

UNIVERSITY OF PUNE
Semester wise course structure and revised draft of syllabus for
T.Y.B.Sc. Zoology w.e.f. the Academic Year 2010-2011.

T.Y.B.Sc. Zoology Semester III

Paper	Course Title	Marks
ZY-331	General Zoology	50
ZY-332	Mammalian Histology	50
ZY-333	Biological Chemistry	50
ZY-334	Environmental Biology and Toxicology	50
ZY-335	a) General Pathology	50
	OR	
	b) Basic Entomology	50
ZY-336	Cell Biology	50

T.Y.B.Sc. Zoology Semester IV

Paper	Course Title	Marks
ZY-341	Biotechnology	50
ZY-342	Mammalian Physiology and Endocrinology	50
ZY-343	Molecular Biology	50
ZY-344	Organic Evolution	50
ZY-345	a) Public Health and Hygiene	50
	OR	
	b) Biodiversity	50
ZY-346	Genetics and Developmental Biology	50
ZY-347	Practical Course I Related Practicals from ZY-331, ZY-332, ZY-341, , ZY-342.	100
ZY-348	Practical Course II Related Practicals from ZY-333, ZY-334, ZY-343, ZY-344.	100
ZY-349	Practical Course III Related Practicals from ZY-335, ZY-336, ZY-345, ZY-346.	100

For T.Y.B.Sc. Zoology class there will be twelve theory papers of 50 marks each and three practical courses of 100 marks each. Six theory papers (from ZY-331 to ZY-336) will be taught in first term for semester III and remaining six theory papers (from ZY-341 to ZY-346) will be taught in second term for semester IV. The practical courses I, II, III (ZY-347 ZY-348, ZY-349) will be conducted and completed through out the academic year. For theory papers examination will be conducted semester-wise, while for practical courses (I, II, III) the practical examination will be conducted at the end of the academic year. For each theory paper, there shall be University examination of 40 marks and 10 marks for internal assessment in each semester. So each theory paper will be of 50 mark The practical courses I, II, & III each of 100 marks. The university practical examination of each course will be of 80 marks and 20 marks for internal assessment.

T.Y.B.Sc. Zoology
Theory University Question Paper Pattern

Total: 40 Marks

Time Allotted: 2 Hours

- Que. 1 Ten marks should be allotted to objective type questions. There should be ten sub-questions. All sub-questions are compulsory and shall be based on entire syllabus. Each sub-questions for one mark.
- Que.2 There should be three sub-questions. Each sub-question of 5 marks. Student will be asked to attempt any two.
- Que.3 There should be four sub-questions. Each sub-question of 5 marks. Student will be asked to attempt any two.
- Que. 4 Long essay type answer question for 10 marks. Student will be asked to attempt any one out of two such questions.

General Guidelines
While Setting University Question Papers.

1. Repetation of questions should be avoided.
2. Question should be testing conceptual knowledge and understanding of the basic concepts of the subject.
3. Question paper should cover the entire syllabus

Internal Assessment and Question Paper

For comprehensive continuous internal assessment of students by the respective teachers, teaching the course shall be evaluate the student on the basis of written test comprises of (1) MCQ (2) True/False (3) Basic definitions (4) Single line answers. Students be asked to answer 20 questions in 40 minutes. Each question will be for ½ marks. In the classroom, different sets of equivalent sets of question papers may be experimented. It will be preferred two such tests per course and average be considered for internal marks. If teacher have prefer to have one test only, it should be at the end of the term covering entire syllabus.

ATKT (as earlier)

1. Student shall clear 8 heads of passing (out of 12 such heads) while going from F.Y.B.Sc. to S.Y.B.Sc., however he must pass in all F.Y.B.Sc. subjects while going to T.Y.B.Sc.
2. Student shall clear 12 heads of passing (out of 20 such heads) while going from S.Y.B.Sc. to T.Y.B.Sc.

University Of Pune
Equivalences for the Old Courses with New Courses in Zoology
Semester III

	Papers in Old Course		Equivalent papers in new Course
Z0331	Animal Systematic & Diversity	ZY331	General Zoology
Z0332	Histology Of Mammals	ZY332	Mammalian Histology
Z0333	Environmental Biology And Toxicology	ZY334	Environmental Biology And Toxicology
Z0334	Any One Of The Following a. General Entomology b. General Pathology c. Dairy Science d. Computer Applications	ZY335	Any One Of The Following a. Basic Entomology b. General Pathology
Z0335	Cell-Biology	ZY 336	Cell Biology
Z0336	Biological Chemistry & Biotechniques	ZY333	Biological Chemistry

Semester IV

Z0341	Genetics	ZY 341	Biotechnology
Z0342	Physiology & Endocrinology Of Mammals	ZY 342	Mammalian Physiology And Endocrinology
Z0343	Zoogeography, Paleontology And Evolution	ZY 344	Organic Evolution
Z0344	Any One Of The Following a. Economic Entomology b. Public Health & Hygiene c. Aquaculture d. Bioinformatics	ZY 345	Any One Of The Following \ a. Biodiversity b. Public Health & Hygiene
Z0345	Molecular Biology	ZY343	Molecular Biology
Z0346	Developmental Biology	ZY346	Genetic & Developmental Biology
Z0347	Practical I Z0331, Z0332 Z0341, Z0342	ZY347	Practical I ZY331, ZY332 ZY341, ZY342
Z0348	Practical II Z0333, Z0334 Z0343, Z0344	ZY348	Practical II ZY333, ZY334 ZY343, ZY344
Z0349	Practical III Z0335, Z0336 Z0345, Z0346	ZY349	Practical III ZY335, ZY336 ZY 345, ZY346

ZY 331: Paper I
General Zoology

Total lectures - 45

1. Study of following following groups with reference to : (5)

- 1.1 Arthropoda : Larval forms in Crustacea
- 1.2 Mollusca : Torsion
- 1.3 Hemichordata : Affinities.

2. Study of *Pila* with references to the following: (10)

- 2.1 Systematic position, habit and habitat, external characters,
- 2.2 Organs of pallial complex
- 2.3 Functional anatomy: - digestive, circulatory, respiratory, excretory,
reproductive system, nervous system and sense organs.

3. Comparative study with reference to the following topics in the vertebrates: (10)

- Heart : Structure of heart of *Scoliodon*, Frog, *Calotes*, Pigeon and Rat
- Kidney : Evolution of Archinephros, Pronephros, Mesonephros, Metanephros .
- Evolution of : Aortic Arches
- Brain : Morphological variations in the different regions of the brain of *Scoliodon*, Frog, *Calotes*, Pigeon and Rat

4. Study of following groups with reference to: (8)

- Pisces : Electric organs, Dipnoi, Accessory respiratory organs.
- Amphibia : Neoteny and paedogenesis
- Reptilia : General characters of Rhynchocephalia
- Mammalia : Dentition in Mammals

5. Study of *Calotes* with references to the following: (12)

- 5.1 Systematic position, habit and habitat, external characters,
- 5.2 Functional anatomy: - digestive, circulatory, excretory,
reproductive, nervous system and sense organs.

Reference book:

1. Living invrtebrates, 1987: Pearse/ Buchshaum, Blackwell Scientific Publication, California.
2. A text book of zoology Invertebrates, vol. I 1992, 7th edn. Parker and Haswell edited by marshall and William, CBS publishers and distributors , New delhi.
3. Invertebrate zoology, 1992; E.L.Jorden, S. Chand and Co.,New delhi.
4. Life of invertebrate, 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 6th edn.. 1992, R.L.Kotpal, Rastogi publ.,Meerut.
7. Invertebrates structure and function, 2nd edn. 1992, R.L.Kotpal, Rastogi publication,Meerut.
8. Invertebrate zoology, 1982, R.D.Barnes; Saunder college, Philadalphia.
9. The protochordata, 1972, K.Bhatia, Central Book Depot, Allahabad.
10. Invertebrate zoology , 1991, Meglitsch P.A. and Ssharm F.R. Oxford University Press; U.K.
11. Invertebrata : New synthesis , 1988, Barnes R.S.K.Calow P. and Olive P.J.W.,Blackwell Scientific , U.K.
12. Invertebrate zoology 1987, 5th edn. Barnes R.D.Saunders College Publishing U.S.A.
13. Introduction to protochordata, 1990, S.H.Bharmrah and Kavita Juneja, Anmol publication, New Delhi.
14. The Invertebrates : Protozoa through Ctenophora Vol.I, 1959,McGraw – Hill Book Co., Inc. New York.
15. A text book of Zoology, Vol. II, 1990,T.J. Parker and W.A.haswell, Low price publication, Delhi.
16. Chordata zoology, 1982, P.S.Dhami and J.K.Dhami, R.chand and Co.,New Delhi.
17. Modern text book of zoology, 1992, R.L.Kotpal,Rastogi publication meerut.
18. Text book of zoology, vertebrates , Vol.II, T.J.Parker and W.A.Haswell, Edited by Marshall and Williams,CBS publications, New Delhi.

19. The life of vertebrates, 3rd edn.1993, J.Z.Young, E.L.B.S.,Oxford.
20. The phylum chordate, 1987, H.H.Newman, Distributor Satish book enterprise, Agra,
21. A text book of zoology, 1984, R.D.Vidyarthi, S. Chand and Co., New Delhi.
22. Chordate zoology, E.L.Jorden, S,Chand and Co., New Delhi.
23. The anatomy of Garden Lizard, S.Y.Paranjape, Pune University Publication, Pune.
24. Comparitive anatomy of the vertebrates, G.C.Kent.
25. Invertebrate Practical Zoology; S.S. Lal,
26. Vertebrate Practical Zoology; S.S.Lal.
27. A text book of Invertebrate Practical Zoology by R.L.Kotpal.
28. A text book of Vertebrate Practical Zoology by R.L. Kotpal.
29. Practical Zoology: Non chordate and Chordate by Sharma.

ZO-332: Paper II
Mammalian Histology

Total lectures - 45

- 1. Introduction.** (2)
 - 1.1. Definition and scope.
- 2. Tissues:** (3)

Definitions and review of different types.
- 3. Histological study of following organs.**
 - 3.1 Skin (V.S.) (2)
 - 3.2. Tooth (V.S.) (1)
 - 3.3. Tongue (C.S.) with reference to mucosa papillae and taste bud. (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 exocrinal and endocrinal 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.) (1)
 - 3.8. Kidney (L.S.) ,structure of nephron and juxta glomerular 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. (4)
- 4. Histology of endocrine glands:** 1)Pituitary. 2) Thyroid 3)Adrenal. (5)
- 5. Microtechnique:** (5)
 - 5.1 Histological localization of lipids, carbohydrates and proteins in different tissues.
 - 5.2 Histochemical staining for carbohydrates (PAS), protein(Millon's staining method)
and lipids (Sudan black-B method) and Fulgen nuclear staining for DNA.

Reference Books

1. Bailey Text book of Histology, 1971, 16th edn. Wilfred M.Copenhaver
Richard P.Bung & Mary bartell Bunge, The William & Wilkins compay
Baltimore.
2. Histology 979, 8th edn. Arthur W.Ham. David H. Cormark. J.B.
Lippincott. Co.Philadelphia.
3. A text book of Histology , 1991 2nd edn. Krishan Garg. Indira Bahl &
Mohini Kaul CBS publication & Distributors Delhi.
4. Histology, 1973 3rd edn.,. R.D.Greep & L.Weill, McGraw Hill Int. Book C.
New York.
5. Histology of Mammals 183 Athawale & Latey, Narendra Prakashan, Pune.
6. Hand book of Basic Mictotechnique, 1964, 3rd edn. Peter Gray McGraw
Hill Book Co. New York.
7. Hand Book of Histological & Histochemistry Technique, 1991, 1st edn.
S.K.David, CBS publisher & Distributors, Delhi.

ZY- 333: Paper III
Biological Chemistry

Total lectures - 45

1 Basic biochemistry : (8)

- 1.1 Chemical bond: Types of bonds, covalent bonds (peptide and disulphide bonds), noncovalent bonds (hydrogen bonds, hydrophobic bonds, electrostatic bonds, Vander wals forces), their functions in biomolecules.
- 1.2 Water : Structure of water molecule, physico-chemical properties
- 1.3 Colloids : definition, properties, types, uses.
- 1.4 Concept of Bronsted acid and base, Concept of pH, Sorensen scale, Henderson – Hasselbalch equation , Measurement of pH (indicator, pH paper, pH meter)
- 1.5 Buffer: Types of buffers, buffering capacity, Biological buffer systems: Phosphate and bicarbonate (acidosis, alkalosis), and Hb

2 Biomolecules : Concept of Micromolecules, Macromolecules. (5)

- 2.1 **Carbohydrates:** Definition, classification, stereochemical properties, physical and chemical properties, structure of common monosaccharide, disaccharides, polysaccharides (homo & heteropolysaccharides), their biological importance.
- 2.2 **Amino Acids and Proteins:** Basic structure of amino acid, essential and (8) nonessential amino acids, classification of amino acids
Properties related to functional group (NH_2 , COOH , R group): solubility, acid-base behaviour, titration of amino acids, optical properties
 NH_2 group : salt formation, Sorenson's formal titration, methylation, reaction with HNO_2 , Sanger's reagent, PITC, Ninhydrin
 COOH group : ester formation, decarboxylation, amide formation,
R group Peptides ,their importance.
Protein structure : primary, secondary, tertiary, quaternary, Types of proteins

- 2.3 Lipids (6)
- Definition, classification of lipids with examples,
physical and chemical properties of lipids: saponification,
hydrogenation, oxidative rancidity.
Fatty acids : saturated and unsaturated, essential fatty acids
biological and clinical significance of lipids(obesity, arthrosclerosis,
myocardial infarction).
- 3. Enzymes :** 3.1 Classification and properties, (8)
regulatory and nonregulatory enzymes
3.2 Enzyme kinetics and its importance (MM equation, LB equation)
Enzyme inhibition – reversible and irreversible and their types.
3.3 Factors affecting enzyme activity –enzyme concentration, substrate
concentration pH, temp., activators and inhibitors, Allosteric enzymes
and their co-operative behaviour, holoenzyme, apoenzyme, prosthetic
group, coenzyme, Immobilize enzyme Isoenzymes,
clinical significance of enzymes
- 4 Vitamins:** 4.1 Introduction, study with reference to occurrence, biochemical (8)
function and deficiency, water soluble vitamins –B1, B2, B6, B12,
nicotinic acid, folic acid, lipoic acid ,biotin, pantothenic acid,
ascorbic acid .Fat soluble vitamins – A, D, E, K; Hypervitaminosis
4.2 Minerals: with reference to sources, biological functions and (2)
deficiency: Na, K, Ca, Mg, Fe

Reference books :

1. Principles of Biochemistry, 1993, 2nd & 3rd edn. Lehninger A.L. Nelson D. L. and Cox. M.M. CBH publisher and distributors, Delhi.
2. Biochemistry, 1995, 5th edn. Zubay G. Wm. C.Brown communication U.S.A.
3. Harper's Biochemistry 1996, 26th edn. Murray R.K. Granner D.K. Mayes P.A. and Rodwell V.W. prentice. Hall international U.S.A.
4. Outlines of Biochemistry 1955, 5th edn. Conn E.E. stumph P.K. Bruening G. and Doi R.H. John Wiley and Sons U.S.A.
5. Principles of Biochemistry 1993, 1st edn. Pattabiraman T.N. Gajanan Book publishers and Distributors Bangalore.
6. Clinical Biochemistry, 1994, B.P.Godkar, Bhalani Publishing house, Bombay.
7. Biochemistry 1990, 8th edn. D. Voet and J.Voet Willey, New York.
8. Biochemistry 1994, 5th edn. Stryer, sanfrancisco W.H.Freeman and co.
9. Fundamentals of Bio chemistry- Jain, Jain, Jain – S. Chand and Co.

ZY-334: Paper IV
Environmental Biology and Toxicology

Total Lectures: 45.

- 1. Environmental Biology** (2)
 - 1.1 Introduction
 - 1.2 Definition, basic concepts and scope.
- 2. The Ecosystem** (8)
 - 2.1 Definition, abiotic and biotic components and their interrelationship.
 - 2.2 Nutrient cycles in ecosystem. atmospheric cycles & edaphic nutrient cycles.
 - 2.3 Energy flow in ecosystem and flow models.
 - 2.4 Major Ecosystems
 - 2.4.1 Natural ecosystem: fresh water eg. pond water, Forest.
 - 2.4.2 Artificial ecosystem: crop land.
 - 2.5 Food chain in ecosystem and food web.
 - 2.6 Ecological pyramids.
- 3. Environmental Pollution:** (8)
 - 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 pollutants, their effects.(biodegradable, non biodegradable)
 - 3.4 Air pollution and its relation with the following.
 - 3.4.1 Acid rain
 - 3.4.2 Green house effect
 - 3.4.3 Ozone layer.
 - 3.5 Water pollution: definition, sources of water pollutants, their effects on ecosystem
Community waste with reference to following.
 - I. Sewage.
 - II. Industrial wastes.
 - .III. Agricultural waste
 - 3.6 Land / Soil pollution: definition, sources of land / soil pollutants, their effects.
 - 3.7 Noise pollution: definition, sources of noise pollutants, their effects and control measures.
- 4. Environment and Development.** (4)
 - 4.1 Bioindicators and environmental monitoring.
 - 4.2 Environmental challenges in India: land degradation, population explosion, urbanization and industrialization
 - 4.3 Efforts to meet the environmental challenges.
- 5. Natural Resources and Conservation:** (4)
 - 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 , threatened species.
- 6.4 Wild life conservation

7. Environmental Education: (3)

- 7.1 Goals and objectives.
- 7.2 Role of environmental organizations & agencies.

8. Toxicology of pollutants: (3)

- 8.1 Introduction definition and scope.
- 8.2 Basic tests for
 - i) Air pollutants.
 - ii) Water pollutants.
 - iii) Soil pollutants.

9. Toxicants and Toxicity: (5)

- 9.1 Definition and types.
- 9.2 Factors influencing toxicity (pH, temperature, reproductive status, ages, physiological state).
- 9.3 Dose, LD50, LC50, effects & types of effects, response.

10. Toxicants of Public Health and Hazards: (3)

- pesticides, heavy metals, fertilizers, food additives and radioactive substances.

Reference Book:

1. Ecology and environment, 1996, P. D. Sharma, Rastogi Publ. Meerat.
2. Environmental Biology, 1996, P. S. Sharma and V.K.Agrawal, S.Chand and Co. New Delhi.
3. Ecology, 1995 Mohan P Arora Himalaya Publ. House Delhi.
4. Fundamentals of ecology, 1993 M.C. Dash, Tata Megrew Hill, New Delhi.
5. Elements of ecology, George L. Clarke, John Wiley and Sons, New York.
6. Ecology of Natural resources, 1995 John Wiley and Sons, New York.
7. Concepts of Ecology, 1996, E.J. Koprmondy, Pentice Hall of India.New Delhi.
8. Modern concepts of Ecology , H. D. Kumar, vikas Publi. House, New Delhi
9. Ecology, E. P. Odum, Oxford & IBM Publi.Co. New Delhi.
- 10 Environmental problems and Solution, D. K. Asthna, Meera Asthana, S.Chand Publi. Ramnagar, New Delhi.
11. P.D. Sharma Toxicology, Rastogi Publi. Meerut.
- 12 R. Kumar, Pollution and Health hazards in India. Ashish Publi. House, 8/81 Panjab Bagl, New Delhi-110026.
13. M. A. Subramanian, Toxicology – Principals and Methods, MJP Publishers, Chennai.
14. A. Albert, Selective Toxicity, Rastogi Publi. Meerut.
15. M.Satake, Y. Mide, Environmental Toxicology, M.S. Sethi, S.A. Iqbal Discovery Publi. House, New Delhi.
16. E.J. Ariece, Simonis, Introduction to General Toxicology, Academic Press, London.

ZY-335: Paper V
a) General Pathology

Total Lectures: 45.

- 1. Introduction:** (4)
 - 1.1 Definition, scope and basic branches.
 - 1.2 Applied pathology, biopsy and surgery.
 - 1.3 Autopsy pathology, 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:** (3)
 - 3.1 Infectious diseases: aetiology, infectious agents, viruses-hepatitis, bacteria- tuberculosis, fungi-skin diseases.
- 4. Retrogressive changes:** (4)

Definition, cloudy (changes) swelling, degeneration, fatty degeneration, mucoid degeneration, amyloid degeneration.
- 5. Disorders of pigmentation:** (2)
 - 5.1 Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice.
- 6. Disorders of mineral metabolism:** (3)

Calcification, normal calcium metabolism, important function or role of calcium and pathological calcification (dystrophic and metastatic and its effects).
- 7. Necrosis:** (3)
 - 7.1 Definition and causes.
 - 7.2 Nuclear and cytoplasmic changes.
 - 7.3 Types of necrosis.
- 8. Gangrene:** (3)
 - 8.1 Necrosis superadded by putrefaction.
 - 8.2 Types: dry, moist and gas gangrene.
- 9. Circulatory disturbances:** (7)
 - 9.1 Hyperaemia; active and passive (causes and effects).
 - 9.2 Ischaemia: causes and effects.
 - 9.3 Haemorrhage: causes, types and haemorrhagic effects.
 - 9.4 Thrombosis: thrombus formation and its causes and effects.
 - 9.5 Embolism: Definition, sources, types and effects.
 - 9.6 Oedema: Definition, factors (involving), causes and types.
 - 9.7 Infraction: causes, types and effects.
- 10. Inflammation:** (5)
 - 10.1 Definition and causes, cardinals of inflammation (signs), vascular phenomenon and cellular response.
 - 10.2 Acute and chronic inflammation.

11. Repair: (4)

11.1 Process of repair.

11.2 Types: by regeneration and by connective tissue proliferation.

11.3 Healing: primary and secondary.

12. Neoplasia: (3)

12.1 Tumours: histopathological identification of benign and malignant.

12.2 Leukemia: acute and chronic.

Reference Book:

1. A text book of pathology, 1996, Day N.C. and Day T.K.; New central book agency, Kolkotta.
2. General Pathology, Vol. I & II 5th edn. Bhende Y.M. and Deodhar S.G.; Bombay Prakashan, Mumbai.
3. Medical Pathology by Gayton.
4. Pathology by Kumar and Robins.

OR
ZY-335: Paper V
b) BASIC ENTOMOLOGY

Total Lectures : 45

- 1. Introduction:** (4)
- 1.1 Definition, distinguishing features of Insects.
 - 1.2 Importance & Scope for Entomology.
 - 1.3 Branches of Entomology : Agricultural, Medical, Forest, Forensic & Industrial .
- 2. Body covering:** (2)
- 2.1 Integument structure & function.
 - 2.2 Cuticular processes & appendages.
- 3. Body organization:** (15)
- 3.1 Head :** General morphology & it's articulation patterns.
 - 3.1.1 Antenna : Basic structure & types.
 - 3.1.2 Eyes : Location, structure & functions of ocelli & compound eyes.
 - 3.1.3 Mouth parts : Basic types.
 - 3.2 Thorax:** Segmentation & various sclerites.
 - 3.2.1 Leg : Structure of typical leg & it's modifications (fossorial, cursorial, saltatorial, natatorial, clasporial, raptorial & suctorial).
 - 3.2.2 Wing : Basic structure & wing venation in a generalized insect, wing coupling structures, flight mechanism & wing modifications (Tegmina, Elytra, Hemelytra, Halteres, Brachypterous & Hairy fringed wings)
 - 3.3 Abdomen :** Segmentation & sexual dimorphism
 - 3.3.1 Abdominal appendages: Pregenital & genital appendages
- 4. Sensory receptors:** (3)
- General account of tactile, auditory, olfactory, gustatory, hygro & thermal receptors.
- 5. Insect metamorphosis:** (6)
- 5.1 Definition & types of metamorphosis (ametabola, hemimetabola, paurometabola & hypermetabola)
 - 5.2 Hormonal control of metamorphosis.
 - 5.3 Structure of insect egg & types of eggs, larvae & pupae.
- 6. Insect pheromones:** (3)
- 6.1 Definition & importance of pheromones.
 - 6.2 Types of pheromones : Alarm, aggregation, trail making, releaser, primer & sex pheromones

7. Bioluminescence in insects: (4)

- 7.1 Definition with examples of insects.
- 7.2 Structure of light producing organ & it's mechanism.
- 7.3 Significance of bioluminescence in insects.

8. Sound production in insects: (3)

- 8.1 Structure & mechanism of sound producing organs in cicada & crickets.
- 8.2 Significance of sound production in insects.

9. Insect biotechnology: (5)

General introduction

- 9.1 Use of insects in tissue culture & genetic studies as model animals.
- 9.2 Use of insects as biological weapons.
- 9.3 Importance of insects in medicines & cosmetics.

Reference Book:

1. Imm's General Text book of Entomology Vol. I & II (1993), Richards O.W. & Davis R.F., B.I. Pul (Indian edition) New Delhi.
2. Principals of insect morphology, Snodgrass R.E. (1994) Indian Reprint, SBS Pub. New Delhi.
3. Structure & functions of Insects. Chapman R.F. (1983), 3rd edition, ELBS, London.
4. Entomology, Gillott Cedric (1980), Plenum Press, New York.
5. The Science of Entomology, Romoser W.S. (1981) 2nd edition, Mac millon Co., New York.
6. General Entomology, Mani M.S. (1998) Reprint Oxford- IBH, India.
7. An Introduction to Entomology, Srivastav R.D. & Singh R.P. (1997), Concept Pub. New Delhi.
8. General & Applied Entomology, Nayar K.K., T.N. anantkrishanan & B.V. David, (1983), tata McGrow Hill, Pub. New Delhi.
9. Insects, Mani M.S. (2006) Reprint NBT Pub. New Delhi.

ZY-336: Paper VI
Cell biology

Total lectures: 45

- 1. Introduction to cell biology:** (2)
 - 1.1 Definition and scope
 - 1.2 Generalized 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-Dawson) and Fluid Mosaic.
 - 2.3 Membrane receptors
 - 2.4 Modifications: Microvilli, Desmosomes and Plasmadesmata.
 - 2.5 Transport: Passive and Active.
 - 2.6 Pinocytosis, Phagocytosis and secretion.
- 3. Endoplasmic reticulum:** (3)
 - 3.1 Discovery, 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 microsomes
 - 5.3 Functions
- 6. Mitochondria:** (3)
 - 6.1 Origin, occurrence and morphology
 - 6.2 Ultrastructure and functions (explanation of cycles not expected)
- 7. Nucleus:** (6)
 - 7.1 Size, shape, 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. Microtubules and microfilaments:** (3)
 - 8.1 Microtubules: Ultrastructure, biochemical composition and functions
 - 8.2 Microfilaments: Location, chemical composition and functions
- 9. Cell cycle and cell division:** (5)

Mitosis, meiosis and various phases of cell cycle. Role of centriole in the cell division.
- 10. Cell adhesion:** cell to cell contact and cell movements. (2)
- 11. Cellular ageing and cell death:** (4)
 - 11.1 Concept of ageing theories:
 - 11.1.1 Intracellular changes: Free radicals, somatic nutrition, immunological, clonal selection and errors in DNA and RNA functions.
 - 11.1.2 Extra cellular changes.

11.2 Cell death:

Apoptosis: Definition and significance

Necrosis: Definition and examples

Necrobiosis: Definition and examples.

12. Cancer cell:

(5)

12.1 Characteristics

12.2 Theories/ hypothesis regarding causes of cancer

12.2.1 Extrinsic causes: Physical. Chemical and biological agents(viruses).

12.2.2 Intrinsic causes: Somatic mutations ,oncogenes and ageing related phenomenon.

Reference Book:

1. Cell and molecular biology, 1988, De Robertis EDP and De Robertis EME, Molt Saunders Inc.
2. Cell biology, 1986, C. B. Powar, Himalaya Publi. House.
3. Cell and molecular biology, 1968, Dupraw I, Academic Press New York.
4. Cell biology, 1986, Avers C.J. Addison Wesley Puub. Co. New York & London.
5. Cell and molecular biology, 1996, G.Carp John Waley,USA.
6. Cell biology, 1993,David E. Sadava Johnes and Bartlett Publi. London.
7. Cell Structure and Function, 1991, 3rd edn, A.G. Lowey & Siekevitz, J.R. Menninger & J.A.N. Gallew, Saunder college Publi. Philadelphia.

T.Y.B.Sc. Zoology Semester IV

ZY-341: Paper I
Biotechnology

Total Lectures: 45

- 1. Introduction & Scope of biotechnology.** (2)
- 2. Recombinant DNA technology.** (3)
Introduction, Restriction enzymes, cloning vectors (plasmids, bacteriophages, cosmids), PCR technique, Blotting techniques, (Southern blotting, Northern blotting and Western blotting), ELISA, Application towards living systems.
- 3. Animal cell and tissue culture.** (10)
Introduction, advantages and disadvantages, laboratory facility for tissue culture, culture media, culture procedure, cell culture and cell lines, somatic cell fusion, organ culture, pharmaceutical applications of animal cell culture.
- 4 Hybridoma technology.** (10)
Production of Monoclonal & Polyclonal antibodies.
Transgenic animals : - Value of transgenic animals, method of creation of transgenic animals (physical, chemical, virus and bacteria mediated) and its applications.
Stem cell bioengineering/technology : - Division of stem cells, biological role and properties of stem cells, types of stem cells and applications (cell replacement therapy, cardio-vascular therapy, haemopoiesis, diabetes and liver therapy)
- 5. Advance biotechnology .** (6)
Aquaporin structure, artificial intelligence, biosensors, hydroponics, nanotechnology.
- 6. Biopesticides.** (8)
Advantage of biopesticides,
Microbial and antimicrobial pesticides (Bacteria / Virus/ Fungi as pesticides)
Natural pesticides, Nematode biopesticides.
- 7.Industrial fermentation.** (6)

Introduction, fermentation technology, (fermenters, selection of microbes, fermentation medium), Penicillin production, Riboflavin, Amylase production (bacterial alpha amylase)

Reference Book:

1. Biotechnology by Trehan.
2. Comprehensive Biotechnology 4th edn., 2009, K.J. Ramawat and Shaily Goyal, S. Chand & company.
3. Principles of biochemistry 3rd and 4th edn., Lehninger.
4. Genetic Engineering University press, Science source books.
5. Experimental biotechnology, P.M. Philopose, Dominant publishers and distributors, New Delhi.
6. Culture of animal cells, R.I. Freshney 4th edn.
7. Pharmaceutical microbiology, Experiments and techniques, 2nd edn. C.R. Kokare.

ZY-342: Paper II
Mammalian Physiology and Endocrinology

Total lectures: 45

- 1. Definition and scope.** (1)
- 2. Nutrition:** (8)
 - 2.1. Physiology of digestion: Names of digestive enzymes and their actions—salivary, gastric and intestinal digestion .Role of liver and pancreas.
 - 2.2. Metabolic pathway:
 - 2.2.1 Carbohydrates - glycogenesis, glycogenolysis, gluconeogenesis, glycolysis, Kreb's cycle, ETS.
 - 2.2.1 Lipids - Fatty acid beta oxidation.
 - 2.2.3 Proteins - Deamination, transamination, decarboxylation, transmethylation.
 - 2.2.4 Integration of carbohydrate, lipid and protein metabolism.
- 3. Circulation:**
 - 3.1. Cardiac cycle – systole, diastole, pacemakers. (4)
 - 3.2. Definitions and clinical significance of- ECG, Eco-cardiograph, color Doppler, angiography, angioplasty, angina pectoris, heart attacks, coronary bypass.
- 4. Respiration:** (3)
 - 4.1. Mechanism of transport of gases
 - a) Transport of oxygen—oxyhaemoglobin formation.
 - b) Transport of carbondioxide in the form of --- physical solution of carbonic acid, carbamino compounds and bicarbonate ions or chloride shift.
 - 4.2. Respiratory quotient and BMR.
 - 4.3. Respiratory disturbances –Definitions - Apnoea, dyspnoea, arterial hypoxia, hypo- and hypercapnia, asphyxia.
- 5. Excretion:** (4)
 - 5.1. Physiology of urine formation—ultrafiltration, selective reabsorption, tubular secretion.
 - 5.2. Counter current multiplier theory for urine concentration.
 - 5.3. Definitions and clinical significance —renal failure, renal calculi, dialysis.
- 6. Muscle physiology:** (5)
 - 6.1. a) Ultra structure of striated muscle (structure of sarcomere).
b) Chemical composition of striated muscle.
 - 6.2. Sliding filament theory of muscle contraction.
 - 6.3. Physical and chemical changes during muscle contraction.
 - 6.4. Response of muscle to stimulation – simple muscle twitch, tetany, muscle fatigue, rigor mortis.

7) Nervous Excitation: (5)

- 7.1. Definitions- Impulse, stimulation, conduction, response, EEG and epilepsy.
- 7.2. Origin and conduction of nerve impulse, salutatory conduction.
- 7.3. Synapse – Ultra structure and transmission of nerve impulse.
- 7.4. Neurotransmitters- definition, properties and types- serotonin, dopamine, histamine, acetylcholine, GABA.

8. Reproduction: (8)

- 8.1. Reproductive cycle with hormonal control-oestrous & menstrual.
- 8.2. Pregnancy, parturition, lactation and their hormonal control.
- 8.3. Hormonal control of male reproduction.

9. Endocrinology: (7)

- 9.1. Introduction.
- 9.2 Concept of positive and negative feed back mechanism of hormone action.
- 9.3. Physiology of— pituitary, thyroid, pancreas and adrenal.

Reference Book:

- 1. Animal Physiology, 1990 4th edn. Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
- 2. Physiology of Mammals & other vertebrates, 1980, 2nd edn. Marshall & Hughes. Cambridge University Press Cambridge.
- 3. Animal Physiology, 1987, Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
- 4. Text of Animal Physiology, 1976, Hurt & Mathur, S.Chand & Co. New Delhi.
- 5. General & Comparative Physiology, 1991. 3rd edn. William S Hoar, Prentice hall, India, New Delhi.
- 6. Text of Animal Physiology, 1991, 2nd edn, Nagbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
- 7. Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) 4th edn. 1991, CLadd Prosser, Wiley-Liss, Publication, New York
- 8. Comparative Animal Physiology (Neural & Integrative Animal Physiology), 1991, 4th edn. C. Ladd Prosser, Wiley-Liss, Publication New York.
- 9. Human Physiology, Vol.I & II 1980. 12th edn. Dr.C.C.Chatterjee, Medical applied Agency, Calcutta.
- 10. Comparative Vertebrate Endocrinology, 1982, 2nd ed, P.J.Bently, Cambridge University Press, London.
- 11. Handbook of Experimental Physiology & Biochemistry, 1993, Dr.P.V.C.Chandha Jaypee Brothers Medical Publishers, New Delhi.
- 12. General Endocrinology, 1976, 6th . edn. Turner C.D. & Baganara J.T. W.B.Saunders Co., Philadelphia.
- 13. Biochemistry, 1993, 3rd edn. Zubay G.Wm.C.Brown Communications Inc.U.S.A.
- 14. Text book of Medical Physiology, 1991, 8th edn. Guyton. A.C. W.NB.Saunders com., Philadelphia (Indian edn. Prism Book Bangalore.

ZY-343: Paper III
Molecular Biology

Total lectures: 45

1. Nucleic Acids : (5)

- 1.1 Structure of DNA and RNA
- 1.2 Types of DNA – A,B,Z, & H forms
- 1.3 Types of RNA
- 1.4 Physico-chemical properties of DNA
- 1.5 DNA as a genetic material –Evidences
- 1.6 RNA as a genetic material in viruses

2. Bacterial Genetics / Recombination in Bacteria: (6)

- 2.1 Bacterial transformation – Griffith's expt., process of transformation
- 2.2 Bacterial conjugation – Lederberg and Tatum expt,Hfr cells, plasmids
- 2.3 Transduction by Bacteriophage – Zinder and Lederberg expt.,specilised and generalized transduction

3. Chromatin Structure : (4)

- 3.1 Prokaryotic chromosome structure
- 3.2 Eukaryotic chromatin structure
- 3.3 Ultrastructure of nucleosome
- 3.4 Higher order structure

4. Central Dogma of Molecular Biology: (5)

4.1 DNA Replication

DNA replication in prokaryotes, eukaryotes

Types of DNA replication, experimental proof that DNA replication is semi conservative type

4.2 Transcription: (5)

Transcription in prokaryotes and eukaryotes, processing of RNA,
SnRNPs and ScRNPs

4.3 Translation:

(8)

Components : Genetic code, deciphering of genetic code,
Transfer RNA – Structure , activation of amino acid,
Ribosome – Molecular structure , active sites, function
Mechanism of protein biosynthesis – Initiation, elongation, termination,
detail mechanism in both pro- & eukaryotes. regulation of protein synthesis,
inhibitors of protein synthesis

5. Regulation of Gene Activity:

(7)

- 5.1 Gene regulation in prokaryotes – Lac operon
- 5.2 Trp operon – organization, regulation
- 5.3 Gene regulation in eukaryotes

6. DNA Damage and Repair:

(5)

- 6.1 DNA damage due to ionizing radiations, chemicals and other substances.
- 6.2 DNA repair mechanism : photorepair, dark repair, base excision repair, SOS repair

Reference Book:

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

ZY-344: Paper IV
Organic Evolution

Total Lectures: 45

- 1. Introduction.** (5)
 - 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, palaeontology, 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:** (3)
 - 5.1 Isolating mechanism.
 - 5.2 Classification of isolating mechanism
 - 5.3 Pre-zygotic and post-zygotic isolating mechanism.
- 5. Speciation:** (4)
 - 4.1 Types of speciation.(Allopatric & Sympatrise)
 - 4.2 Mechanism of speciation.
 - 4.3 Patterns of speciation
 - 4.4 Factors influencing speciation.
- 6. Geological Time Scale.** (2)
- 7. Animal Distribution:** (4)
 - 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
(*Kenyamapithecus*, *Australopithecus*, *Homo habilis*, *Homo erectus*, *Homo sapiens*, including *Neanderthals* and *Cro-Magnons*)
- 9. Zoogeographical Realms:** (4)

With reference to geographical regions. fauna

Reference Book:

1. Organic Evolution, Richard Swann Lull, Light & Life Publishers.
- 2 Introduction to Evolution, Paul Amos Moody, Kalyani Publishers, New Delhi.
3. Organic Evolution, 1991 T.S. Gopalkrishnan, 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

a) Public Health and Hygiene

Total Lectures: 45

- 1. Introduction and scope** (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 W.H.O. and its programmes.
- 3. Food:** (5)
 - 3.1 Sources: Plants and animals.
 - 3.2 Necessity: deficiency, diseases.
 - 3.3 Beverages and condiments
 - 3.4 Food preservation methods.
- 4. Houses and buildings:** (3)

Standards for urban and rural housing, lodging and hospitals.
- 5. Air and ventilation:** (3)
 - 5.1 Composition of air.
 - 5.2 Purification of air.
 - 5.3 Ventilation system: natural and official.
- 6. Water and water supplies:** (5)
 - 6.1 Sources and properties of water, quality of water for human consumption.
 - 6.2 Purification of water, small scale, medium scale and large scale (rapid sand filters)
- 7. Soil:** (3)

Composition, properties and diseases spread by soil.
- 8. Sanitation:** (5)

The disposal of human and animal waste, refuse, sewage.
- 9. Diseases:** (9)
 - 9.1 Communicable diseases: causative organisms, signs and symptoms, modes of transmission, prevention and control measures of: influenza, chicken pox, measles, tuberculosis, leprosy and encephalitis.
 - 9.2 Non communicable diseases: Rheumatic heart disease, coronary heart disease and diabetes mellitus.
- 10. Pets and public health:** cats, dogs and birds. (2)
- 11. Social and industrial hygiene:** (3)
 - 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 Biosecurity practices to be followed in laboratories.
- 12. Radiation risk:** (2)

Reference books:

1. A text book of preventive and social medicine. Park and park.
2. Preventive and social medicine in India: Dr. B. K. Mahajan.

OR
ZY-345: Paper V
b) Biodiversity

Total Lectures: 45.

- Introduction:** (2)
- 1.1 Definition & scope.
 - 1.2 Types of diversities among insects.
- 2. Insect & it's environment:** (4)
- 2.1 Insect diversity & adaptations with reference to terrestrial habitats : forest, agriculture, subterranean, cave, glacier, mountain & desert.
 - 2.2 Insect diversity & adaptations with reference to aquatic habitats : river, stream, lake, pond, torrents, marine, estuarine & ephemeral water bodies.
- 3. Population dynamics of Insects:** (3)
- 3.1 Concept of population dynamics.
 - 3.2 Factors affecting population dynamics in insects.
 - 3.3 Seasonal variations in insect populations.
- 4. Insect taxonomy:** (9)
- 4.1 Outline of scheme of classification of insects as given by Richards & Davis.
 - 4.2 Distinguishing features of Apterygotan insects.
 - 4.3 Distinguishing features of Pterygotan insects : Exopterygota & Endopterygota.
 - 4.4 Distinguishing taxonomic features & significance of following major insect orders : Orthoptera, Diptera, Hemiptera, Lepidoptera & Coleoptera.
 - 4.5 Useful contribution in molecular phylogenetic studies.
- 5. Insects in social groups:** (5)
- 5.1 Definition, intraspecific & interspecific relationships among insects.
 - 5.2 Social organizations in ants, wasps & termites.
 - 5.3 Significance of social organizations.
- 6. Food & feeding behavior in insects:** (4)
- 6.1 Selection of food by insects.
 - 6.2 Food diversity among insects.
 - 6.3 Significance of diversity in food & feeding habits.
- 7. Breeding behavior in insects:** (6)
- 7.1 Diversity in courtship & oviposition behavior in insects.
 - 7.2 Diversity in oviposition sites among insects.
 - 7.3 Parental care & nest building diversity in insects.
 - 7.4 Diapause behavior in insects.
- 8. Diversity in insect relationships:** (5)
- 8.1 Diversity in mutualistic associations : ant-aphids, ant-coccids, ant-bug, ant-butterfly & ant- membracids.
 - 8.2 Insects as predators, parasites & parasitoids.
 - 8.3 Insect plant interaction : Role of insects as plant bodyguards.
- 9. Survival strategies in insects:** (3)
- Escape, flight, sting, poison, mimicry, hide, camouflage & migration.
- 10. Effect of changing climate & human interference on insect diversity:** (4)
- 10.1 Impact of global changes on diversity of insects at various levels such as local, regional, national & global.
 - 10.2 Important steps essential for conservation & management of insect diversity.

Reference books:

1. Imm's General Text book of Entomology Vol. I & II (1993), Richards O.W. & Davis R.F., B.I. Pul (Indian edition) New Delhi.
2. Principals of insect morphology, Snodgrass R.E. (1994) Indian Reprint, SBS Pub. New Delhi.
3. Structure & functions of Insects. Chapman R.F. (1983), 3rd edition, ELBS, London.
4. Entomology, Gillott Cedric (1980), Plenum Press, New York.
5. The Science of Entomology, Romoser W.S. (1981) 2nd edition, Mac millon Co., New York.
6. General Entomology, Mani M.S. (1998) Reprint Oxford- IBH, India.
7. An Introduction to Entomology, Srivastav R.D. & Singh R.P. (1997), Concept Pub. New Delhi.
8. General & Applied Entomology, Nayar K.K., T.N. anantkrishanan & B.V. David, (1983), tata McGrow Hill, Pub. New Delhi.
9. Insects, Mani M.S. (2006) Reprint NBT Pub. New Delhi.

ZY-346: Paper VI
Genetics and Developmental Biology

Total Lectures : 45

Genetics

1. Mendelian and Modern concept of gene (2)
2. Gene mutation –classical and modern concept (somatic and gametic mutation; spontaneous and induced mutations; forward and reverse mutations and silent mutations; deletion, insertion, substitution and transition, tautomerization (3)
3. Hardy – Weinberg equilibrium and its significance in population biology (2)
4. Cytoplasmic inheritance (2)
with special reference to shell coiling in the snail (*Lymnaea*)
5. Genetics of inbreeding and outbreeding; hybrid vigour (3)
6. Euthenics and euphenics (gene therapy). (2)
7. Genetic Engineering (Isolation and sequencing a gene, restriction enzymes, gene cloning with vectors like plasmids and bacteriophages,). (2)
8. Study of various enzymes used in genetic engineering (restriction endonucleases (3)
ligase, alkaline phosphatase, DNA polymerases, reverse transcription, ribonucleases

Developmental Biology

1. Revision of concepts: (1)
Gametogenesis, types of eggs, fertilization; cleavage .
2. Spermiogenesis, ultrastructure of the spermatozoa (3)
Vitellogenesis and organization of the egg (polarized distribution of components, egg cortex, nucleus and egg membranes)
3. Fertilization (external fertilization only) with special reference to sea urchin (5)
sperm attraction and activation, contact of gametes, fusion, prevention to polyspermy—slow and fast block, activation of egg metabolism, fusion of genetic material
4. Cleavage and blastula: maturation promotion factor and mid-blastula transition (2)
with special reference to frog
5. Gastrulation (6)
Cellular basis of morphogenesis,

Morphogenetic movements, and
Organizer and fate map with reference to frog
Process of gastrulation in chick

6. Organogenesis with reference to chick (only up to 48 hrs of development) (4)
Mesoderm and Mesodermal derivatives: somites, lateral mesoderm and heart
Neural tube and brain (including eye)
7. Basic concepts in regeneration with reference to *Hydra* and *Planaria*. (2)
8. Interesting aspects of experimental embryology: (2)
cloning, chimera, transgenic mice.
9. Importance of cell death during development (at least one example such as digit formation) (1)

Reference books:

1. Genetics. By Verma, PS and Agarwal, VK., S. Chand and Co., New Delhi
2. Principles of Genetics. By. Sinnott, Dunn and Dobzhansky, Tata McGraw Hill, New Delhi, India.
3. Genetics. By Gupta, PK., Rastogi Publications, Meerut
4. Genetics. By Sarin, C., Tata McGraw Hill, New Delhi.
5. Principles of Genetics. By Gardner, EJ, Simmons, MJ and Snustad, DP. John Wiley and Sons
6. An Introduction to Embryology, 1981, Balanskey, Saunders college , Philadelphia.
7. Developmental Biology, 1982, Saunders, Jw, Coilier, McMillon Publ. London.
8. Development of chick Embryo Lillie.
9. Developmental Biology, 1991, 3rd edn. Sinauer Associates USA.
10. Developmental Biology, 1997, 3rd edn. Gilbert S.F., Sinauer Associates USA.

ZY 347: Practicals Course I

General Zoology:

- Pract 1-** Study of external characters , T. S. through proboscis collar and trunk of *Balanoglossus*. (D)
- Pract 2-** Study of larval forms of crustacean. (D)
- Pract. 3** a) Study of digestive system of *Pila* (E)
b) Temporary mounting of osphradium (E)
- Pract 4 –** a) Study of nervous system of *Pila* (E)
b) Temporary mountings of radula, and statocyst of *Pila* (E)
- Pract 5 –** Study of digestive system of *Calotes* (E)
Temporary mountings of Scales of *Calotes* (E)
- Pract 6 –** Study of venous system and arterial system of *Calotes* (E)
- Pract 7 –** a) Nervous system of *calotes* (E)
b) Temporary mountings of pecten and Hyoid apparatus of *Calotes* (E)
- Pract 8 –** Comparative study of :
a) **Heart** : *Scoliodon*, Frog, *Calotes*, Gallus and Rat. (D)
b) **Brain** : *Scoliodon*, Frog, *Calotes*, Gallus and Rat (D)
- Pract.9-** Study of accessory respiratory organs in fishes: *Anabas*, *Labeo*, *Clarius* (D)
- Pract 10-** Study of Dipnoi fishes and Axolotl larva (D)

Histology of Mammals:

- Pract: 1:** Principle & use of camera lucida. (E)
- Pract 2:** Tissue collection & fixation. Block making (E)
- Pract 3:** Sectioning. Staining & mounting. Permanent slides preparation (E)
- Pract: 4:** (a) Study of permanent histological slides of skin, tooth, tongue, stomach, duodenum, ileum, liver, pancreas and any one salivary gland. (D)
(b) Study of permanent histological slides of trachea, lung kidney testis, ovary, thyroid and adrenal. (D)
- Pract: 5:** Temporary mounting of tissues: (E)
a) Medullated nerve fiber.
b) Striated muscle fiber

Biotechnology

Pract 1 . Study of various instruments, their principal and working. (D)

- i. CO₂ incubator
- ii. Fermentor
- iii. Inverted microscope
- iv. Laminar Hood / Laminar Air flow

Pract 2. Establishment of primary cell culture- (D)

Pract 3 Bacteria as bio pesticides – B. Thuringensis (D)

Pract 4 Cell viability assay by trypanblue exclusion method. (E)

Pract 5 Positive & Negative selection (blue-white Selection).

Pract 6 Culture of Bacteria in liquid medium and agar plates. (E)

Pract 7 Antibiotic sensitivity/ resistance (E)

Pract 8 Visit to biotechnology Institute

Mammalian Physiology and Endocrinology

Pract 1 Effect of hypo, iso and hypertonic solutions on RBCs. (E)

Pract 2 A] Clotting time of blood. (E)

B] Preparation of haemin crystals. (E)

C] Study of ECG using recorded graph. (D)

Pract 3 Diffusion of glucose through intestine. (E)

Pract 4 Estimation of blood glucose. (E)

Pract 5 Identification of food constituents— (E)

- a) Carbohydrates—Glucose, Starch.
- b) Protein- Albumin-Biuret test, Ninhydrin test, Millon's test, Xanthoproteic test.
- c) Fats—Olive oil/ Groundnut oil—Emulsion test, Solubility test, Saponification test (Rastogi page-75-77)

- Pract 6** Study of any five clinical conditions associated with hypo/hyper active endocrine glands with the help of photographs—Gigantism, Dwarfism, Acromegaly, Cretinism, Myxodema, Grave's disease, Cushing's disease. (D)

ZY 348: Practicals Course II

Biological Chemistry

- Pract 1** :Carbohydrate tests:Identification of carbohydrate by performing suitable tests(Monosaccharides, Disaccharides, Polysaccharides) (E)
- Pract 2:** Isolation of starch from potato and digestion of starch by salivary amylase (E)
- Pract 3:** Isolation of protein by isoelectric precipitation and its quantification (E)
- Pract 4:** Study of enzyme urease/ invertase, extraction, activeness, effect of temperature, pH, activator and inhibitor. (E)
- Pract 5:** Preparation of buffer of desired pH and molarity (E)
- Pract 6:** Isolation of hemoglobin (E)
- Pract 7:** Estimation of vitamin by titration method (E)

Environmental Biology and Toxicology

- Practical 1:** Study of fresh water plankton.(field collection, preservation and gross identification) (E)
- Practical 2:** A visit to water body to study physiochemical properties of water (Temperature, pH, turbidity, hardness, acidity and alkalinity) using analysis kit. (E)
- Practical 3:** Study of physicochemical properties of soil sample. (Using analysis kit). (E)
- Practical 4:** To determine LC50, 96 hours value of pollutant by using aquatic organism as test animals. (E)
- Practical 5:** Effect of the effect of EDTA on the toxicity of a copper (E)
- Practical 6:** Estimation of dissolve Oxygen in water by Winkler's method. (E)
- Practical 7 :** Estimation of dissolve CO₂ in water (E)
- Practical 8:** A compulsory visit to costal area/ National park/ Forest etc (E)

Molecular Biology

- Pract 1:** Preparation of DNA paper model and study its characteristics. (E)
- Pract 2:** Staining of DNA and RNA by methyl green – pyronin. (E)
- Pract 3:** Estimation of DNA by Diphenylamine method. (E)
- Pract 4:** Estimation of RNA by Bial's Orcinol method. (E)
- Pract 5:** Isolation of DNA from Bacteria / liver. (E)
- Pract 6:** Protein estimation by Lowry et al. Method (E)
- Pract 7:** Isolation of nuclei. and their counting . (E)
- Pract 8:** Isolation of mitochondria and their quantification. (E)
- Pract 9:** To study restriction digestion of DNA. (E)
- Pract 10:** To study cell fractionation, use of sucrose density gradient. (E)

Organic Evolution

- Practical 1:** Study animal adaptations: Turtle, Draco, Exocetus, Bat, and Parrot (D)
- Practical 2:** Study of successive stages of evolution of man: a) Australopithecus
b) *Homo erectus* ,c) *Homo neanderthalis*,d) *Homo cromagon*
f) *Homo sapiens*. (D)
- Practical 3:** To record the zoogeographical distribution of animals on the world map:
(lung fishes, marsupials, flightless birds, camel, elephant, ostrich etc.) (D)

ZY 349: Practicals Course III

General Pathology

Practical 1: Study of pathogenic agents and pathological conditions with help of suitable microscopic slides. (D)

- a) *Mycobacterium tuberculosis*.
- b) *Mycobacterium leprae*.
- c) *Vibrio cholerae*.
- d) Anthrax bacilli.
- e) *Pneumococci* sp.
- f) *Trypanosoma* sp.
- g) Normal cell, diseased cell.(Lung)
- h) Fatty degeneration,(Liver).
- i) Cloudy degeneration/Swelling (Kidney)
- j) Dying cell-necrosis (liver)

Practical 2: Study of following diseased and other pathological conditions with help of suitable microscopic slides. (D)

- a) Lung lobar pneumonia.
- b) Inflammation of any mucous membrane
- c) Lung tuberculosis.
- d) Ovarian cyst.
- e) Spleen infarct.
- f) Chronic polyarthritis.
- g) Thyroid goiter.

Practical 3: Study of following pathological slides or specimens. (D)

- a) Carcinoma in situ. eg. Human cervix.
- b) Malignant melanoma.
- c) Malignant cell.
- d) Thrombus? Organized thrombus.
- e) Ovary fibroid tumour/ carcinoma.
- f) Carcinoma of colon-cauliflower growth.
- g) Carcinoma of stomach

Practical 4: Study of following pathological slides or specimens. (D)

- a) Skin leproma.
- b) Liver cirrhosis.
- c) Fatty liver.
- d) Liver abscess.
- e) Penis malignancy.
- f) Breast fibrocystic disease.
- g) Syphilis.

Practical 5: To detect the normal and abnormal constituents of urine. (E)

Practical 6: Study of gastric juice analysis by Toffler's reagent (alcoholic solution of dimethylamino – azobenzol methyl orange indicator). (E)

Practical 7: Visit to medical college/hospital/ pathological laboratory.

OR

Basic Entomology

Practical 1: a) Study of external characters of grasshopper & butterfly as generalized insect. (D)

b) Study of generalized structure of insect head, types of articulation of head & types of antennae. (D)

Practical 2: a) Study of basic structure of typical insect leg & types of leg modifications. (D)

b) Study of general structure of insect wing, types of wing modifications and wing coupling structures. (D)

Practical 3: a) Study of life cycle of grasshopper, butterfly, dragon fly & beetle. (D)

b) Study of types of insect eggs, larvae and pupae. (D)

Practical 4: a) Study of digestive system of grasshopper. (E)

b) Study of temporary preparation of mouth parts, wings legs, spiracles & tympanum. (E)

Practical 5: Study of nervous system of grasshopper. (E)

Practical 6: Study of different types of hematocytes in cockroach & haemocyte count. (E)

Practical 7: Study of heart beats in cockroach –normal & effect of temperature change. (E)

Practical 8: Study of Von Wisseling's test for presence of chitin in insects cuticle. (E)

Cell Biology

Practical 1: Study of detection of mitochondria by Janus Green B. (E)

- Practical 2:** Study of permanent histological slides of mitosis & meiosis. (D)
- Practical 3:** Study of temporary preparation of different mitotic stages from onion root tip cells. (E)
- Practical 4:** To study the effect of colchicines on mitosis. (E)
- Practical 5:** Study of temporary preparation of different meiotic stages from grasshopper/ Tradescantia/ Onion floral bud. (E)
- Practical 6:** Study of temporary preparation of Barr body. (E)

Public Health and Hygiene

- Practical 1:** To detect adulterants in the food samples by appropriate tests. (E)
- Practical 2:** Study of pets: Ectoparasites of cats, dogs & birds. (D)
- Practical 3:** Study of housefly, cockroach, ants rats with reference to public hygiene. (D)
- Practical 4:** Epidemiological study of chicken guinea, measles, swine flu. (D)
- Practical 5:** A compulsory visit to water purification (treatment) plant. (D)
- Practical 6:** Visit to sewage treatment plant / effluent treatment plant / Public health laboratory. (D)
- Practical 7:** Testing potability of water for human consumption by MPN method. (D)

OR

Biodiversity

- Practical 1:** Study of soil, aquatic, scavenging, arboreal & cave dwelling insects with respect to their body part adaptations & ecological significance. (D)
- Practical 2:** Study of following social insects with respect to their caste system, life cycle & nest types: wasps & termites. (D)
- Practical 3:** Study of different examples of insects showing various kinds of inter/ intra specific, prey/ predator, host/ parasitic, symbiotic mutualistic relationships. (D)
- Practical 4:** Study of simple technique for chromosome preparation from different Insects for cytotaxonomy. (E)
- Practical 5:** Survey of representative habitat of insects for population estimation studies by Quadrature method or Line transect method & for insect diversity studies. (E)
- Practical 6:** Field observations for following kinds of behavioral studies in insects: food-feeding, mating, egg laying, nesting. (D)
- Practical 7:** a) Study of different methods of collection & preservation of insects. (D)
b) Identification of representative insects with the help of suitable taxonomic key. (D)
- Practical 8:** a) Study of preliminary statistical methods in insect diversity & population dynamics. (D)

- b) Study of insect photography techniques as a challenging and rewarding to keeping insect collections. (E)

Genetics and Developmental Biology

- Practical 1:** Temporary preparation of Polytene chromosome from chironomous larvae (E)
- Practical 2:** PTC testing ability in man and calculation of gene & genotype frequency (D)
- Practical 3:** Study of sperm smear (any one animal), Types of eggs (insect, amphioxus, frog & hen), Types of blastulae and gastrulae (insect, amphioxus and hen) (D)
- Practical 4:** Study of chick embryo whole mounts with reference to staging method in chick development (By Hamburger & Hamilton, given the book by Balanskey): 18 h (primitive streak), 21h, 24h, 33h, 48h, 72h & 96h of incubation. (D)
- Practical 5:** Study of permanent histological slides of chick embryo: Primitive streak (T. S), 24h(T. S. through neural tube) and 33H (T. S. through heart). (D)
- Practical 6:** Study of permanent histological slides of chick embryo: 48h (T. S. through pharynx and T. S. through extra embryonic membrane), 72h embryo (T.S.) (D)
- Practical 7:** Study of temporary preparation of whole mount of chick embryo. (E)
- Practical 8:** Study of simple in vitro culture of chick embryo in beaker or any suitable method. (D)