VEER NARMAD SOUTH GUJARAT UNIVERSITY

Course: M.Sc. Zoology

Syllabus for Semester I and Semester II

(Credit Based Semester and Grading System with effect
From the academic year 2016-17)

M.Sc. Zoology Syllabus Semester I and Semester II

Credit Based and Grading System

To be implemented from the Academic year 2016-2017

ZOO 1001: BIOLOGY OF NON-CHORDATES 60 hrs

Unit 1: **15 hrs**

a) Non-chordata - classification with diagnostic features up to class level.

b) Origin of metazoa

c) Origin and Organization of Coelom: Acoelomates, pseudo coelomates and coelomates

Unit 2: **15 hrs**

a) Locomotion: Amoeboid, Flageller and Ciliary movement in protozoa. Hydrostatic movements in Coelenterata. Mollusca and Echinodermata

b) Nutrition and Digestion: Patterns of Feeding and digestion in lower Metazoa, Mollusca, Echinodermata, Filter feeding in polychaeta, Mollusca and Echinodermata

Unit 3: **15 hrs**

a) Respiration and Excretion: Organs of respiration: Gills, lungs and trachea. Respiratory pigments. Mechanism of respiration. Excretion in lower invertebrates. Excretion in higher invertebrates. Mechanism of Osmoregulation.

b) Nervous System: Primitive Nervous systems:- Coelentrata and Echinodermata. Advanced nervous system - Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda). Sense organs and their importance

Unit 4: **15 hrs**

a) Invertebrate larvae: Invertebrate larval forms and their evolutionary significance. Trematoda and Cestoda. Larval forms of Crustacea, Mollusca and Echinodermata.

b) Minor Phyla: Structure affinities and life history of the following minor Phyla-Rotifera, Entoprocta, Phoronida and Ectoprocta

Bibliography

1. Hyman, L.H. The invertebrates, Nol. Protozoa through Ctenophora, McGraw Hill Co., New York
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson & Sons Ltd., London.
3. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
4. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
5. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
6. Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
7. Read, C.P. Animal Parasitism. Parasitism prentice Hall Inc., New Jersey.
8. Sedgwick, A.A. Student text book of Zoology. Vol. I,II & III. Central Book Depot, Allahabad.
9. Parker, T.J., Haswell W.A. Text book of Zoology, Macmillan Co., London.

PRACTICALS: **60 hrs**

1. **Protozoa:** *Trypanosoma, Plasmodium, Radiolaria, Balantidium, Monocystis, Noctiluca, Paramecium*

2. **Porifera:** *Leucosolenia, Euplectella* (Venus flower basket), *Hyalonema*

3. **Cnidaria:** *Hydra*, *Carrybdea* (Cubozoan medusa), *Tubipora*, Alcyonarian coral, *Physalia* (Portuguese man of war), *Pennaria, Velella, Porpita, Aurelia, Obelia*, Sea Anemone

4. **Platyhelminthes & Nemathelminthes:** *Microstomum, Gyrodactylus, Schistosoma haematobium* (Blood worm), *Echinococcus granulosus* (Dog tapeworm), *Ancylostoma duodenale* (Hook worm), *Trichinella spiralis* (Pin worm)

5. **Annelida:** *Nereis, Aphrodite, Tubifex, Placobdella, Hirudinaria* (Leech), *Arenicola, Sabella,* Earthworm, *Chaetopterus*

6. **Arthropoda:** Black widow spider, *Cyclops, Calanus, Lepas, Balanus* (Acorn barnacle), Centipede, Millipede, *Xiphosura limulus* (King crab)

7. **Mollusca:** *Neopalina, Cardium, Sepia, Loligo, Patella, Chiton, Dentalium, Murex xanchus*

8. **Echinodermata:** *Ophiothrix*, Sea urchin, Heart urchin, Starfish, Sea cucumber, Echinoderm larvae

9. **Dissections:** C**ockroach :** 1) Reproductive system of male & female 2) Nervous system.

ZOO 1002: BIOCHEMISTRY AND IMMUNOLOGY 60 hrs

Unit 1: pH and Buffers: **15 hrs**

a) Properties of water, law of mass of action, pH, dissociation of water and its ion product

b) Buffers- formulation and significance of buffers, biological buffers.

Unit 2: Biomolecules and Metabolism: **15 hrs**

a) Carbohydrates: Classification, properties and significance. Derived sugars Metabolism of carbohydrates: Glycolysis, TCA cycle, HMP shunt and their energetic pathways. Glyoxylate cycle, uronic acid pathway. mitochondrial ATP synthesis. Glycogen metabolism - Gluconeogenesis, glycogenesis, glycolysis and regulation of glycogen metabolism.

b) Lipids: Classification, properties and significance, phospholipids, sphingolipids, glycolipids, steroids & prostaglandins. Oxidation of fatty acids & energetic, ketogenesis & its implications

c) Proteins: Amino acids - Classification, properties and significance. Transamination, deamination and decarboxylation. Proteins- Classification, structure, properties and significance

Unit 3: Immunbiology: **15 hrs**

The cellular constituents of the lympho reticular system-phagocytic cells-poly morpho nuclear neutophils, mono nuclear phagocytes eosinophils and lymphocytes

Unit 4: Immunoglobulin: **15 hrs**

a) Immunoglobulins-structure, isotypes and biological function.

b) Antigen-antibody interaction and immunodiagnostics.

c) Immunodeficency and AIDS.

Bibliography

1. Harper HA. Review of Physiological Chemistry (Lange Publications) 1993

2. Lehninger Al, Nelson DL and Cox MM. Principles of Biochemistry (CBC Publishers) 1993

3. Rastogi SC. Biochemistry (Tata Mc GrawHill Publishing Co. Ltd.) 2003

4. Satyanarayana U. Biochemistry (Book Syndicate Pvt. Ltd) 2006

5. Stryer. Biochemistry (WH Freeman and Co. Pub.) 2008

6. Plummer DT. Practical Biochemistry (Tata Mc GrawHill Publishing Co. Ltd.) 1993

7. Varley H. Practical Clinical Biochemistry (CBS Publications) 1980

8. Roitt,I.M.1994. Essential Immunology. Blackwell Scientific, Oxford.

9. Richard A.Goldsby, Thomas T.Kindt and Barbara A. Osborne. 2000. Kuby Immunology.Freeman and Co., New York.

10. Stites,D.P.,Terr,A.I. and Parsloio,T.G. 1997.Medical Immunology. Prentice Hall, New Jersey.

11. Janeway,C.A and Travers,P. 1997.Immunobiology.Current Biology Ltd., London.

12. Paul,W.E.M.1989. Fundamentals of Immunobiology. Raven Press, New York.

13. Srivastava,R.,Ram,B.P. and Tyle,P.1991. Molecular Mechanism of Immune Regulation. VCH Publishers, New York.

14. Champion,M.D. and Cooke,A.1987. Advanced Immunology. J.B.Lippincott Ltd., Philadelphia.

15. Kannan,I.2007. Immunology. MJP Publishers, Chennai.

PRACTICALS: 60 hrs

1. Determination of isoelectric point of casein.
2. Estimation of total amino acids
3. Determination of urine creatinine content
4. Determination of DNA and RNA content
5. Estimation of total proteins
6. To study various cell types from human body.
7. Study of various slides: T.S. of Spleen, Thymus, Lymphnodes and bone.

ZOO 1003: CELL AND MOLECULAR BIOLOGY 60 hrs

Unit I: **15 hrs**

Molecular Architecture of Eukaryotic cell and their environment:

a) Biomemebranes – Composition, Structure, Fluid mosaic model b) Basic functions – Permiability, Osmotic principles, Carrier protein, Channel proteins, Passive transport, Active transport, Na+/K+ Pump, Pinocytosis, Phagocytosis.

Cells and their environment :

a) Cell- matrix adhesion – Collagen, Proteoglycan, Fibronectin, Laminins, Integrins, Extra cellular matrix b) Cell-cell adhesion - Cadherins, Desmosomes, Gap junction.

Unit II:

Molecular mechanisms of cell division and Special chromosomes: **15 hrs**

a) Ultrastructure and organization of – Centrosome, centromere and Kinetochore b)Microtubule and their dynamic instability c) Microtubule associated proteins, d)Metaphase and Anaphase movements e) Cytokinesis.

Special Chromosomes :

(a) Polytene chromosome- Structural organization and significance b) Lampbrush chromosomes- Structural organization and significance c) Supernumerary chromosomes

Sex determination: a) Sex chromosomes b) Chromosomal basis of sex determination.

Heterochromatin: a) Types and Function.

Unit III: **15 hrs**

Recombinant DNA Technology: a) Tools of Recombinant DNA Technology- Restriction enzymes, cloning vectors, Plasmids, Phages, Viruses b) Methods of Introduction - Tranformation, Transduction, Transfection, Electroporation, Biolistics, microinjection, liposome fusion b) Applications of Recombinant DNA Technology and Transgenic animals.

Unit IV: **15 hrs**

Molecular cytogenetic techniques: a) Banding – C, G, R and Fluorescence b)Autoradiography c) *Insitu* hybridization – FISH, Chromosome painting.

Bibliography

1. Alberts B., Bray D, Lewis J, Raff M, Roberts K and Watson JD.2001. Molecular Biology of the Cell. Garland publishing Inc. New York

2. Cooper GM.1997. The Cell: A Molecular Approach. Sinauer Associates. Inc

3. Daniel J, Lodisch H & BaltimoreD 2000. Molecular Cell Biology. Scientic American Books, Inc: USA

4. Glick BR and Paternak JJ. 1994. Molecular Biotechnology-Principles and applications of Recombinant DNA. ASM-Press: Washington DC

5. Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D and Darnell J. 2000. Molecular Cell Biology Freeman WH and Co. New York

PRACTICALS: 60 hrs

1. Vital staining of mitochondrial using Yeast cells.
2. Preparation of salivary gland chromosomes of *Drosophila melanogaster.*
3. Study of Meiotic chromosomes- *Poecilocerus pictus*.
4. Study of Barr body in human using buccal smear
5. Isolation of cellular DNA by rapid method using Cauliflower/ Sheep liver.
6. Demonstration of Agarose gell electrophoresis.

ZOO 1004: HISTOLOGY AND DEVELOPMENTAL BIOLOGY 60 hrs

Unit 1: Tissue organization: **15 hrs**

a) Basic epithelium tissue, glands and tissue organization.

b) Digestive system.

c) Respiratory system.

Unit 2: System organization: **15 hrs**

a) Circulatory system.

b) Urinogenital system.

c) Nervous system.

Unit 3: Early Development: **15 hrs**

a) Historical perspective of the science of embryology.

b) Spermatogenesis, Oogenesis, Fertilization.

c) Basic concepts of growth and differentiation.

d) Dynamic of gastrulation.

Unit 4: Organogenesis: **15 hrs**

a) Formation of organ rudiments.

b) Differentiation and development of heart and kidney in different mammals.

Bibliography

1. Balinsky, B.I.1981 An Introduction to Embryology. W.B Saunders Co., Philadelphia.

2. Karp,G. and Berrill,N.J.1981. Development. McGraw Hill, New York.

3. Saunders, J.W.1982. Developmental Biology. MacMillan Co., London.

4. Nagabhushanam,R. and Sarojini,R.2002 Invertebrate Embryology. Oxford and IBA Publishing Co. 56. Browder, W.1984.Developmental Physiology. Saunders College Publishing, Rinchert and Winston.

6. Gilbert, S.F.2003.Developmental Biology. Sinamer Associates Inc. Saunderland, Massachusets, U.S.A.

7. Oppenheimer, S.B.1980.Introduction to Embryonic Development. Allyn and Bacon,Inc. U.S.A.

PRACTICALS: 60 hrs

1. Study of permanent slides: Epithelium tissue, salivary gland, stomach, intestine, liver, pancreas, lung, heart, artery, vein, kidney, brain.

2. Different stages in development - frog (egg, cleavage, Blastula, Yolk plug stage 24,48,72,96 h Gastrula)

3. Development of chick stage - slide showing C.S. of heart, kidney lens and limb.

ZOO 2001: BIOLOGY OF CHORDATES 60 hrs

Unit 1: **15 hrs**

a) Principles of taxonomy

b) Nomenclature - Binomial, Trinomial nomenclature.

c) Zoological Nomenclature –ICZN

d) New trends in taxonomy

e) Prochordate phylogeny - systematic position of Prochordates

f) Origin of chordates

Unit 2: **15 hrs**

a) **Ostracoderms:** Silurian and Devonian Ostracoderms. Evolutionary position of the Ostracoderms.

b) **Placoderms:** Origin of Jaws- Placoderms as ancient "experiment" in the evolution of the jawed vertebrates. Structural peculiarities of Cyclostomata.

c) **Chondrichthyes:** Fossil history of chondrichthyes, tendencies in Elasmobranch evolution.

d) **Actinopterygii:** Origin and evolution, Adaptive radiation of bony fishes.

e) **Amphibia:** Origin and evolution of Amphibia

Unit 3: **15 hrs**

a) **Reptilia:** Evolution of Reptilia. Saurischian and Ornithischian Dinosaurs - Rhyncocephalia - Adaptive radiation of Reptiles.

b) **Aves:** Birds as glorified reptiles. Fossil history of birds. Palate in Birds. Adaptive radiation in birds.

c) **Mammal:** Evolution of Mammals, Structural peculiarities of Prototheria, Metatheria and Eutheria.

Unit 4: Comparative anatomy: **15 hrs**

a) Origin and evolution of the vertebrate integumentary system.

b) Paired fins and limbs

c) Heart and aortic arches

d) Respiratory organs

e) Urinogenital system

f) Brain and Nervous system

Bibliography

1. Waterman. A.J. 1971. Chordate Structure and Function. McMillan Co. London.

2. Jolie, M. 1968. Chordate Morphology. East West Press. Pvt, Ltd,

3. Romer, A.S. and Parson, T.S. 1978 Vertebrate Body. W.B. Saunders Co. Philaelphia.

4. Young, J.2.1969. Life of Vertebrates. Clarendon Press, Oxford.

5. Colbert, E.H. 1969. Evolution of Vertebrates. John Wiley and Sons Inc, New York.

6. Holstead. 1969 The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U.S.A.

7. Hobart M. Smith,1960Evolution of Chordate Structure,Holt,Rinehart&Winston Inc. NewYork

8. Hyman L.H.1966 Comparative Vertebrate Anatomy. The University of ChicagoPress,Chicago

PRACTICALS: **60 hrs**

1. **Protochordata:** *Balanoglossus, Ascidia, Doliolum, Salpa, Oikopleura, Amphioxus.*

2. **Pisces:** *Carcharius (shark), Trygon, Clarias, Arius, Ostracion, Oreochromis, Channa, Hippocampus, Tetradon.*

3. Amphibia: ***Triton, Gegenophis, Amblystoma, Caccopus, Siren, Hyla, Ichthyophis*.**

4. **Reptilia:** *Chamaeleon*, *Phrynosoma*, *Varanus*, King cobra, Krait, Turtle, Crocodile, Skulls of turtle and crocodile.

5. Aves: **Skull and modifications in palate region – Desmognathous and Schizognathous type. eg. duck and pigeon.**

6. Mammalia: ***Loris*, bat, squirrel, *Platypus*, porcupine, *Pangolin*, skulls of dog, goat, cat, rabbit, monkey and man.**

7. Dissections: **Major Carp : 1) Digestive system 2) Urineogenital system**

ZOO 2002: ANIMAL PHYSIOLOGY 60 hrs

Unit 1: System Physiology: 15 hrs

a) Blood and body Fluids: Blood and its components, Heart cycle, Electrical Properties of the heart, ECG, Control of cardiac output. Vascular system, Regulation of arterial blood pressure.

b) Respiration: Gas exchange and mechanism of respiration in invertebrates and vertebrates oxygen curves and control of respiration.

c) Gastrointestinal system: Motility, secretion and absorption of nutrients, carbohydrate, protein and fat digestion. Role of dietary fiber in digestion. Nutritional disorders. Ruminant and non-ruminant digestive patterns, Endoparasitism.

Unit 2: Exercise Physiology: 15 hrs

a) Physiology of Exercise, Circulatory changes in muscular exercise, Blood pressure during exercise, Respiratory responses to exercise.

b) Types of exercise, Response of muscle to exercise Endocrine response to exercise. Fatigue- induced biochemical and physiological changes.

c) Role of Meditation, Yoga and their effects.

Unit 3:Hormones 15 hrs

a) Autocrine, paracrine and endocrine secretions - an overview of mammalian endocrine system. Hypothalamus- structure and functions, hypothalamo hyposhysial portal system, regulation of hypophysial secretions, Hypophysis

b) Morphology, synthesis and action of hormones of endocrine glands- thyroid, parathyroid, adrenal gland, pancreas and pineal glands, Pathophysiology- cretinism, cussing syndrome and Addison's disease.

Unit 4: Mechanism of hormone action: 15 hrs

Types of hormone receptors (membrane bound cytoplasmic and nuclear receptors) regulation of receptor number, signal transduction- secondary messengers, cyclic AMP, prostaglandin, Cadmodulin mediated pathways, genomic mechanism of hormone action- thyroid and steroid hormones, termination of hormone action.

Bibliography

1. Eckert, Marsall, Animal Physiology Mechanism and Adaptations, 2002
2. Eckert & Randall, Animal Physiology (CBS), 2nd Ed, 2000.
3. Ganong. Review of Medical Physiology (21st Ed.), Lang Medical Publications, 2003
4. Gordon M. Animal Physiology Macmillan & Co.; First edition (1972)
5. Guyton and Hall: Text Book of Medical Physiology (10th Ed.), (W.B. Saunders), 2001
6. Hill R.W Comparative Physiology of Animals) Sinauer Associates) Third edition
7. Hoar W.S., General and Comparative Physiology(Prentice – Hall)1983

8. Houssay, Human Physiology, McGraw Hill Books Company, Second edition

9. Hutchinson, Hunter and Bomford, Hutchinson's Clinical Methods, (Lippincott)

10. Chandra. S. Nagi : Introduction to Endocrinology PHI (New Delhi)

11. Degroot. L.J. and Neill, J.D. 2001: Endocrinology-IV Ed, Vol. I-III. W.B. Saunders company(Ed)

12. Gorbman and Beru .1962: A text book of Comparative Endocrinology

13. Highman and Hill 1972: Comparative Endocrinology of Invertebrates

14. Pickford G.E & Atz W.J.1957: The Physiology of Pituitary gland of fishes (Zoological Survey; New Delhi)

PRACTICALS: **60 hrs**

1. Study of blood pressure during rest and exercise
2. Visit to Yoga Centre / Demonstration by expert
3. Effect of exercise on breathing rate, pulse rate and blood lactate of man
4. Electrocardiogram and its interpretation
5. Permanent slides: Pituitary gland, thyroid gland, Pineal gland, Pancreas, Adrenal gland, Gonads.

ZOO 2003: ANIMAL BIOTECHNOLOGY AND BIOSTATICS 60 hrs

Unit 1 **15 hrs**

Animal cell culture: Equipment and materials for animal tissue culture technology, various systems of tissue culture, their distinguishing features, advantages and limitations.

Culture medium: natural and synthetic media, Cell and organ culture, Characteristics of cells in cultures

Primary cultures Behaviour of cells, properties, explants culture and suspension cultures

Unit 2 **15 hrs**

Genomic and organelle DNA isolation, polymerase chain reaction (PCR), Restriction, digestion and ligation ; genomic and c DNA libraries; Vectors- Properties, cloning and expression , expression of cloned gene in E.Coli, Hybridoma technology.

Unit 3 **15 hrs**

Definition, Concepts and application of biostatistics in zoology. Measures of central location (tendency)-Mean, Median and Mode. Methods of sampling, sampling error, non sampling error, standard error Measure of variability- Range, Mean deviation, Variance, Standard Deviation and Coefficient of Variation.

Unit 4 **15 hrs**

Test of statistical significance- Chi square and T-test. Basic Probability concepts- addition of probabilities, Multiplication of probabilities, Distributions (Binomial, Poisson and Normal). Meaning of Correlation and Regression.

Bibliography

1. Tools and techniques of biotechnology. By Mousumi Debnath
2. Biostatistics by Jasra, P.K. and Gurdeep raaj, Krishna prakashan media (P),Ltd. Meerut
3. A text book of biochemistry P K Gupta, Rastogi publication
4. Animal cell biotechnology , Methods and protocols by Nigel Jenkins.
5. Biostatistics by P. Ramakrishnan

PRACTICALS: **60 hrs**

1. Cleanliness, media preparation sterilization, culturing methods and dilution techniques
2. Preparation of animal cell culture medium
3. Sterility test of media and serum
4. Cell counting and cell viability
5. Principal of single cell suspension from liver/ spleen
6. Cell suspension culture from different tissues
7. Western blotting
8. Calculation of mean media and mode
9. Calculation of standard a deviation and standard error

ZOO 2004: ANIMAL ECOLOGY AND ENVIRONMENTAL BIOLOGY 60 hrs

Unit 1: Introduction: **15 hrs**

Concepts, principles, scope, basic elements of ecosystems.

Population ecology: Structure, growth curves, concept of carrying capacity, Oscillation. Energy flow at population level; population interaction.

Community ecology: Structure, diversity, patterns in community, biotic community concept. Ecological dominance; Community analysis, Ecotone. Community production – primary and secondary production.

Unit 2: Applied ecology: **15 hrs**

Exobiology, space travel and life support system.

Conventional and Non-conventional energy resources – Wind, solar, bio-fuel and others. Nuclear Energy – Nuclear power plants. Ecological tourism.

Ecological model: Nature of ecological models; goals of model building; basic tools in model building. Approaches to development of models. Energy flow models.

Unit 3: Environment quality, its issues and sustainable development: **15 hrs**

Sources, causes and control of air, water, soil pollution with special reference to present scenario in India. Natural hazards (Earthquakes, cyclones and volcanoes); Tsunami; Soil erosion (degradation and fertility); Forest fires, mining and quarrying. Bioremediation of xenobiotics – principles and types (Phyto-, Zoo- and microbial - remediation).

Unit 4: Human health and hazards: **15 hrs**

Chemical and Biological hazards in developed and developing countries. Risk analysis – Scope, general aspects, communication and management. Occupational health hazards. Industrialization, urbanization and globalization

Bibliography

1. Boughey A S 1971 Fundamental Ecology (Intext Educational Pub.) Pp 222
3. Chenn P 1999 Ecology (John Murray Pub.) Pp 213
4. Collin R, Townsend, Harper J L, and Michael Begon 2000 Essentials of ecology. (Blackwell Sci. Comp.) pp 552
5. Dilip R 1998 Environment management with Indian experience (APH Pub. Cor.)
6. Krebs C J 1994 Ecology (Harper and Collins) pp 801
7. Mackenzie A, Ball A S and Virdee S R 2002 Ecology (Viva Books Pvt. Ltd.) P 339
8. Miller Jr and G T 2002 Living in the environment (Wardsworth, Brooks/Cole)
9. Mishra P C 1990 Fundamentals of Air and Water Pollution (Ashish Publishing House)
10. Odum E P 1971 Fundamentals of ecology (WB Saunders Co.) Pp 574
11. Paul W P 1948 Limnological Methods (The Blakistan Co.)
12. Raven P H, Berg L R, Johnson G B 1993 Environment (Saunders College Pub.) pp 569
13. Singh M C 2000 Environment Protection and the Law (Ashish Publishing House)

PRACTICALS: **60 hrs**

1. Estimation of chloride, sulphate in water samples.
2. Estimation of the B.O.D. (Demonstration) and C.O.D. in water sample
3. Estimation of carbon-di-oxide and oxygen during photosynthesis in aquatic bodies.
4. Population ecology- Population growth in Paramecium/ Drosophila larva.
5. Identification and observation of - a) Hospital waste (Solid waste) b) Pollution indicator species