. / T. Y. - B. Sc. Practical Paper:

University Examination – 80 marks (at the end of 2 nd term)

Internal Examination – 20 marks

Medium of Instruction: The medium of instruction for the course shall be **English.**

7 Equivalence of Previous Syllabus:

F.Y.B.Sc. :-

Old Course (2008 Pattern)	**New Course (2013 Pattern)**
Paper I: Nonchordates and Chordates	Animal Systematics and Diversity –I and II
Paper II: Genetics and Parasitology	Fundamentals of Cell Biology and Genetics
Paper III: Practical course	Paper III: Practical course

S.Y.B.Sc. :-

Semester	**Old Course (2009 Pattern)**	**New Course (2014 Pattern)**
Semester-I	Paper I: General Zoology and Biological Techniques-I	Paper I: Animal Systematics and Diversity –III
Semester-I	Paper II: Applied Zoology-I	Paper II: Applied Zoology-I
Semester-II	Paper I: General Zoology and Biological Techniques-II	Paper I: Animal Systematics and Diversity –IV
Semester-II	Paper II: Applied Zoology-II	Paper II: Applied Zoology-II
Annual Examination	Paper III: Practical course	Paper III: Practical course

T.Y.B.Sc. :-

Semester- III

	Papers in Old Course (2010 Pattern)		**Equivalent papers in new Course (2015 Pattern)**
ZY-331	General Zoology	ZY-331	Animal Systematics and Diversity V
ZY-332	Mammalian Histology	ZY-332	Mammalian Histology
ZY-333	Biological Chemistry	ZY-333	Biological Chemistry
ZY-334	Environmental Biology and Toxicology	ZY-334	Environmental Biology and Toxicology
ZY-335	Any one of the following a. Basic Entomology b. General Pathology	ZY-335	Parasitology
ZY-336	Cell Biology	ZY-336	Any one of the following a. General Pathology b. Cell Biology

Semester-IV

	Papers in Old Course (2010 Pattern)		**Equivalent papers in new Course (2015 Pattern)**
ZY-341	Biotechnology	ZY-341	Biological Techniques
ZY-342	Mammalian Physiology and Endocrinology	ZY-342	Mammalian Physiology and Endocrinology
ZY-343	Molecular Biology	ZY-343	Genetics and Molecular Biology
ZY-344	Organic Evolution	ZY-344	Organic Evolution
ZY-345	Any one of the following a. Biodiversity b. Public Health and Hygiene	ZY-345	General Pathology
ZY-346	Genetics and Developmental Biology	ZY-346	Any one of the following a. Public Health and Hygiene b. Medical Entomology
ZY-347	Practical I ZY-331, ZY-332, ZY-341, ZY-342	ZY-347	Practical I ZY-331, ZY-332, ZY-341, ZY-342
ZY-348	Practical II ZY-333, ZY-334, ZY-343, ZY-344	ZY-348	Practical II ZY-333, ZY-334, ZY-343, ZY-344
ZY-349	Practical III ZY-335, ZY-336, ZY-345, ZY-346	ZY-349	Practical III ZY-335, ZY-336, ZY-345, ZY-346

8 **University Terms:** Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on minimum 75 percent attendance at theory and practical course and satisfactory performance during the term.

9 **Qualification of Teachers:** M.Sc. Zoology or equivalent master degree in science with class/grades and NET/SET/Ph.D. as per prevailing rules and regulations laid down by University/Government /UGC.

SAVITRIBAI PHULE PUNE UNIVERSITY

BOARD OF STUDIES IN ZOOLOGY

Revised Syllabus for T. Y. B. Sc. (Zoology) to be implemented from June, 2015

Semester-III:-

ZY-331: Animal Systematics and Diversity V

ZY-332: Mammalian Histology

ZY-333: Biological Chemistry

ZY-334: Environmental Biology and Toxicology

ZY-335: Parasitology

ZY-336: General Pathology or Cell Biology

Semester-IV:-

ZY-341: Biological Techniques

ZY-342: Mammalian Physiology and Endocrinology

ZY-343: Genetics and Molecular Biology

ZY-344: Organic Evolution

ZY-345: General Embryology

ZY-346: Public Health and Hygiene or Medical Entomology

ZY-347: Practical I- ZY-331, ZY-332, ZY-341, ZY-342

ZY-348: Practical II- ZY-333, ZY-334, ZY-343, ZY-344

ZY-349: Practical III- ZY-335, ZY-336, ZY-345, ZY-346

SAVITRIBAI PHULE PUNE UNIVERSITY

BOARD OF STUDIES IN ZOOLOGY

COURSE STRUCTURE OF UNDERGRADUATE CLASSES

(To be implemented from June 2015)

Class: F.Y. B. Sc.

Paper	Course No.	Term I	Term II
I	ZY 101	Animal Systematics and Diversity -I	Animal Systematics and Diversity –II
II	ZY 102	Fundamentals of Cell Biology	Genetics
III	ZY 103	Practical course	

Class: S.Y. B. Sc.

Paper	Course No.	Semester I	Course No.	Semester II
I	ZY.211	Animal Systematics and Diversity -III	ZY. 221	Animal Systematics and Diversity –IV
II	ZY.212	Applied Zoology I	ZY.222	Applied Zoology II
III	ZY.223	Practical course		

Class: T.Y. B. Sc.

Paper	Course	Semester III	Course	Semester IV
I	ZY.331	Animal Systematics and Diversity V	ZY.341	Biological Techniques
II	ZY.332	Mammalian Histology	ZY.342	Mammalian Physiology and Endocrinology
III	ZY.333	Biological Chemistry	ZY.343	Genetics and Molecular Biology
IV	ZY.334	Environmental Biology and Toxicology	ZY.344	Organic Evolution
V	ZY.335	Parasitology	ZY.345	General Embryology
VI	ZY.336	General Pathology or Cell Biology	ZY.346	Public Health and Hygiene or Medical Entomology
VII	ZY.347	Practicals corresponding to ZY 331, ZY 332, ZY 341 & ZY 342		
VIII	ZY.348	Practicals corresponding to ZY 333, ZY 334, ZY 343 & ZY 344		
IX	ZY.349	Practicals corresponding to ZY 335, ZY 336, ZY 345 & ZY 346		

Prin. (Dr) D. K. Mhaske
Chairman, B.O.S. in Zoology
Savitribai Phule Pune University, Pune

T. Y. B. Sc. Zoology

ZY- 331 (Paper I)

Animal Systematics and Diversity- V

Total lectures: 48

1 Study of *Pila globosa* with reference to the following: 12

1.1 Systematic position, habit, habitat and external characters

1.2 Body wall & pallial complex

1.3 Functional anatomy: digestive, respiratory, circulatory, excretory, reproductive, nervous system & sense organs

2 Study of the following groups with reference to: 08

2.1 Protozoa : locomotion & nutrition

2.2 Porifera : skeleton and canal system

2.3 Coelenterata : polymorphism and corals

2.4 Hemichordata : affinities

3 Study of *Calotes versicolor* with reference to the following : 14

3.1 Systematic position, habit, habitat and External characters

3.2 Functional Anatomy - Digestive, Circulatory, Excretory, Reproductive, Nervous system and Sense organs

4 Comparative study of following topics in vertebrates 08

4.1 **Integument:** Skin of *Scoliodon*, Frog, *Calotes*, Pigeon & Rat

4.2 **Heart:** Structure of heart of *Scoliodon*, Frog, Calotes, Pigeon & Rat

4.3 **Kidney:** Evolution of Archinephros, Pronephros, Mesonephros, Metanephros

4.4 **Brain:** Morphological variation in the different regions of the brain of *Scoliodon*, Frog, *Calotes*, Pigeon and Rat/Rabbit

5 Study of following groups with reference to 06

5.1 Pisces : Dipnoi, Accessory respiratory organs , Electric organs

5.2 Reptilia : Temporal vacuities, General characters of Rhyncocephalia

5.3 Mammalia : Dentition in mammals

Reference Books

1. Living Invertebrates, 1987: Pearse, Buchsbaum, Blackwell Scientific Publication, California.
2. A Text book of Zoology Invertebrates, Vol. I 1992, 7th Edn. Parker and Haswell edited by Marshall William, C B S publishers and distributors, New Delhi.
3. Invertebrate Zoology, 1992; S. N. Prasad, Vikas Publishing House, New Delhi.
4. Life of Invertebrates, 1992; S.N. Prasad, Vikas Publishing House, New Delhi.
5. Invertebrate Zoology, 1992 4th Edn., reprint, P.S. Dhami and J. K. Dhami, R. Chand and Co., New Delhi.
6. Modern text book of Zoology, Invertebrates 10th Edn., 2009, R.L. Kotpal, Rastogi publ., Meerut.
7. Invertebrates Structure and Function, 2nd Edn.1979, EJW Barrington, John Wiley and Sons Inc.
8. Invertebrates Zoology, 1994, 6th Edition, Ruppert, E. Edward, R. D. Barnes; Saunders college Publishing, USA.
9. Invertebrate Zoology, 1991, P.A. Meglitsch and F. R. Schram, Oxford University Press; New York.
10. Invertebrate: A New synthesis, 1988, R.S.K. Barnes, P. Calow and P.J.W., Olive Blackwell Scientific, U.K.
11. An Introduction to Protochordata, 1990, H. S. Bhamrah and KavitaJuneja, Anmol publication, New Delhi.
12. The invertebrates: Protozoa through CtenophoraVol.I, 1959, Hyman, Libbie Henrietta, McGraw-Hill Book Co., Inc. New York.
13. A text book of Zoology, Vol.II, 1990, T. J. Parker and W. A. Haswell, Low price Publication, Delhi.
14. Modern Text Book of Zoology, 1992, R. L. Kotpal, Rastogi Publication, Meerut.
15. Chordate Zoology, 1982, P. S. Dhami and J. K. Dhami, R. Chand and Co., New Delhi.
16. The life of Vertebrates, 3rd edn.1993, J. Z. Young, Oxford University Press, USA.
17. The Phylum Chordata: Biology of Vertebrates and their Kin, 1987, H. H. Newman, Distributor Satish book enterprise, Agra.
18. A text book of Zoology, 1984, R. D. Vidyarthi, S. Chand and Co., New Delhi.
19. Comparative Anatomy of the Vertebrates, G. C. Kent, R. K Carr,9thEdn., 2001, McGraw Hill, Boston, USA

20. Practical Zoology Invertebrates, 11th revised Edn., 2014, S. S. Lal, Rastogi publ., Meerut.
21. Vertebrate Practical Zoology, 11th revised Edition, 2014, S. S. Lal, Rastogi publ., Meerut.
22. Practical Zoology, 2004, Vijay Laxmi Sharma, Paragon International Publishers.
23. The anatomy of Garden Lizard, 1974, S.Y. Paranjape, Pune University Publication, Pune.
24. Chordate Zoology, 2009 reprint, E. L. Jorden, S. Chand and Co., New Delhi.
25. Text book of Zoology, Vertebrates, Vol. II, T.J. Parker and W.A. Haswell, edited by Marshall and Williams, CBS Publications, New Delhi.

ZY- 332 (Paper II)

Mammalian Histology

Total lectures: 48

1	**Introduction**	1
	1.1 Definition and scope	
2	**Tissues:**	6
	2.1 Definitions and review of tissues (location, structure and functions): epithelial, connective, nervous and muscular	
3	**Histological study of following organs**	
	3.1 Skin (V.S.)	3
	3.2 Tooth (V.S.)	2
	3.3 Tongue (C.S.) with reference to mucosa papillae and taste buds	2
	3.4 Alimentary canal: Basic histological organization with reference to: Oesophagus (T.S.), stomach (T.S.), duodenum (T.S.) Ileum (T.S.) and rectum (T.S.)	8
	3.5 Glands associated with digestive system: Salivary glands – parotid (C.S.), submandibular (C.S.) sublingual (C.S.), liver (C.S.) and pancreas (C.S.) including both exocrine and endocrine components	6
	3.6 Respiratory organs: Trachea (T.S.) and lung (C.S.)	2
	3.7 Blood vessels: Artery (T.S.), vein (T.S.) and capillaries (T.S.)	2
	3.8 Kidney (L.S.), Structure of nephron and juxtaglomerular complex	4
	3.9 Reproductive organs: a) Testis (T.S.) with reference to Seminiferous Tubules and cells of Leydig b) Ovary (C.S.) - primary, secondary and matured (Graffian) follicle, corpus luteum and corpus albicans	6
4	**Histology of endocrine glands :**	**6**
	4.1 Pituitary gland	
	4.2 Thyroid gland	
	4.3 Adrenal gland	

Reference Books

1. Inderbir Singh's Textbook of Human Histology (With Colour Atlas and Practical Guide), 2014, 7th Edn., Neelam Vasudeva and Sabita Mishra, Jaypee Brothers Medical Publishers, New Delhi, India.

2. Bailey's Text book of Histology, 1971, 16th edn. Wilfred M. Copenhaver, Richord P. Bung & Mary Bartell Bunge, The William &Wilkings Company, Baltimore.

3. Histology, 1987, 9th Edn., Arthur W. Ham, David H. Cormack, J. B. Lippincott Co. Philadelphia.

4. Essential Histology, 2001, 2nd Edition, David H. Cormack, Lippincott Williams & Wilkins, Philadelphia.

5. A text book of Histology, 2014, 5thedn. Krishna Garg, Indira Bahl & Mohini Kaul CBS publication & Distributors, Delhi.

6. Histology, 1977, 4th Edn., R. O. Greep and L. Weiss, McGraw Hill Int. Book Co., New York.

7. Histology of Mammals, 1983, M. V. Athawale and A. N. Latey, Narendra Prakashan, Pune.

8. Hand book of Basic Mictotechnique, 1964, 3rd Edn., Peter Gray, McGrawHill Book Co. New York.

9. Hand Book of Histopathogical& Histochemical Techniques, 1983, 3rd Edition reprint, Butterworth & Co. (Publishers) Ltd, UK.

10. Hand Book of Histological and Histochemical Techniques, 1991, 1st Edn. S. K. David, CBS publisher & Distributors, Delhi.

ZY-333 (Paper III)

Biological chemistry

Total lectures: 48

1. Basic Biochemistry: 10

1.1 Bonds –Types: Ionic, covalent, noncovalent bonds (hydrogen, hydrophobic, electrostatic, Van der Waal forces) and their functions in bio molecules

1.2 Structure of water molecule (liquid, ice and colloid)

1.3 Physico-chemical properties of water

1.4 Concept of acid and base, pH, Sorenson's scale, derivation of Henderson Hasselbalch equation and its applications

1.5 Concept of Buffer-types of buffer, buffering capacity and buffers in biological system (Phosphate, bicarbonate)

2. Carbohydrates: 10

2.1 Definition and classification of carbohydrates

2.2 Isomerism in carbohydrates- Structural and stereoisomerism

2.3 Stereo chemical properties-enantitiomeres, anomers, epimerism, mutarotation, racemisation, biological significance and clinical significance-hypoglycemia and hyperglycemia

3. Proteins: 08

3.1 Essential and non essential amino acids

3.2 Structure and classification of amino acids, Peptide bond, types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example), bonds responsible for protein structures and Biological significance of proteins

4. Enzymes: 12

4.1. Classification and properties of enzymes

4.2 Regulatory and non regulatory enzymes

4.3 Enzyme kinetics, MM equation and its importance and LB plot

4.4 Reversible and irreversible enzyme inhibition

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

4.6. Introduction of isoenzymes, allosteric enzymes, immobilized enzymes and ribozymes

4.7. Clinical significance of enzymes- PKU and AKU

5. Lipids: 08

5.1 Introduction, classification and chemistry

5.2 Clinical significance (obesity, atherosclerosis, myocardial infarction)

5.3 Biological significance of lipids

Reference books

1. Principles of Biochemistry, 1993, 2nd Edn, Lehninger A. L. Nelson D.L. & Cox M.M. CBH Publisher and distributors, Delhi.
2. Biochemistry, 1995 5th Edn. Zuby G. Wm, C.Brown Communications USA
3. Harpers Biochemistry ,1996 ,26 th Edn., Murray R.k.,Granner D.K. ,Mayes P.A. &Rodwell V.W. Prentice Hall international USA.
4. Outline of biochemistry, 1995 5th Edn, Conn E.E., Stumph P.K. Bruening G &Doi R.H.John Wiley & Sons, USA
5. Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T.N.,Gajanan Book publisher s and distributors Bangalore.
6. Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing house, Mumbai.
7. Biochemistry, 1995 5th Edn, Stryer Sanfrancisco, W. H. Freeman & Co.
8. Biochemistry, 1990, 8th Edn., D.Voet & J. Voet, JohnWilley, New York

ZY-334 (Paper IV)

Environmental Biology and Toxicology

Total lectures: 48

1 Environmental Biology 2

Introduction- Definition, basic concepts and scope

2 The Ecosystem 8

2.1 Definition, abiotic and biotic components and their interrelationship

2.2 Energy flow in ecosystem and flow models

2.3 Major Ecosystems: (a) natural ecosystem: e.g. fresh water, forest (b) artificial ecosystem: e.g. cropland

2.4 Food chain in ecosystem and food web

2.5 Ecological pyramids

3 Environmental Pollution: 12

3.1 Definition and types of pollution

3.2 Pollutants, types of pollutants (metallic, gaseous, acids, alkalis, biocides)

3.3 Air pollution: Definition, sources of air pollution and their effects

3.4 Air pollution and its relevance with the following

3.4.1 Acid rain

3.4.2 Greenhouse effect

3.4.3 Ozone layer depletion

3.5 Water pollution: definition, sources of water pollution and their effects on ecosystem. Community waste with reference to following:

I. Sewage

II. Industrial wastes

III. Agricultural wastes

3.6 Land / Soil pollution: definition, sources of land / soil pollution and their effects

3.7 Noise pollution: definition, sources of noise pollution and their effects and control measures

4 Environment and Development 5

4.1 Bioindicators and environmental monitoring

4.2 Environmental challenges in India: land degradation, population explosion, urbanization and industrialization

5 Natural Resources and Conservation: 5

5.1 Renewable and non-renewable resources

5.2 Soil conservation

5.3 Forest conservation

5.4 Energy sources: conventional and non-conventional

6 Wildlife Management: 5

6.1 Definition, causes of wildlife depletion

6.2 Importance of wildlife management in India

6.3 Endangered species, vulnerable species, rare species and threatened species

6.4 Wild life conservation

7 Toxicants and Toxicity: 7

7.1 Definition of toxicology, scope and branches

7.2 Types of toxicants

7.3 Factors influencing toxicity (pH, temperature, reproductive status, age, physiological state)

7.4 Dose, LD_{50}, LC_{50}

8 Toxicants of Public Health and Hazards: 4

Pesticides, heavy metals, fertilizers, food additives and radioactive substances

Reference Books

1. Ecology and environment, 2014, 12th revised Edition, P. D. Sharma, Rastogi Publ. Meerat.
2. Environmental Biology, 1996, P. S. Verma and V. K. Agrawal, S. Chand and Co. New Delhi.
3. Ecology, 2007, 1st Edn. Mohan P. Arora, Himalaya Publ. House, Delhi.
4. Fundamentals of ecology, 2009, 3rd Edn., M. C. Dash, Tata Mcgraw Hill, New Delhi.
5. Elements of ecology, 1967, George L. Clarke, John Wiley and Sons, New York.
6. Ecology of Natural resources, 1985, Francois Ramade, W. J. Duffin, John Wiley and Sons, New York.
7. Concepts of Ecology, 1996, E.J. Kormondy, Prentice Hall of India. New Delhi
8. Modern concept of Ecology, 1995, 8thEdn. H. D. Kumar, Vikas Publishing House, New Delhi

9. Fundamentals of Ecology, 2006, 5th Edn., E. P. Odum, Oxford & IBM Publi.Co. New Delhi.
10. Environmental problems and Solution, 1998, 2ndEdn. D. K. Asthana, Meera Asthana, S. Chand Publi., New Delhi.
11. Toxicology, 2011, 3rd revised Edn., P.D. Sharma, Rastogi Publi. Meerut.
12. Pollution and Health hazards in India, 1987, R. Kumar,. Ashish Publi. House, New Delhi.
13. Toxicology – Principles and Methods, 2010, 2nd Edn., M. A. Subramanian,, M J P Publishers, Chennai.
14. Selective Toxicity, 1973, A. Albert, Chapman and Hall, London.
15. Environmental Toxicology, 2003, M. Satake, Y. Mido, Discovery Publi. House, New Delhi.
16. Introduction to General Toxicology, 1976, E. J. Ariens; A. M. Simonis; J. Offermeier, Academic Press, London.

ZY-335 (Paper V)

Parasitology

Total lectures: 48

1	**Introduction:** Scope and branches of Parasitology Definition: host, parasite, vector, commensalisms, mutualism and parasitism	3
2	**Types of parasites:** ectoparasites, endoparasites and their subtypes	3
3	**Types of hosts:** intermediate and definitive, paratenic, reservoir	3
4	**Host-Parasite relationship:** Host specificity- definition, structural specificity, physiological specificity and ecological specificity	3
5	**Study of the following parasites** with reference to habit, habitat, Life cycle, Mode of Infection, pathogenicity and control measures - *Plasmodium vivax, Entamoeba histolytica, Ascaris lumbricoides* and *Taenia solium*	16
6	**Study of the following parasites** with reference to morphology, life cycle, pathogenicity and control measures: Head louse, Tick, Mite (*Sarcoptes scabei*)	6
7	**Parasitological significance of Zoonosis**: Bird flu, Rabies and Toxoplasmosis	4
8	**Control measures of arthropod vectors of human diseases:** Malaria *(Anopheles stephensi, A culicifacies),* Dengue, Haemorrhagic fever (*Aedes aegypti, A. albopictus*), Filariasis *(Culex pipiens fatigans)*	6
9	**Epidemic diseases:** Typhoid, Cholera, Small pox; their occurrence and eradication programmes	4

Reference Books

1. Comparative Protozoology: Ecology, Parasitology, Life history, 1988, Anderson, O.R. Springer Verlag, Berlin.
2. Parasites and parasitism, Cameron, 1958, T. W. M. Methuen, London
3. An Introduction to Parasitology, 1961, Chandler, A.C.& C. P. Read, Wiley, New York
4. Parasitology and Helminthology in relation to Clinical Medicine, 1980, Edn.12 Chatterjee, K.D., Chatterjee Medical publishers, Calcutta.
5. The biology of animal parasites, 1964, Cheng T.C., Saunders, Philadelphia.
6. Symbiosis, 1970, Cheng T.C., Pegasus, New York.
7. Parasitology -The biology of animal parasites, 1971, Noble E.R. & G. A. Noble, Lea and Febiger, Philadelphia U.S.A.

8. Fundamentals of Ecology, 1971, Edn.3, Odum E.P., Saunders, Philadelphia U.S.A.
9. Entomology.Edn.10 Vols.1&2 McGraw Hill, New York.
10. Animal Parasitism, 1972, C.P. Read, Prentice Hall, Englewood Cliffs, N.J., U.S.A.
11. Parasites: Lice, Ticks& Fleas (Free Kindle), 2014, C.D. Shelton

ZY-336 (Paper VI)

a) General Pathology

Total lectures: 48

1 Introduction: 4

1.1 Definition, scope and basic branches

1.2 Applied pathology- biopsy and surgery

1.3 Autopsy- post mortem changes

2 Clinical pathology 4

2.1 Definition and scope

2.2 Gastric analysis

2.3 Urine examination

2.4 Importance of CSF examination

2.5 Liver function test

2.6 Renal function test

3 Diseases: **4**

3.1 Definition and causes

3.2 Infectious diseases: aetiology and infectious agents

4 Retrogressive changes: 4

Definition, cloudy (changes) swelling, degeneration, fatty degeneration, mucoid degeneration and amyloid degeneration

5 Necrosis: 3

5.1 Definition and causes

5.2 Nuclear and cytoplasmic changes

5.3 Types of necrosis

6 Gangrene: 3

6.1 Definition and causes

6.2 Types: dry, moist and gas gangrene

7 Circulatory disturbances: 8

7.1 Hyperemia: active and passive (causes and effects)

7.2 Ischaemia: causes and effects

7.3 Hemorrhage: causes, effects and hemorrhagic effects

7.4 Thrombosis: thrombus formation, its causes and effects

7.5 Embolism: Definition, sources, types and effects

8 Inflammation: 5

8.1 Definition and causes, cardinals of inflammation (signs), vascular phenomenon and cellular response

8.2 Acute and chronic inflammation

9 Repair: 4

9.1 Process of Repair

9.2 Types: by regeneration, by connective tissue proliferation

9.3 Healing: primary and secondary

10 Neoplasia: 4

10.1 Definition, causes and types of tumours-benign and malignant

10.2 Leukemia: acute and chronic.

11 Disorders of pigmentations: 2

Brief idea about normal process of pigmentation, melanosis and jaundice

12 Disorders of mineral metabolism: 3

Mechanism of calcification, pathological calcification (dystrophic and metastatic) causes and its effects. Gout aetiology and pathogenesis

Reference Books

1. A text book of Pathology, 2009, 15th Rev Edn., Dey N. C. and Dey T. K. Sinha Debashish, New central book agency, Kolkota
2. General pathology and pathology of systems, 2008, 6th Edn., Bhende Y. M. and Deodhar S.G.; Popular Prakashan Ltd, India.
3. Robins Basic Pathology, 2012, 9th Edn., Vinay Kumar, Abul K. Abbas, Jon C. Aster, Saunders, Philadelphia.
4. Textbook of Pathology, 2014, 7th Edition, Harsh Mohan, Jaypee Brothers Medical Publishers (P) Ltd
5. Essentials in Hematology & Clinical Pathology, 2012, 1st Edition, Ramadas Nayak, Sharada Rai, Astha Gupta,
6. Concise Book On Medical Laboratory Technology, 2005 reprint, 1st Edn., C. R. Maiti, New Central Book Agency (p) Ltd, Kolkata, India

ZY- 336 (Paper VI)

b) Cell Biology

Total lectures: 48

1	**Introduction to Cell biology:**	3
1.1	Definition and scope	
1.2	Prokaryotic and eukaryotic cell: size, shape and structure	
2	**Plasma membrane:**	6
2.1	Unit membrane concept	
2.2	Models: Lipid membrane, Protein-Lipid (Danielli-Davson) and Fluid Mosaic	
2.3	Membrane receptors	
2.4	Membrane transport: Passive and Active	
2.5	Exocytosis and Endocytosis (Phagocytosis and Pinocytosis)	
3	**Endoplasmic reticulum:**	5
3.1	Occurrence and ultrastructure	
3.2	Type: smooth and rough	
3.3	Functions	
4	**Golgi complex:**	3
4.1	Origin, occurrence and morphology	
4.2	Ultrastructure and functions	
5	**Lysosomes:**	3
5.1	Origin, occurrence and morphology	
5.2	Ultrastructure, polymorphism and functions	
6	**Mitochondria:**	4
6.1	Origin, occurrence and morphology	
6.2	Ultrastructure and functions (explanation of the cycles not expected)	
7	**Nucleus:**	6
7.1	Shape, Size, number and position	
7.2	Ultrastructure of nuclear membrane and pore complex	
7.3	Nucleolus: general organization, chemical composition and functions	
7.4	Nuclear sap/ nuclear matrix	
7.5	Nucleocytoplasmic interactions	

8 Cytoskeleton: 3

8.1 Microfilaments: location, ultrastructure, biochemical composition and functions

8.2 Intermediate Filament: location, ultrastructure, biochemical composition and functions

8.3 Microtubules: location, ultrastructure, biochemical composition and functions

9 Cell cycle and cell division: 6

Various phases of cell cycle, mitosis, meiosis & role of centriole in the cell division

10 Cellular ageing and cell death: 4

10.1 Concept of ageing theories:

10.1.1 Intracellular changes: free radicals

10.1.2 Extra cellular changes

10.2 Cell death:

10.2.1 Apoptosis: definition and significance

10.2.2 Necrosis: definition and examples

11 Cancer cell: 5

11.1 Characteristics

11.2 Theories/ hypothesis regarding causes of cancer

11.2.1 Extrinsic causes: physical, chemical and biological agents (viruses).

11.2.2 Intrinsic causes: somatic mutations, oncogenes and ageing related phenomenon

Reference Books

1. Cell and molecular biology, 2010, 8th Edn., De Robertis EDP and De Robertis EMF Jr., Lippincott Williams & Wilkins, Philadelphia
2. Molecular Cell biology, 2013, 1st Edn., C. B. Powar, Himalaya Publi. House.
3. Cell and molecular biology, 1968, Dupraw E. J., Academic Press, New York.
4. Molecular Cell biology, 1986, Avers C.J. Addison Wesley Pub. Co., New York & London.
5. Cell and Molecular biology, 2013, 7th Edn., Gerald Karp, John Wiley and Sons, USA.
6. Cell biology, 1993, David E. Sadava, Johnes and Bartlett Publi., London.
7. Cell Structure and Function, 1991, 3rd Edn, A.G. Loewy & Siekevitz, Saunder college Publi., Philadelphia
8. Becker's World of the Cell, 2012, 8th Edition, Jeff Hardin, Gregory Paul Bertoni, Lewis J. Kleinsmith, Benjamin Cummings, UK
9. The Cell: A molecular approach, 2013, 6th Edn., Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, USA
10. Molecular Biology of the Cell, 2007, 5th Edn., Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Taylor & Francis, UK

ZY- 341(Paper I)

Biological Techniques

Total lectures: 48

1 Introduction to biological techniques 10

1.1 **Solution/strengths of chemicals:** percentage, normality, molarity, molality, osmolarity, osmolality, ppm, ppb

1.2 Separation techniques: principle and applications, techniques related to isolation, purification and characterization of bio molecules

1.2.1 Chromatography (paper, ion-exchange), gel filtration

1.2.2 Electrophoresis-(agarose, polyacrylamide)

1.2.3 Ultracentrifugation

1.2.4 Colorimetry and spectroscopy

2 Haematological Techniques: 08

2.1 Blood cell count –Total count of RBCs, WBCs and Differential count of WBCs and their significance. Examination of bone marrow. Hb%, bleeding time, clotting time and their significance

2.2 Microscopy**:** simple, compound, phase contrast, electron - their principle & working

2.3 Micrometry

2.4 Camera Lucida

3 Micro technique: 10

3.1 Procurement of tissues and precautions to be taken to avoid tissue damage during procurement

3.2 Fixatives: Classification of fixatives and importance of fixation of tissues

3.3 Methods of fixation

3.4 Dehydration, clearing, impregnation and block making:

3.4.1. Clearing and alcoholising agents

3.4.2. Clearing and dealcoholisation

3.4.3. **Impregnation and Embedding:** Types of embedding media**,** methods of embedding and block making. Comments on hardening of paraffin

4 Microtomes and Knives: 08

4.1 Types of microtomes

4.2 Types of microtome knives

4.3 Section cutting**:** Microtomy- steps and precautions**,** common faults in section cutting- reasons & remedies**.** Mounting and spreading of ribbons

5 Stains and Staining 06

5.1 Classification of stains

5.2 Methods and types of staining

5.3 General procedure for staining of sections

5.4 Vital Stains

5.5 Mounting and labeling of sections: Classification of mounting media**,** refractive indices of mounting media

6 Histochemical staining: 06

6.1 Demonstration of Carbohydrates (PAS technique)

6.2 Demonstration of Nucleic acid (Feulgen Reaction)

References

1. Introduction of Medical Laboratory Technique,1998, 7th Edn., Baker F. J., Silverton R. E., Pallister C. J., Butterworth-Heinemann, UK
2. Hematology: Basic Principles and Practice, 2008, 5th Edn., Ronald Hoffman , Bruce Furie, Philip McGlave, Churchill Livingstone Elsevier, USA
3. Histological and Histochemical Methods, Theory and Practice, 2008, 4th Edn., John A. Kiernan, Scion Publishing Ltd, UK
4. Basic Separation Techniques in Biochemistry, 1998, Okotore R. O., New Age International, New Delhi.
5. Cytological techniques: The Principles Underlying Routine Methods, 1963, Baker J.R, Methuen & Co, London
6. Davenport H. A.: Histological and Histochemical techniques.
7. Handbook of basic Microtechnique, 1958, 2nd Edn., Gray P., McGraw-Hill, USA
8. The microscope and how to use it, 1970, George Stehli, Dover Publications Inc., New York.
9. Histopathological technique and Practical Histochemistry, 1976, 4th Edn, Lillie R.D McGraw-Hill, USA
10. Staining methods (Histological and Histochemical), 1960, Mc Manus J. F. A. And Mowry R.W., Paul B. Hoeber, Inc.; Harper & Brothers, NY
11. Notes on Microscopical Techniques for Zoologist, 1964, Pantin C. F.A.: Cambridge University Press
12. Elementary Microtechnique, 1973, 4th Edn., Peacock H.A., Edward Arnold Publ. Ltd., UK
13. Histochemistry, 1968, Pearse A.G.E., Vol. I & II., W.B. Saunders Company (WBS) of Philadelphia
14. Microscope and microscopic life, 1979, 2nd Edn., Peter Healey, Hamlyn, UK
15. Biological Instrumentation and methodology, 2008, 2nd Revised Edition, P.K. Bajpai, S. Chand and Co. Ltd., New Delhi.

ZY- 342 (Paper II)

Mammalian Physiology & Endocrinology

Total lectures: 48

1 Introduction: Definition and scope 1

2 Nutrition: 6

2.1 Concept of nutrition and energy requirements

2.2 Physiology of digestion**:** digestive enzymes and their actions- salivary, gastric and intestinal digestion. Role of liver and pancreas in digestion

3 Circulation : 6

3.1 Cardiac Cycle- systole, diastole and pacemakers

3.2 Cardiac output and blood pressure

3.3 Definitions and significance of electrocardiogram, colour doppler, angioplasty, angiography, angina pectoris, and coronary bypass

4 Respiration: 5

4.1 Definition and types- Pulmonary and tissue respiration

4.2 Mechanism of transport of gases

(a) Transport of Oxygen- Oxyhaemoglobin formation

(b) Transport of Carbon-dioxide

(c) Respiratory Quotient and BMR

5 Excretion: 5

5.1 Physiology of Urine formation- ultrafiltration, reabsorption, tubular secretion

5.2 Counter-Current Multiplier theory for urine concentration

5.3 Role of ADH, and Renin angiotensin system

5.4 Definitions and clinical significance of- renal failure, renal calculi, dialysis

6 Muscles: 5

6.1 Ultrastructure of striated muscle

6.2 Sliding filament theory of muscle contraction – physical and chemical changes

6.3 Response of muscles to stimulation- simple muscle twitch, muscle fatigue and rigor mortis

7 Nervous Excitation: 5

7.1 Origin and conduction of nerve impulse, saltatory conduction

7.2 Synapse- ultrastructure and transmission of nerve impulse

7.3 Definitions/concepts: impulse, stimulation, conduction, response, EEG, epilepsy

8 Reproduction: 8

8.1 Reproductive cycles with hormonal control- estrous and menstrual

8.2 Hormonal control of pregnancy

8.3 Hormonal control of parturition and lactation

8.4 Hormonal control of male reproduction

9 Endocrinology: 7

9.1 Introduction

9.2 Mechanism of hormone action

9.3 Endocrine disorders: gigantism, acromegaly, dwarfism, diabetes insipidus, goiter, cretinism, myxodema, rickets, Addisson Disease, Cushing's syndrome

Reference Books

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

ZY -343 (Paper III)

Genetics and Molecular Biology

Total lectures: 48

1. Linkage, crossing over and molecular basis of recombination 5

2. Gene Mutation 6

2.1 Definition

2.2 Types of mutations: spontaneous, induced, somatic, gametic, forward, reverse. Types of point mutation- deletion, insertion, substitution, transversion, transition

2.3 Mutagenic agents.

a) UV radiation and ionising radiation

b) Base analogs, alkylating and intercalating agents

3. Population Genetics 5

3.1 Basic Concepts in population genetics: Mendelian population, gene pool, gene frequency, chance mating (Panmictic mating)

3.2 Hardy Weinberg law and its equilibrium

4. Molecular Biology

4.1. DNA as genetic material- evidences (Griffith's, Avery et al and Hershey and Chase experiment), RNA as genetic material-TMV 4

4.2. Chromatin-Heterochromatin, Euchromatin, histones, nucleosome arrangement, packaging of DNA 3

5. Central Dogma of Molecular Biology

5.1. DNA Replication-Semiconservative (Messelson and Stahl experiment) Mechanisim in prokaryotes and eukaryotes 5

5.2. **Transcription-** Transcriptional unit, RNA polymerase, transcription in prokaryotes and eukaryotes, post transcriptional modification (splicing- mRNA, modifications at 3' and 5' end) 5

5.3. **Translation-**Genetic code, properties of genetic code, ribosome structure [prokaryotes and eukaryotes], protein synthesis–initiation, elongation, termination and concept of post translational modification (glycosylation) 5

6. Concept of operon - regulation of gene action, Lac operon, Trp operon 5

7. Recombinant DNA Technology- 5

Introduction, restriction enzymes, cloning vector, PCR (polymerase chain reaction), DNA finger printing

Reference Books

1. Principles of Genetics, 1997, P. D. Snustad, M. L. Simmons J. B. Jenkins, John Wiley & Sons, USA
2. Genetics, 2014, 9th Edn., Verma P. S. and Agarwal V. K., S. Chand and Co., New Delhi
3. Genetics, 2014, 4th rev Edn., 3rd reprint, Gupta P. K., Rastogi Publications, Meerut
4. Genetics, 2004, 1st Edn. Sarin, C., Tata McGraw Hill, New Delhi.
5. Principles of Genetics, 2006, 8th Edn., Gardner E. J., Simmons M. J. and Snustad D. P., Wiley India Pvt Ltd
6. Genetics, 1997, 3rd Edn., D. L. Hartl, Jones and Bartlett Publishers, USA
7. Genetics, 1985, 3rd revised Edn., Strickberger M. W., Macmillan USA
8. Molecular Biology of the Cell, 2007, 5th Edn., Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Taylor & Francis, UK
9. Gene V & VI, 1994, Lewin Boxford University Press ,Oxford
10. Molecular Biology of the gene, 1993, Watson J. Hopkins, Roberts, Steitz and Weiner, Benjamin Cummings.
11. Text book of Molecular biology, 1994, K. ShivramaSastry, G. Padmanabhan & C. Subramanyan, Mc. Millan India.
12. Cell and molecular biology, 2010, 8th Edn., De Robertis EDP and De Robertis EMF Jr., Lippincott Williams & Wilkins, Philadelphia

ZY-344 (Paper IV)

Organic Evolution

Total lectures: 48

1	**Introduction.**	4
	1.1 Origin of life	
	1.2 Origin of eukaryotic cell (Origin of mitochondria , plastids & symbionts)	
2	**Evidences in favour of organic evolution:**	8
	Evidences from: anatomy, embryology, geographical distribution, palaentology, physiology, biochemistry, genetics and molecular biology	
3	**Theories of organic evolution**	8
	3.1 Lamarckism	
	3.2 Darwinism and Neo Darwinism	
	3.3 Mutation Theory	
	3.4 Modern Synthetic theory	
4	**Isolation:**	6
	4.1 Isolating mechanism	
	4.2 Classification of isolating mechanism: Pre-zygotic and post-zygotic	
5	**Speciation:**	4
	5.1 Types of speciation(Allopatric & Sympatric)	
	5.2 Mechanism of speciation	
	5.3 Patterns of speciation	
	5.4 Factors influencing speciation	
6	**Geological Time Scale**	4
7	**Animal Distribution:**	2
	7.1 Methods of distribution	
	7.2 Classification of animal distribution	
	7.3 Patterns of animal distribution	
	7.4 Factors affecting distribution	
8	**Antiquity of Man:**	7
	Evolution of anthropoids including man (Kenyapithecus to *Homo sapiens*)	
9	Zoogeographical Realms: With reference to fauna	5

Reference Books

1. Organic Evolution, Richard Swann Lull, Light & Life Publishers.
2. Introductions to Evolution, Paul Amos Moody, Kalyani Publishers, New Delhi.
3. Organic Evolution, 1991 T.S. Gopalkrishanan, Itta Sambashivarab Publ. House
4. Evolution, 1996 P. K. Gupta, Rastogi Publ., Meerut
5. Evolutionary Biology, 1990, Mohan P. Arora, Himalaya Publi. House, Delhi.
6. Evolution, 1968, E. O. Dodson, Reinhold Publ. Crop., New York.
7. The major features of evolution, 1953, Simpson G. G. Columbia, New York.
8. The origin of species, 1959, Charles Darwin, New American Library, New York.

ZY-345 (Paper V)

General Embryology

Total lectures: 48

1 Introduction: 4

1.1 Definition and scope

1.2 Theories of preformation, pangenesis, epigenesis, axial gradient and germ plasm

2 Concepts in Developmental Biology: 2

Growth, differentiation, dedifferentiation, cell determination, cell communication, morphogenesis, induction and regeneration

3 Gametogenesis: 8

3.1 General aspects and origin of germ cells

3.2 Sperm: general structure, mention variations with reference to Insect, Amphioxus, Frog, Bird and Human

3.3 Ultra structure of typical sperm. (entire, T.S. through head, middle piece and tail)

3.4 Spermatogenesis: phases & spermiogenesis (nuclear and cytoplasmic changes)

3.5 Oogenesis phases: growth phase- pre-vitellogenesis, vitellogenesis and post-vitellogenesis

3.6 Oocyte maturation: role of MPF (maturation promotion factor)

3.7 Ovum: general structure

3.8 Egg membranes: primary, secondary and tertiary

3.9 Types of eggs

4 Fertilization: 7

4.1 Concept and types

4.2 Attraction of gametes: sperm activation, chemotaxis (fertilizin and antifertilizin as enzymes and gamones as hormones)

4.3 Sperm penetration: acrosome reaction, capacitation & decapacitation

4.4 Activation of ovum: fertilization cone, polyspermy prevention: fast block (fertilization potential) & slow block (cortical reaction) & perivitelline space fertilization membrane

4.5 Amphimixis

4.6 Significance of fertilization

5 Cleavage 5

5.1 Mechanism

5.2 Planes and symmetry

5.3 Patterns / Types

5.4 Significance

6 Blastula: Definition and types 3

7 Gastrulation: 6

7.1 Concept

7.2 Basic cell movements in gastrulation: epiboly, emboly, convergence, invagination, ingression &involution (with reference to frog)

7.3 Organizer: primary, secondary, tertiary

7.4 Organogenesis: cell differentiation, tissue differentiation & organ formation up to rudimentary stage

8 Chick Embryology: 11

8.1 Structure of Hen's egg

8.2 Fertilization and cleavage

8.3 Gastrulation:

8.3.1 Formation of primitive endoderm

8.3.2 Primitive streak development

8.3.3 Head process and regression of Primitive streak

8.4 Development of nervous system up to 48 hours

8.5 Development of heart and blood vessels up to 48 hours

8.6 Development of digestive system up to 48 hours

9 Extra embryonic membranes 2

Reference Books

1. An Introduction to Embryology 2012, 5thEdn., Balinsky B. L., Fabian B. C. Brooks Cole Pub. Co., USA.
2. Developmental Biology: Patterns**,** principle and problems, 1982, Saunders J. W., Prentice Hall Coll Div.
3. Developmental Biology 1992 3rd den Browder L. W., Erickson C.A. & Jeffery W. R., Saunders college pub., London.
4. Developmental Biology, 2013, 10thEdn. Gilbert S. F., Sinauer Associates Inc.

ZY- 346 (Paper VI)

a) Public Health and Hygiene

Total lectures: 48

1	**Introduction and scope of public health**	1
2	**Health:**	4
	2.1 Definition, factors affecting health (inborn, environmental)	
	2.2 Personal and community health.	
	2.3 Effects of alcohol, tobacco and drugs	
	2.4 WHO and its programmes	
3	**Food:**	6
	3.1 Sources: Plants and Animals	
	3.2 Necessity: deficiency diseases	
	3.3 Beverages and condiments	
	3.4 Food preservation methods	
4	**Air and ventilation:**	3
	4.1 Composition of air	
	4.2 Purification of air	
	4.3 Ventilation system: natural and artificial	
5	**Water and water supplies:**	5
	5.1 Sources and properties of water, quality of water for human consumption	
	5.2 Process of purification of water- small scale and large scale	
	5.3 Slow sand or biological filtration of water and rapid sand or mechanical filtration of water	
6	**Soil:**	3
	Composition, properties and diseases spread by soil	
7	**Sanitation:**	5
	7.1 Definition and concept	
	7.2 Disposal of human and animal waste, refuse, sewage	
8	**Diseases:**	10
	8.1 Communicable diseases: causative organisms, signs and symptoms, modes of transmission, prevention and control measures of: influenza, chicken pox, measles, tuberculosis, leprosy, swine flu and encephalitis	

8.2 Non Communicable diseases: rheumatic heart disease, coronary heart disease and diabetes

9 Demographic Biostatistics: 4

9.1 Introduction

9.2 Purpose of data sampling

9.3 Methods of sampling

10 Epidemiology 3

10.1 Introduction

10.2 Epidemiologic methods

10.3 Causes of epidemiology

11 Social and Industrial hygiene: 2

11.1 Accident, emergencies in home and industries

11.2 Occupational disease (details of diseases not expected)

11.3 Provisions for disabled and mental hygiene

11.4 Bio-safety for disabled and mental hygiene

12 Radiation risk 2

Reference Books

1. A text book of preventive and social medicine 2011, 21st Edn., Park. K.,Banarsidas Bhanot Publishers, Jabalpur, India
2. Preventive and social medicine in India, 2013, 4th Edn., B. K. Mahajan, M. C. Gupta, Jaypee Brothers Medical Publishers, New Delhi, India
3. Medical Zoology and Medical Technology. R.C. Sobti, Shobanlal and Co., Jalandhar
4. Review in community medicine, 2006, 2nd Edn., V. V. R. Seshu Babu, Paras Medical Books Pvt. Ltd., Hyderabad.

ZY-346 (Paper VI)

b) Medical Entomology

Total lectures: 48

1	**Fundamentals of** Agricultural, Forest, Medical and Veterinary Entomology	02
2	**Introduction to medical entomology**	06
	2.1 Morphology and anatomy of insects	
3	**Veterinary entomology-** Insects as disease spreading agents in general	06
4	**Insects as social groups-**	06
	4.1 Definition, intraspecific and interspecific relationships among insects	
	4.2 Social organization in wasps and termites	
	4.3 Significance of social organizations	
5	**House hold insects in relation to human-**	12
	5.1 Cockroach	
	5.2 House cricket	
	5.3 Silver fish	
	5.4 Carpet beetles	
	5.5 Furniture beetles	
	5.6 Ants	
6	**Study of following insects as causing agents of human diseases- their classification up to family, appearance, habit, brief life history, distribution, diseases caused and control measures-**	16
	6.1 Mosquito	
	6.2 Flea	
	6.3 House fly	
	6.4 Bed bug	
	6.5 Louse	
	6.6 Tick	
	6.7 Mite	
	6.8 Blister beetle	

Reference Books

1. Social Insects: Their Origin and Evolution, 2006, W. M. Wheeler, Discovery Publishing House, Delhi
2. Lives of Social Insects, 1968, P. P. Larson, M. W. Larson, World Pub. Co.
3. Handbook of medical entomology, Riley W. A., Johannsen O. A., Comstock Pub., New York.
4. Medical and Veterinary Entomology, 1995, 2nd Edn., Kettle D. S., CABI, UK
5. Medical Entomology for Students, 2012, 5th Edn., Mike Service, Cambridge University Press, UK
6. Essentials of Parasitology, 2008, 8th Edn., Schmidt G. D., McGraw Hill.
7. Parasitology: Biology of animal parasites, 1982, 3rd Edition, Noble E. A. and Noble G. A., Lippincott Williams and Wilkins
8. A text book of preventive and social medicine 2011, 21st Edn., Park. K. Banarsidas Bhanot Publishers, Jabalpur, India.

ZY-347 (Practical I)

ZY -331 Paper I Animal Systematics and Diversity V

Practicals:

1	Study of external characters and digestive system of *Pila*	E
2	A. Study of Nervous system of *Pila*	E
	B. Temporary mounting of radula, osphradium and statocyst of *Pila*	E
3	Study of external characters and digestive system of *Calotes*	D
4	Study of arterial and venous system of *Calotes*	D
5	Study of nervous system of *Calotes*	D
6	A. study of male and female urinogenital systems of *Calotes*	D
	B. Temporary mounting of scales, pecten and hyoid apparatus of *Calotes*	D
7	Study of Spicules in sponges	D
8	Study of *Balanoglossus*-external characters, T. S. through proboscis, collar and trunk	D
9	Comparative study of	D

A. Scales in fishes: Placoid, Cycloid, and Ctenoid

B. Heart: *Scoliodon,* Frog, *Calotes*, Pigeon and Rat

C. Brain: *Scoliodon,* Frog, *Calotes*, Pigeon and Rat

10	Study of accessory respiratory organs in fishes: *Anabas, Labeo, Clarias*	D
11	Compulsory study tour to visit costal locality / Bio-diversity area / Hilly area / ponds/ lakes / tanks / zoo / museum / science center- prepare tour report and submit at the time of examination	

ZY-332 Mammalian Histology

Practicals:

1	Study of the different types of tissues with the help of permanent slides	D
2	Temporary mounting of tissues:	E

a) medullated nerve fiber b) striated muscle fiber

3	Study of permanent histological slides of skin, tooth, tongue, stomach, duodenum, ileum, liver, pancreas and any one salivary gland	D
4	Study of permanent histological slides of trachea, lung, kidney, testis, ovary, thyroid and adrenal	D
5	Study of human blood smear to observe different cells	E

ZY- 341 Biological Techniques

Practicals:

1	a) Principle & use of camera lucida	E
	b) Study of micrometer	E
2	Tissue collection & fixation. Block making	E
3	Sectioning, staining & mounting. Submission of any three permanent slides from three different organs	E
4	Total count of W.B.Cs.	
5	Principle and applications of colorimeter and spectrophotometer.	E
6	Separation of amino acid mixture by ascending paper chromatography.	E

ZY-342 Mammalian Physiology & Endocrinology

Practicals:

1	a) Estimation of haemoglobin	E
	b) Preparation of haemin crystals	E
2	To study the effects of various osmolarities on erythrocytes	E
3	To estimate the blood glucose level	E
4	Estimation of bleeding and clotting time	E
5	Study of any five disorders caused by endocrine glands with the help of photographs	E

Minimum 24 practicals be performed during the year

ZY-348 (Practical Course II)

ZY- 333 - Biological Chemistry

Practicals

1	Study of principle and working of pH meter and measuring pH of three samples	D
2	To study the effect of pH, temperature and inhibition on salivary amylase	E
3	Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests	E
4	Isolation of casein by adjusting isoelectric point	E
5	Study of preparation of standard acid and alkali and its standardisation	E

ZY- 334- Environmental Biology and Toxicology

Practicals:

1	**Study** of fresh water plankton (field collection, preservation and gross identification)	E
2	A visit to water body to study physiochemical properties of water. (Temperature, pH, turbidity, hardness, acidity and alkalinity) using analysis kit	E
3	Study of physiochemical properties of soil sample (using analysis kit)	E
4	Estimation of dissolved oxygen in water by winkler's method	E
5	Estimation of dissolved CO_2in water	E
6	Hypothetical problem to determine LC_{50} and LD_{50}	E

ZY-343- Genetics and Molecular Biology

1	Study of Hardy- Weinberg law with suitable recording of genetic traits	E
2	Temporary preparation of polytene chromosome from suitable material	E
3	Estimation of DNA by Diphenylamine method	E
4	Detection of DNA and RNA by Methylgreen Pyronin	E
5	Preparation of DNA paper model	E

ZY 344-Organic Evolution

Practicals:

1. Study of morphological similarities and differences between man and ape D
2. Study of types of fossils with the help of specimens/ charts/ photos D
3. Study of animal adaptations in: Turtle, Draco, Exocoetus, Bat and Parrot D
4. Study of evidences of evolution- embryological, palaentological, connecting links, morphology and comparative anatomy D
5. Study of successive stages of evolution of man: a) Australopithecus b) *Homo erectus* c) *Homo neanderthalis* d) Cro-magnon man e) *Homo sapiens* D
6. To record Zoogeographical distribution of animals to respective zoogeographical realms on the world map (Lung fishes, marsupials, flightless birds, Camel, Elephant, Ostrich etc.) E

ZY- 349 (Practical Course III)

ZY-335: Parasitology

Practicals:

1 Study of Life cycle of *Plasmodium vivax* and *Entamoeba histolytica* (whole mounts of life stages) D

2 Study of Life Cycle –*Ascaris lumbricoides* and *Taenia solium* (whole mounts of life stages) D

3 Study of morphology and pathogenicity of Head louse, Tick, Mite and blister beetle D

4 Study of vectors—mosquito, rat flea, house fly and bed bug D

5 To study rectal parasites of cockroach E

ZY-336 a) General Pathology

Practicals:

1 Study of pathogenic agents and pathological conditions with the help of suitable microscopic slides D

a) *Mycobacterium tuberculae*
b) *Mycobacterium leprae*
c) *Vibrio cholerae*
d) *Anthrax bacilli*
e) *Pneumococci* sp.
f) *Trypanosoma* sp.

2 Study of pathological conditions with the help of suitable microscopic slides D

a) Normal and diseased cell (Lung)
b) Fatty degeneration (Liver)
c) Cloudy degeneration/Swelling (Kidney)
d) Dying cell –necrosis (Liver)
e) Lung lobar pneumonia
f) Ovarian cyst
g) Thyroid goitre

3 Study of following pathological slides or specimens D

a) Carcinoma in situ eg. Human cervix

b) Malignant cell

c) Organized thrombus

d) Ovary fibroid tumour/carcinoma

e) Carcinoma of colon-cauliflower growth

f) Carcinoma of stomach

g) Liver cirrhosis

h) Breast fibrocystic disease

4. To detect the normal and abnormal constituents of urine E

5. Study of Gastric juice analysis by Toffler's reagent (alcoholic solution of dimethylamino-azobenzol methyl orange indicator). E

6. Visit to medical college/hospital/pathological laboratory

OR

ZY-336: b) Paper VI- Cell biology

Practicals:

1	Study of detection of mitochondria by Janus Green B	E
2	Study of permanent slides of mitosis & meiosis	D
3	Study of temporary preparation of different mitotic stages from onion root tip cells	E
4	To study the effect of Colchicine on mitosis	E
5	Study of temporary preparation of different meiotic stages from grasshopper testis / Tradescantia/ Onion floral bud	E

ZY-345 General Embryology

Practicals:

1	Study of sperm smear (any one animal), types of eggs (insect, amphioxus, frog and hen)	D
2	To study the types of blastulae and gastrulae (amphioxus, frog and hen)	D
3	Study of whole mount slides of chick embryology – 24h, 33hr and 48 hr	D
4	To study the sections of chick embryo--24hr, 33hr and 48 hr	D
5	Ex-ovo culture of chick embryo	E
6	Temporary preparation of chick embryo	E

ZY-346 – a) Public Health and Hygiene

Practicals:

1	To detect adulterants in the food samples by appropriate tests	E
2	To study the food preservation methods	E
3	Study of housefly, cockroach, ants and rats with reference to public health and hygiene	D
4	A compulsory visit to water purification / sewage treatment /effluent treatment plant	D
5	Testing potability of water for human consumption by MPN method	E
6	Any suitable example of measurement of dispersion (Mean deviation or Standard deviation)	E

OR

ZY-346 -b) Medical Entomology

Practicals:

1	Study of interrelationships of insects and man (Any three)	D
2	Study of household insects in relation to human health	D
3	Study of social insects- honey bee and termites	D
4	Temporary preparation of mouth parts of harmful insects—mosquito, bed bug and house fly	E
5	To study control methods of harmful insects with suitable examples (biological control measures, repellants, fumigation, dusting, netting)	D