Ref:- 1. U.O of even No. dt: 18/O7/2014
2.U.O of even No.dt:O3/O7/2017
3. U.O. No.Acad/c4/8008/2014 dt: 3/05/2017
4. U.O No. Acad/C2/2408/2020 dt: 27/11/2020
5. Minutes of the meeting of the Expert Panel (M.Sc. Zoology) held on 02/12/2020.

Sir,

An Expert Committee was constituted for the framing of Regulations, Curriculum and Syllabus of new Generation Course, M.Sc. Zoology (Structure, Physiology, Development and Classification of Animals) sanctioned in Nirmalagiri College, Kuthuparamba as per the University order No 4 sited above, the committee involve the following members.

1. Dr.Anil Kumar Gopinathan
   Senior Professor School of Bio Sciences and Technology,
   VIT University Vellore,
   Tamil Nadu
2. Dr.Binu Ramachandran
   Asst.Professor& DST-SERB-ECR Fellow
   Department of Zoology
   Christ College (Autonomous)
   Iringalakkuda
3. Dr.P.K Prasadan
   Asso.Professor
   Department of Zoology
   Mananthavady Campus
   Wyanadu.
4. Dr.Jijil joseph (Convener)
   Asst.Professor
   Department of Zoology
   Govt.Brennen College
   Thalasseri
5. Dr.Siby Philip
   Asst.Professor
   Department of Zoology
   Nirmalagiri College
   Kuthuparamba

This committee conducted an online meeting on 02/12/2020 for discussing the draft of the syllabus for elective papers **Animal Form and Function (ZOO3E 01), Animal Systematics and Species Interactions (ZOO4E 02), Molecular Developmental Biology (ZOOE4 03), Systematics, Physiology, Development & Animal Interactions (ZOO3&4P 06).**The modifications to the draft syllabus were approved by the members through email on 4/12/2020 and submitted the approved copy of syllabus for further perusal.

Dr. Jiji Joseph V.

Convener Expert Committee

KANNUR UNIVERSITY

M.Sc. Zoology

(Structure, Physiology, Development and Classification of Animals)

Under

KUCBSS

Scheme and Syllabus

2020-21

M.Sc. Zoology (Animal structure, physiology, development and classification) at Nirmalagiri College

Introduction

In this curriculum, M.Sc. Zoology programme has 11 core theory courses, 3 elective theory courses and 6 practical courses, and one dissertation/project course. The total marks for the entire course shall be 1500 and total credit for the entire course shall be 80. 20% of marks shall be allocated for internal assessment of theory and practical papers each.

While framing the courses, due meaning has been given to the thrust areas in Zoology/Life sciences such as Molecular biology, Biotechnology, Environmental biology and Biodiversity, Systematic Zoology, Microbiology etc. Topics from the C.S.I.R. NET/JRF syllabus in Life sciences has also been incorporated in various courses considering the future prospects of the students. The Elective courses offered for the programme are **"Animal structure, physiology, development and classification" at Nirmalagiri College**. Students are required to submit a collection of 20 specimens related to the elective subject as part of the practical course. An independent project/dissertation with 3 credits form an important component of the programme in order to inculcate research aptitude among students. Students are required to undertake a compulsory study tour and a report of the tour has to be presented. The scheme, detailed syllabi and pattern of question papers are presented herewith.

Semester	Course code	Title of Course	Marks			Credits
			Internal	External	Total	
I	ZOO1C 01	Cell Biology and Genetics	15	60	75	4
	ZOO1C 02	Biological Chemistry	15	60	75	4
	ZOO1C 03	Systematic Zoology and Behavioral Science	15	60	75	4
	ZOO1C 04	Microbial Science	15	60	75	4
	ZOO1 &2P 01	Cell Biology, Genetics & Molecular Biology	--	--	--	--
	ZOO1 &2P 02	Biological Chemistry, Biophysics & Biometry	--	--	--	--
	ZOO1 &2P 03	Environmental Biology& Systematic Zoology	--	--	--	--
Total for I Semester			60	240	300	16
II	ZOO2C 05	Molecular Biology & Molecular Evolution	15	60	75	4
	ZOO2C06	Biophysics and Biometry	15	60	75	4
	ZOO2C07	Environmental Biology	15	60	75	4
	ZOO2C08	Immunology	15	60	75	4
	ZOO1 &2P 01	Cell Biology, Genetics & Molecular Biology	10	40	50	3
	ZOO1 &2P 02	Biological Chemistry, Biophysics & Biometry	10	40	50	3
	ZOO1 &2P 03	Environmental Biology & Systematic Zoology	10	40	50	3
	ZOO2C09	Viva Voce	5	20	25	1
Total for Semester II			95	380	475	26
III	ZOO3C 10	Animal Physiology	15	60	75	4
	ZOO3C 11	Developmental Biology and Endocrinology	15	60	75	4
	ZOO3E 01	**Animal Form and Function**	**15**	**60**	**75**	**4**
	ZOO 3 &4P 04	Animal Physiology	--	--	--	--
	ZOO3 &4P 05	Developmental Biology, Histology & Histochemistry	--	--	--	--
	ZOO3 &4P 06	**Systematics, Physiology, Development & Animal Interactions**	--	--	--	--
	ZOO3 &4 Pr.0 1	Project/Dissertation				
Total for Semester III			45	180	225	12
IV	ZOO4C 12	Biotechnology and Bioinformatics	15	60	75	4
	ZOO4E 02	**Animal Systematics and Species Interactions**	**15**	**60**	**75**	**4**
	ZOO4E 03	**Molecular Developmental Biology**	**15**	**60**	**75**	**4**
	ZOO 3 &4P 04	Animal Physiology	10	40	50	3
	ZOO3 &4P 05	Developmental Biology. Histology & Histochemistry	10	40	50	3
	ZOO3 &4P	**Systematics, Physiology, Development**	**10**	**40**	**50**	**3**

	06	**& Animal Interactions**				
	ZOO3&4P 07	Personal collection related to elective subject	5	20	25	1
	ZOO3 &4 Pr.01	Project/Dissertation	15	60	75	3
	ZOO4 C 13	Viva-voce	5	20	25	1
Total for Semester IV			100	400	500	26
Total for semesters I, II, III, and IV			300	1200	1500	80

1. Eligibility

BSc Zoology/Life Science with not less than 50 % marks or equivalent GPA excluding subsidiaries/Complementary Courses

2. Project Work and Viva Voce

a) Each student shall carry out a project work in one of the broad areas of zoology in the III & IVth semester under the supervision of a teacher of the department. A student may, in certain cases be permitted to do the project work in a research organization on the recommendation of the Head of the Department /Department coordinator. In such cases, one of the teachers from the department shall act as supervisor/internal guide.

b) The candidate shall submit 2 copies of the dissertation based on the results of the project work at the end of the program.

c) Every student has to do the project work independently. No group projects are accepted. The project should be unique with respect to title, project content and project layout. No two project report of any students should be identical, in any case as this may lead to the cancellation of project report by the university.

d) The assesment of the project work shall be conducted by two external examiners. The evaluation of the project will be done at two stages.

i. Internal evaluation (supervising teacher/s will assess the project and award internal marks)

ii. External evaluation (by external examiners appointed by the university)

e) Pass conditions

i. The students shall declare to pass the project report course if she/he secures minimum 40% marks (internal and external put together). In an instance of inability of obtaining a minimum of 40% marks, project work may be redone and the report may be resubmitted along with subsequent exams through parent department. There shall be no improvement chance for the marks obtained in the project report.

f) Assessment of different components of project may be taken as below

Internal (Viva) 20% of total External (80% of Total)

g) Viva voce shall be conducted by two examiners; both of them shall be external examiners..

3. Continuous assessment

a) This assessment shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and attendance in respect of theory courses and based on tests, lab skill, record/viva and attendance in respect of practical courses.

b) The percentage of marks assigned to various components for internal is as follows

Theory

Components % of internal marks

1) Two test paper 40

2) Assignments 20

3) Seminars/Presentation of case study 20

4) Attendance 20

Practicals

Components % of internal marks

1) Two test papers 40

2) Lab skill 20

3) Records/viva 20

4) Attendance 20

2. Grading system

Seven point indirect grading system

3. Pass requirement

Those who secure not less than 40% marks (ESE and CA put together) for the all courses of a semester shall be declared to have successfully completed the semester. The marks obtained by the candidate for CA in the first appearance shall be retained (respective of pass or fail). The candidate who fails in theory unit shall reappear for theory unit only and the marks secured by them in practical unit, if passed in practicals will be retained. A candidate who fails to secure a minimum for a pass in a course will be permitted to write the same examination along with the next batch. For the successful completion of a semester a candidate should pass all courses and secure a minimum SGPA of 4. A candidate who secures minimum marks (40%) for a pass in a course will be permitted to write the same examination along with the next batch if he/she desires to improve his/her performance in ESE. There shall be no improvement chance for the marks obtained in the internal

assessment. Improvement of a particular semester can be done only once the students shall avail the improvement chance in the succeeding year along with the subsequent batch. There shall be one improvement chance for a course.

4. Conduct of external examination

a) External examination in each semester shall be conducted after five months from the commencement of process..

b) The board of examiners will value the theory papers, conduct practical and vivavoce examination and evaluate the project work. The evaluation of the answer scriptsb shall be done by examiners based on well-defined scheme of valuation. The project work shall be adjudicated by two external examiners. The practical examination, viva-voce and project evaluation will be conducted by two examiners (internal and external). The viva-voce examination will be based on the theory papers, practical papers, and project work as applicable.

c) The candidate shall be given one chance for improving the theory and practical papers of each semester by permitting him/her to appear for paper(s) along with the subsequent batch of students in accordance with the syllabus in course that time.

5. Objectives (within brackets the papers covering the objective)

To gain knowledge about animal classification, quantification, anatomy, development and evolution (Cell biology, genetics, biochemistry, biodiversity, entomology and physiology)
To gain knowledge about how animals maintain homeostasis and the different bodily structure involved (Cell biology, genetics, biochemistry, entomology and physiology)
To gain in-depth knowledge on the molecular mechanisms of the cell, metabolism and its interactions (Cell biology, genetics, biochemistry and physiology)
To gain knowledge about microbes, pathogens and their environment (microbiology)
To learn about environmental interactions of animals and microbes (microbiology, ecology and behavior)
Apply biological knowledge to solve human needs demands (biotechnology, entomology and applied zoology)

6. Outcomes

Understand ecological interactions and apply the knowledge in conserving biodiversity
Able to identify and classify animals
Understand homeostasis and the molecular underpinnings
Able to empirically analyze environmental destruction and suggest remedial measures
Able to advise apiculture, aquaculture and pest management
Undertake basic science research problems to learn fundamental biological properties and mechanisms
Undertake applied science and molecular biology research to solve problems related to animal systematic, animal biodiversity and diseases

SEMESTER I

ZOO1C01: Cell Biology and Genetics

(Theory 60 Hours- Credits- 4)

A Cell Biology (30 Hours)

1. Cell Membrane and permeability: Molecular organization; Permeability - passive permeability - passive diffusion - active transport - sodium pump - ionic transport through charged pores- transport proteins- carrier and fixed pore mechanism; Differentiation of cell membrane - microvilli- tight junction - belt and spot desmosomes - intercellular communications and gap junctions - cell coat and cell recognition. **6 Hours**

2. Synthesis, sorting and trafficking of proteins: site of synthesis of organelle and membrane proteins - transport of secretory and membrane proteins across ER - posttranslational modification in RER - Transport to mitochondria, nucleus, chloroplast and peroxisome - protein glycosylation - mechanism and regulation of vesicular transport - golgi and post golgi sorting and processing - receptor mediated endocytosis: Synthesis of membrane lipids. **8 Hours**

3. Nucleus: Nuclear envelope- nuclear matrix – organization of chromatin- supercoiling, linking number, twist - nuclesome and high order of folding and organization of chromosome. **6 Hours**

4. Cell Cycle and Regulation: Overview of cell cycle – Molecular mechanisms of regulating mitotic events – check points in cell cycle. **6 Hours**

5. Cell Death: Apoptosis - necrosis – autophagy - ageing. **4 Hours**

B. Genetics (30 Hours)

.6. Molecular mechanisms involved in recombination of DNA - gene conversion - Rec-A protein and its role in recombination. **8 Hours**

7. Genetics of microorganisms: the genetics of viruses- Bacteriophage T4 & Lamda, Genetics of Bacteria - mechanism of genetic exchange in bacteria transformation, conjugation, and transduction. **10 Hours**

8. Transposable genetic elements: Transposable elements in bacteria transposable in eukaryotes- retroviruses and retrotransposons. **6 Hours**

9. Genetics of Cancer: Onocogenes- tumor suppressor genes- BRCA genes- pathways to cancer. **6 Hours**

References:

Lodish et al., Molecular Cell Biology. W.H Freeman & Co.

Becker W M et al., the World of the Cell. Person.

DeRobertis E D F and DeRobertis E MF, Cell and Molecular Bilogy, Sauders.

Karp and Gerald, Cell and Molecular Bilogy. John Wiley.

Polland Thomas D, Cell Biology. Saunders.

Standzinski George P Editor, Cell growth, differentiation and senescence.

Pxfor University Press.

Alberts B, Molecular Cell Biology.

Roberts j Brooker, Genetics: Analysis and Principles. Addison Wesley Longman

Klug W S & Cumming W S, Concepts of Genetic. Prentice Hall.

Gardnerand Simmon, Principles of Genetics. John wiley & Sons.

Strickberger, Genetics. Monroe w.

Bhasin M.K & Walter H, Genetics from Genes to Genome.

Stent G, Molecular Genetics. Freeman.

Burns G W & Hottins P J, The Science of Genetics. Mapwell Macmillan.

Strickberger M W, Experiments in Genetics with Drosophila. John wiley.

Hartl, David L, Genetics. Jones and Bartlett.

King William S & M R Qumming. Genetics. Prentic Hall

Waseem Ahamed. Genetics and Genomics Pearson Education.

ZOO1C02:Biological Chemistry

(Theory-60 hrs -Credits-4)

1. Biomolecules and its Cellular metabolism

1.1.Carbohydrates

a. Classification, structure and properties

b. Carbohydrates derivatives- sugar alcohols, sugar acids, amino sugars etc.

c. Glycolysis, Fate of pyruvic acid (Pyruvic acid dehydrogenase), TCA cycle, Glycogenolysis, Glycogenesis, Gluconeogenesis, pentose phosphate patyhway, glyoxylic acid cycle.

d. Regulation of glucose metabolism

6 Hours

1.2.Protein

a. Classification of amino acids, structure and properties

b. Peptide bonds, Zwitter ions

c. Reactions of Proteins

d. Classification of proteins

e. Three dimensional structure of proteins;

f. protein folding

g. Deamination, transamination and transmethylation

h. Urea Cycle

i. Metabolism of glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine and histidine

j. Inborn errors in amino acid metabolism

15 Hours

1.3.Lipids

a) Classification, structure and properties

b) Phospholipids, glycolipids, sphingolipids

c) HDL and LDL

d) Biosynthesis and oxidation of fatty acids

e) Biosynthesis of phospholipids, spingolipid, glycolipid

f) Regulation of fatty acid metabolism

14 Hours

1.4.Nucleic Acid

a) Structure of nitrogen bases, nucleosides and nucleotides

b) Structure of DNA and RNA

c) Biosynthesis and degradation of purines

d) Biosynthesis and degradation of pyramidines.

5 Hours

1.5 Enzymes

a) IUB classification, nomenclature and specificity

b) Mechanism of enzyme action

c) Michaelis-Menten equation- derivation, double reciprocal plot, Line-Weaver-Bruke-
method, Significance of KM and Vmaax values

d) Factors affecting enzyme action,

e) Regulation of enzyme activity, enzyme inhibition, allosteric enzymes- positive
and negative modulators

f) Vitamins as co-enzymes **10 Hours**

2. Bioenergetics

a) Enthalpy, entropy, free energy concept

b) Living body as a thermodynamic system, energy of activation, standard free energy

c) Energy-rich compounds- ATP, Creatine Phospate and Pyrophosphate

5Hours

3. Biological oxidation

a) Electron transport system in mitochondria, redox potential

b) Mechanism of oxidative phosphorylation

c) Chemiosmotic coupling hypothesis.

5Hours

References:

1. Stryer, L. (1995): Biochemistry(4th Ed), W. H. Freeman & Co., New York
2. Lehninger, A. L. (1990): Principles of Biochemistry, CBS Publishers & Distributers Pvt. Ltd.
3. Mahler, H. R. & Cordes, E. H. (1968): Basic Biological Chemistry, Harper & Row Publishers
4. Lehninger A. L., Nelson, D. L. & Cox, M. M. (1993): Principles of Biochemistry (2nd Ed.), CBS Publishers & Distributers Pvt. Ltd.
5. Donald Voet and Judith G Voet.(2011): Biochemistry (4th Ed.), John Wiley and Sons. INC.
6. Awapara, J. (1968): Introduction to Biological Chemistry, Prentice-Hall of India, New Delhi
7. Ranganatha Rao, K. (1986): Textbook of Biochemistry (3rd Ed.), Prentice-Hall of India, New Delhi
8. Cohn, E. E. & Stump, P. K. : Outlines of Biochemistry, Wiley Estern, New Delhi
9. Wilson, J. & Walker, K. (1996): Practical Biochemistry- Principles and Techniques (4th Ed.), Cambridge
10. Sadasivan, S. & Manikam, A. (1996): Biochemical methods (2nd Ed), New Age International Publishers
11. Pattabhiraman, T. N. (1998): Laboratory Manual in Biochemistry (3rd Ed.), All India Publishers and Distributers, Chennai
12. Nelson David L., 2000, Principals of Biochemistry (McMiillan)
13. Sathyanarayanan, U., 2002, Biochemistry (Books and Allied)
14. Rastogi, S. C., 2003, Biochemistry (Tata-McGraw Hill)
15. Dandekar, S. P., 2004, Medical Biochemistry (Elsevier)
16. Veerakumari, L., 2004, Biochemistry (MJP)
17. Chatterjee, M. N., 2005, Text Book of Medical Biochemistry (Jaypee)

ZOO1C03: Systematic Zoology and Behavioral Science

(Theory-60 hrs -Credits-4)

A. Systematic Zoology (30hrs)

1. Introduction

Definition and basic concepts; Systematics and Taxonomy; Historical resume; Levels of Taxonomy- alpha, beta and gamma taxonomy; importance of Taxonomy

4 Hours

2. Classification

History;Princi;ples and Rules of classification; Functions of Classification; Kinds of Classification- Phenetic, Cladistic, Evolutionary and Hierarchial.

4 Hours

3. Species Concepts

Species concepts-Typological, Nominalistic, Biological and Evolutionary . Intraspecific Catagories; Variety, Race, Cline, Subspeicies.

5 Hours

4. Taxonomic Characters

Definition and Funcstions; Kinds of Taxonomic Characters-Morphological, Anatomical, Embryologiucal, Ecological, Ethological, Cytological, Biochemical, Geographical and Molecular.

6 Hours

5. Taxonomic Procedure

Taxonomic Collections, Curation, Labelling, Cataloguing, Descrioption, IdentificationMethos of identification- Taxonomic key.

5 Hours

6. Zoological Nomenclature

History; International Code of Zoological Nomenclature-important Codes of Zoological Nomenclature- Nature of Scientific names; Species and infraspecific names; Genus group

taxa; Synonyms and Homonyms; Authors' name in bracket; Law of Priority; Type Method and kinds of Types.

6 Hours

B. Behavioural Science(30hrs)

1. Introduction

Definition and concepts; Ethology and its relation to other schools studying Animal Behaviour

2 Hours

2. Instinctive Behaviour

Instinctive behavior; Fixed Action Pattern; Sign Stimuli and Releasers; Supernormal Stimuli.

4 Hours

3. Reflex and Complex Behaviour

Latency ; After discharge; Summation; Warm up; Fatigue; Inhibition; Feedback regulation; Orientation and Navigation in birds; Displacement Activities.

5 Hours

4. Biological Communication

Nature and Functions- Forms of signals; Costs and benefits of signaling; Types of Communications- Chemical, Visual, Auditory, Tactile and Electrical

5 Hours

5. Reproductive Behaviour

Evolution of sex and reproductive strategies; Mating system; Courtship; Sperm competition; Sexual selection; Parental care. **4 Hours**

6. Genetics of Behaviour

Relationship between genes and behavior; Experimental methods demonstrating genetic basis of behavior; Relationship between genes and environment in the

control of behaviour

5 Hours

7. Evolution of Behaviour

Adaptiveness of behavior; Cultural transmission of behavior; kin selection and inclusive fitness; Alturism and Reciprocal altruism.

5 Hours

References:

Balckwelder, R.. C (1967) Taxonomy- A text and reference book. John wiley and Sons Inc., New York , London , Sydney , 698 pp.

Dalela, R.C and R. S Sharma (1992) Animal Taxonomy. Jaiprakashnath Co., Meerut .

Hills, D. M., Moritz, C. and Mable, B. K (eds.) (1996) Molecular Systematics, Sinauer Associates, Sunderland , MA

Kapoor, V.C (1998) Theory and ractice of Animal Taxonomy. Oxford & IBH, Publ., Co., New Delhi .

Mayr, E., Linsley, E.G . and Usinger, R.L (1953) Methods and principles of Systematic Zoology. Mc Graw Hill Book Company, Inc., New york . 336 pp

Mayr E (1969) Principles of Systematic Zoology. MC Graw Hill Inc., New York

Mayr, E and Peter D.Ashlock (1991). Principles of Systematic Zoology. McGraw-Hill

MInelli, A. (1993) Biological Systematics. Chapman & Hall, London , 387 pp.

Ross, H. H. (1974) Biological Systematics. Addison - Wesley Publishing Company, Inc., London , 345 pp.

Simpson, G.C (1961) Principles of Animal Taxonomy, Oxford IBH

Amita Sarkar 2004, Development of Animal Behaviour, discovery Publishing house.

Bolchuis J J and Hogan J.A (1999). The development of Animal Behaviour.

Blackwell Publisher.

Boulenger, E.G 2003, An Introduction to animal behaviour, Discovery

Publishing house, New Delhi .

Goodenough, J.; McGuire B. and Robert, W. (1993) Perspectives on Animal behaviour

John Wiley and Sons, Lond.

John Alcock, (2001) animal behaviour- 7th edition. Sinauer assn. publ.

John Alcock, 2005. Animal Behaviour.- 8th edition. Sinauer Associates, Inc.

Publishers.

Lee Alan Dugattan (2004) Principles f animal behaviour w.w. Norton & company

Lehner, P. (1996) Handbook of Ethological methods. Cambridge Univ.

press, Lond

Manning, A. and Dawkins, M.S (1995) An Introduction to Animal Behaviour.

Cambridge University Press.

Manning, A (1967) An Introduction to Animal Behaviour. Edward Arnold pub.,

London

Martin, P. and Bateson, P. (2001) Measuring Bechaviour. An Introductory guide.

Cambridge University Press.

Narendran T.C.(2005). An Introduction to Taxonomy. ZSI

Postlewait, J. H. and Hopkins , B.L. (1995) Nature of life. McGraw Hill

Slater, P.J B (1995) An Introduction to Ethology. Cambridge Univ. Press. Lond.

Slater. P. J. B (1999) Essentials of Animal Behaviour. Cambridge Univ. Press

Slater, P. J. B and Halliday, T.R 1994) Behaviour and Evolution . Cambridge Univ.

press. Lond.

ZOO1CO4: Microbial Science

(Theory – 60 hours - Credits-4)

A. Microbial Science

1. History and scope of Microbiology **4 Hours**

2. **Microbial Diversity:** Place of microorganisms in the living world – criteria used in Microbial taxonomy; Classification of bacteria – past and present status – classification based on morphology, gram's staining and culture characteristics. Classification based on Bergey's manual of systematic bacteriology (details of sections not expected) Classification of viruses-classification based host, vital morphology and nucleic acid characteristics. **10 Hours**

3. Structural organization of bacteria and viruses: Ultra structure of bacterial cell wall, cell membrane – flagella – pili – capsule and genome; Structure and architecture of bacteriophages. **8 Hours**

4 Bacterial culturing: Physical and chemical methods of sterilization – growth media mixed microbial population – selection of pure culture – physical conditions of rowth – growth curve – storage and transport of microbes **8 Hours**

5. Microbial toxins: Exotoxins – endotoxin and other virulence factors **6 Hours**

6 Disinfectants and antibiotics: Methods of testing antimicrobial substances – mechanism and action of important classes of disinfectants and antibiotics - drug resistance of antibiotics.

6 Hours

7 Microbes and diseases: Bacterial diseases – Streptococcal diseases – Tuberculosis Plague – Anthrax – Syphilis – Tetanus – Leprosy; Viral diseases – Chicken pox – Small pox – Rabies – AIDS **10 Hours**

8 Microbes and Pollution: Major pollution problems – pathogens, microbial toxins, oxygen depletion, biodeterioration, eutrophication, hazardous transformation etc., and management of pollution problems using microorganisms. **8 Hours**

References:

Prescott, Harley and Klein, Microbiology, McGraw – Hill

Jacquelyn G Black, Microbiology: Principles and Exploration, John Wiley & Sons

Nester er al, Microbiology: A human perspective. McGraw Hill

Albert G Moat et al, Microbial physiology, John Wiley & Sons

Kathleen Park Talaro, Arthur Talaro, Foundations in Microbiology, Mc Graw Hill

Alcamo, Foundations of Microbiology, Jones and Bartiett Publishers

Cappuceino James, Microbiology: A Laboratory Manual; Pearson Education

Toratora Gerad, Berdell R Funke and Christine L Case (2011), Microbiology: An introduction(9th Ed.) .Pearson education

Edward A I, Microbiology. Tata McGraw Hill

Lim Daniel, Microbiology. Mc Graw Hill

Pelczar M J Jr, Chan E C S Krieg, Microbiology

Godkar, PB (1998), A Text book of Medical Laboratory Technology, Bhalani Publishing house, Mumbai

Ronald M. Atlas and Richard Bartha((2008). Microbial Ecology Fundamentals and Applications (4th Ed.) Pearson Education

SEMESTER II

ZOO2C05: Molecular Biology and Molecular Evolution (Theory-60 hours - Credits-4)

A - Molecular biology (45 Hours.)

1. Three dimensional structure and synthesis of DNA: Structure and chemistry of double helical DNA, Semi-conservative replication – experiments of Messelson and Stall and Cairn's experiment. Replication - link between bacterial growth and DNA replication, semi-discontinues replication of DNA, rolling circle and D-loop model, Replication apparatus- enzymes involved in DNA replication, Types of DNA- A,B,Z etc., Triplex DNA. **10 Hours**

2. Restriction, modification and repair of DNA: excision repair pathways- error prone repair- recombination repair- SOS system. **6 Hours**

3. Transcription and processing of RNA: Synthesis of mRNA in prokaryotes and eukaryotes, processing of mRNA: capping – poly A tailing and splicing, tRNAcloverleaf and L-shaped tertiary structure - base modifications – wobbling, rRNA synthesis. **8 Hours**

4. Translation: Genetic code, various steps involved translation, post- translational modifications. **8 Hours**

5. Eukaryotic genome: C-value paradox; unique, moderately repetitive and highly repetitive DNA sequences; re-association kinetics - Cot value and complexity of genome; satellite DNA; Rot value. **5 Hours**

6. Regulation of gene expression: Operons - lac, tryptophan, arabinose and galactose **8 Hours**

B – Molecular Evolution (15 Hours)

1. Molecules and origin of life: Origin of basic molecules – origin of organized structures (coacervates, microspheres): RNA world – evolution of protein synthesis - evolution of genetic code; prokaryotes and eukaryotes- evolution of eukaryotic organelle; genetic constancy and variability – chromosomal variation, gene mutation, gene duplication;

evolutionary history of haemoglobin, cytochrome C, pseudogenes, genetic polymorphism, eukaryotic clock; genetic drift and gene flow. **6 Hours**

2. Microevolution, macroevolution and punctuated equilibrium, anagenesis and cladogenesis. 5 Hours

3. The evolution of genome: DNA alterations- genome size- gene diversificationintrons-repeat sequences. **4 Hours**

References:

Benjamin Lewin, Genes XI, John Wiley
Benjamin Lewin, Gene Expression Vol1-3 john Wiley.
Watson J D et al., Molecular Biology. Scientific American Books. W.H Freeman.
Lodish H ET al., Molecular Cell biology. Scientific American Books. W H Freeman.
David Freidfelder, Molecular Biology. Narosa.
Brown T A, Genomes. Bioscientific.
Winnackeer Ernst l, From genes to Clones. Panima.
Dale J W and von Schantz, from genes Genomes. John Wiley.
Malathi. V Essewntials of Molecular Biology. Pearson Education.
Micklos D A et al, DNA Science. Cold spring Harbor.
Weaver Robert F, Molecular Biology. Viva Books.
Kreuzer Helen, Molecular Biology and Biotechnology: A Guide for Teachers.
Alber Bruce, Molecular Biology of the Cell. Garland Science.
Calladine, Horace Drew, Ben luisi, understanding DNA. Elsevier.
De Robertis, E.D.F and De Robertis E.M.F, Cell and Molecular Biology.
Dale J W and von Schantz, From genes to Genomes, john Wiley.
L H Hartwell et al., Genetics from Genes to Genomes, john Wiley.
Li W. H, Molecular Evoloution, Sinauer Associate.
Strickberger M W, Evoloution, jones & Barllett
Volpe E P, Understanding Evolution. Universal Books Stall
Edwin H McConkey, Human Genetics: The Molecular Evolution, jones and Bartlette.
Masatoshi Nei and Sudhir kumar, Molecular Evolution and phylogenetics. Oxford University Press.

ZOO2C06: Biophysics and Biometry

(Theory -60 hrs-Credits -4)

A. Biophysics (40 hrs)

1. Principle and applications of Biophysical methods

1. Microscopy: Fluorescence, Scanning and Transmission Electron Microscopy, Scanning tunneling Microscopy

2. Flow-cytometry

3. Chromatography : gel filtration, ion-exchange and affinity chromatography, thin layer and gas chromatography, High Performance Liquid Chromatography (HPLC)

4. Electrophoresis: PAGE, 2DE, IEF, PFGE

5. Centrifugation : gradient and differential; ultra centrifugation

6. X-ray diffraction,

7. Ramachandran Plot

8. Spectroscopy-fluorescence, UV, ORD, Visible, NMR, ESR, Atomic absorption and Plasma emission spectroscopy

16 Hours

2. Radiation Biology

1. Principles and applications of tracer techniques in biology,

2. Uses of X-rays in biomedical applications,

3. Measurement of Radioactivity- Autoradiography, liquid scintillation counter, gamma counter

6 Hours

3. Physics of photobiological system

1. Photodynamic action

2. Biophysics of photosynthesis

4 Hours

4. Biophysics of vision

1 Light and its attenuation of vision,

2 Eye as an optical instrument,

3 Formation of image

4 Hours

5. Biomagnetism Generation and nature of biomagnetic fields

2 Hours

6. Bioacoustics

1 Physical basis of hearing- limit of intensity of sound, audible sound frequency
2 Physical basis of voice- infra or subsonic sounds and ultra sonic sounds
3 Physical organization of ear
4 Physical aspects of transmission of sound in the ear
5 Echo-location
6 Echocardiography,
7 Doppler ultra sonography
8 lithotripsy

8 Hours

B. Biometry (20 hrs)

1.Nature and scope of biometry and its applications in Biology

a) Discrete and continuous variables

b) Collection, classification and tabulation of data

c) Frequency table

d) Diagrammatic and graphic representation of data- bar diagram, pie diagram, histogram, frequency polygon, frequency curve.

4 Hours

2.Measures of central tendency

Arithmetic mean, median and mode

1 Hour

3.Measures of dispersion

Range, quartile deviation, mean deviation, standard deviation and Skewness

2 Hours

4.Probability theory

Basic concepts and definition of probability, relative frequency definition,

probability distributions – binomial, Poisson and normal distributions and their

applications

3 Hours

5.Testing of hypothesis

Level of significance, critical region, type I and type II error, Tests based on normal distribution- t-test, F-test, Z-transformation test and chi-square test

4 Hours

6.Correlation

Positive correlation, negative correlation, co-efficient of correlation (r)

2 Hours

7.Regression analysis

Types of regression analysis, Regression equation and its application in computing X or Y

2 Hours

8.Analysis of variance

ANOVA- one way and two way classifications

2 Hours

References:

1. Ackerman, E. (1962): Biophysical Sciences, Prentice-Hall, Inc
2. Kane, J.W. & Steinhein, M. M. (1978): Life Science Physics, John Wiley & Sons
3. Roy, K. N. (1996): A text book of Biophysics, New Central Book Agency, Pvt. Ltd., Culcutta
4. Thiravia Raj, S. (1995): Biophysics, Saras Publications
5. Jasra, P. K. & Raj, G. (2000): Biostatistics, Krishna Prakasan Media Pvt. Ltd.
6. Khan, I. A. & Khanum, A. (1994): Fundamentals of Biostatistics, Ukaaz Publications, Hydrabad
7. Dixon, W. J. & Massey, F. J., Jr. (1985): Introduction to Statistical Analysis (4th Ed)
8. Sokal, R. R. & Rohlf, F. J. (1969): Introduction to Biostatistics, W. H. Freeman and Co
9. Lewis, A. I. (1966): Biostatistics (2nd Ed), Reinhold Publishing Corporation
10. Snedecor, G. W. & Cochran, W. G. (1967): Statistical Methods (6th Ed), Oxford & IBH Publishing Co.
11. .Rama Krishnan, P. (2005) Biostatistics, Saras Publications
12. . Mariappan, P (2013). Biostatistics An Introduction. Pearson
13. Padmini, E (2007). Biochemical calculation and Biostatistics. Books and Allied(P) Lt

ZOO2CO7: ENVIRONMENTAL BIOLOGY

(Theory- 60hrs.,Credits-4)

1. Population Ecology

1.1.Population growth-Exponential growth,Sigmoid growth,Chaotic system,Catastrophic theory,Intrinsic rate of natural increase,Concept of carrying capacity.

1.2.Life history strategies(r and k selection)

1.3.Life tables and survivorship curves

1.4.Metapopulation dynamics **7 Hours**

2. Biogeochemical Cycles

2.1.Anthropogenic influence on nitrogen , carbon and water cycles. 5 Hours

3. Ecological Energetics

3.1.Models of energy flow, Flow of energy in a forest ecosystem, Ecological modelling. **5 Hours**

4. Ecosystem Studies

4.1.Ecology of wetlands: Importance, threats and management

4.2.Ecology of Coral reefs: Importance, threats and management

4.3.Ecology of Tropical Rainforests: Importance, threats and management. **9 Hours**

5. Evolutionary Ecology

5.1.Definition,Defense mechanisms in plants.

5.2.Co-evolution:plant-animal interactions-pollination and seed dispersal, evolution of predator-prey systems. **4 Hours**

6. Coservation Ecology

6.1.Impact of major ecosystem processes like habitat degradation, loss and fragmentation, over exploitation, species invasion and land use changes on biodiversity.

6.2.Restoration ecology.

6.3.Sustainable development.

6.4.Ecological footprinting. 10 Hours

7. Taxasphere and Inventorying

7.1.Reasons for udertaking inventorying, priority conservation area recognition.

7.2.Indexing of world's known species,species 2000.

7.3.Evaluation of biodiversity indices-Shannon-Weiner index,Similarity and dissimilarity indices,Association index. 8 Hours

8. Human Ecology

8.1.Human poulation growth-consequences and solutions.

8.2.Global environmental issues-ozone depletion and its impacts,human mediated global climate change-greenhouse effect and its impacts. 6 Hours

9. Environmental Biotechnology

9.1.Cleaner technologies:solid waste and pollution management

9.2.Bioremediation

9.3.Ecological impacts of genetically modified plants and other organisms. 6 Hours

References:

Krebs, C.J (1985): Ecology (3rd Ed.), Harper & Row, New york

Ricklefe, R.E (1980): Ecology, john Wiley & sons, new York

Pianke, E.R (1985): Evolutionary Ecology (3rd Ed.), Harper & Row, New York

Begon, K.., Harper, L & Townsend, C.R (1987): individuals, Population and communities, Blackwell Scientific publishers, Oxford, London

Riseth, G.D & Baumardner, K.D (1981): Population Biology, Van Nostrand New York.

Pielon, E.C (1974): Population and community Ecology: Principles and Methods

Pielon, E.C (1977): Mathematical Ecology, john Wiley & sons, New York

Poole, R.W (1974) : An introduction to Quantitative Ecology, McGraw-Hill publishing co;. New york.

Bhatt, S. (1997): Biodiversity, Oxford University press

Sharma, P.D (1997): Environmental Biology, Rastogi publications

Asthana, D.K & Asthana, M. (1998): environment- Problems and solutions,

S. chand & co.

Smith, R.L 1990: Ecology and Field Biology, Harper Collins

Agarwal, K.C (1998): Biodiversity,Agrabotanica

Kumar, R. (1987): Environment Pollution and health- Hazards in India,

Ashigh publishing House, New Delhi.

Brewer, R. (1994) : the Science of Ecology, Saunders college Publication

Ricklefs, R.E (1990): Ecology, W.H Freeman & Co.

Townsend, C.R (2000): Essentials of Ecology, Blackwell Science

Odum, E.P. 1994): Ecology and our Endagered support, sydwin- sinauer Associate

Bossel, Earth at a crossroads- path for a sustainable future. Cambridge University press.

Caughley, Graeme, Sinclair and Antony (1994) wild life ecology and management,

Blackwell Science, USA

Carson, R. (1963) Silent spring, Houghton, Mifflin, Boston, USA

Chauhan, T.S and jodhi, K.N. (1996) applied remote sensing and photo- Interpretation,

vigyan prakash, jodhpur

Cunningham, P.W and Woodworth, S.B. (1999) Envirinmental Science. WCB/

McGraw Hill

Fred van dyke (2003) conservation biology : foundation, concepts, Application.

McGraw Hill.

Jhanwar, M.L. and chauhan, T.S (1998) Remote sensing and photogrammetry,

Vigyan prakash, jodhpur.

Kormondy, E.J (1986) Concepts of Ecology. Prentice hall, New Delhi.

Odum E.P (1971) Fundamentals of Ecology. Saunders, USA

Mukerjee (1982) Endangered animals of India. ZSI, India

Miller, Tyler Jr.G (2005) Living in the Environment, Principles, Connections

and Solutions. Thirteen edition, Thomson Brookes/Cole

Manjunath D L(2007). Environmental studies. Pearson

Negi, S.S (1993) Biodiverstiy and Conservation in India. Indian Publ. Co.

Odum, E.P (1997) Ecology: A bridge between science and society.

Sinauer assosiatesInc.

Osborne, P. L (2000) Tropical Ecosystems and Ecological concepts.

Cambridge Univ. press

Peter, S. (2002) Ecology: Theories and Applications, prentice Hall of India

Quarrie J.E G. (1992) Earth summit, 1992. The Regency press, London

Southwood. T.R.E and Henderson, P.A (2000) Ecological methods. Blackwell Science

UNEP (1995) Global Biodiversity Assessment. Cambridge univ. press., lond.

Wilson, E.O (1992) The diversity of life. Harvard univ. press, USA

Smith,TM&Smith,RL(2006).Element of Ecology,sixth edn.,Pearson.

Maiti,PK&Maiti,P(2011).Biodiversity-Perception,Peril and Preservation,PHI.

O'Riordan,L&Stoll-Kleeman,S.(2002).Biodiversity,Sustainability and Human

Communities.Cambridge University Press.

Peter,S(2002).Ecology.Theories and Applications.PHI.

Seragg,A(1999).Environmental Biotechnology.ELBS.

Seragelglin(1999).Biotechnology and Biosafety.World Bank,Washington.

Wilson,EO(1988).Biodiversity.Academic Press.

ZOO2C08: IMMUNOLOGY

(Theory -60 hrs-Credits -4)

1. Historical background and scope of immunology **1 Hour**

2. Overview of the immune system:

Innate immunity, Acquired immunity

Cellular and humoral immunity

Passive and active immunity **1 Hour**

3 .Cells and organs of immune system:

Basophils, Eosinophils, Nutrophils, B-Cells, T-cells, Natural killer cells,

Monocytes an Macrophages

Primary and secondary Iymphoid organs **10 Hours**

4. Lymphocyte activation , proliferation and differentiation – **4 Hours**

B Lymphocytes and T-lymphocytes

5. Phagocytosis and inflamation **3 Hours**

6. Antigens (Immunogens)

Basis of specificity, epitopes, haptens **2 Hours**

7. Antibodies:

Structure of a typical antibody molecule

Different classes of immunoglobulins (Ig A IgD, lgD, IgM and lgE)

Organization and expression of Immunoglobulin genes- Primary immunoglobulin gene

Rearrangement; Immunoglobulin genes: Somatic recombination of gene segments, Rearrangement of V, D and J gene segments, V (D) J recombinase **6 Hours**

8. **Major histocompatibility complex:**

General organization: MHC class I and MHC class II

Antigen processing and presentation **4 Hours**

9. Complement system:

Classical pathway and Lectin pathway **4 Hours**

10 .Cytokines **3 Hours**

11. Hypresensitivity reactions:

Types I, Type II and Type III hypersensitivity

Delayed type hypersensitivity (DTH) **5 Hours**

12 .Autoimmunity and Autoimmune diseases **2 Hours**

13. Immunodefiency syndrome **2 Hours**

14. Transplantation and graft rejection **4 Hours**

15.Tumer immunology **2 Hours**

16.Antigen – antibody interactions:

Agglutination reactions

Haemagglutinations, WIDAL test.

Precipitation reaction

ELISA, RIA, Immunoelectrophoresis **5 Hours**

17. Vaccination

Different types of vaccines

Live attenuated vaccine; inactivated polypeptides as vaccines; recombinant vaccines and DNA vaccines

Route of vaccination **2 Hours**

References:

Fahim Halim Khan (2013) The Elements of Immunology.Pearson Education.

Janis Kuby (1997), Immunology, WH Freeman, New York

Joshi, K.R. and Osamo N.O. (1994), Immunology, Agro Botaqnical Publishers, Bikaner

Kenneth M.Murphy, Paul Trafers and Mark Walport (2007) Janeway's Immunology (Seventh Edition) Garland Science, New York

Peter Parham (2004). The Immune System (2nd Edition) Garland Science, New York

Raif Geha and Fred Rosen (2007), Case Studies in Immunology: A Clinical Companion (Fifth Edition). Garland Science, New York

Richard A. Goldsby, Thomas J,Kindt, Barbara A. Osborne and Janis Kuby (2003). Immunology (Fifth Edition) WH Freeman, New York

Shetty, N (1993). Immunology. Wiley Eastern Ltd. New Delhi

Thomas J.Kindt, Barbara A. Osborne and Richard A. Goldsby (2007). Kuby Immunology (sixth Edition). WH GReeman, New York

PRACTICALS

(First and Second Semester)

ZOO 1 & 2 P 01: Cell Biology, Genetics & Molecular Biology

(Credits – 3)

1. Study of meiosis in grasshopper testis squash and determination of chiasma frequency.
2. Preparation of Human karyotype from photographs of chromosome spreads- normal and abnormal.
3 Preparation of human blood smears to demonstrate drumsticks in neutrophils.
4. Induction of chromosome aberration in onion root tips by a suitable clastogenic agent and its demonstration by means of root tip squashes.
5. Cell fractionation isolation of nuclei and mitochondria from any suitable material (Rat liver).
6. Maintenance of Drosophila melanogaster culture and demonstration of sex linked inheritance of any suitable gene by means of crosses.
7. Gene mapping of Drosophila melanogaster, using text book problems.
8. Preparation and analysis of salivary gland chromosomes of Drosophila
9. Extraction and estimation of chromosomal DNA from animal tissues (by diphenylamine test).
10. Extraction and estimation of total RNA from any suitable material (by Orcinol test).
11. Extraction and estimation of protein from any suitable material (by Lowry test)
12. Hypo and hyper chromic effect of DNA- spectrophotometric analysis.
13. Preparation and sterilization of culture media.
14. Bacterial culture technique: Streak plates, spread plate, pour plate methods, hanging drop method.
15. Staining methods: Simple, negative and Gram staining.
16. Immunodffusion: Detection of specific reactivity of precipitating antibody with soluble antigen.

17. ELISA

ZOO1 & 2P 02: Biological Chemistry, Biophysics & Biometry

(Credits-3)

Biological Chemistry

1.Chromatographic separation and elution of amino acids

2.Colorimetric estimations of total free amino acids

3.Quantitative estimation of Protein-Biuret method

4.Estimation of total carbohydrates – Phenol sulphuric acid method

5.Colorimetric estimation of glucose – GOD- POD method

6.Lipid Soxhlet extraction

7.Colorimetric estimation of lipids

8.Colorimetric estimation of protein bound hexose

Biophysics

1. Beer-Lambert's law and its demonstration using colorimetry

2. Spectral studies of protein using UV spectrophotometer

3. Electrophoretic separation of proteins

4. Demonstration of diffusion using dialysis tubing

5. Get filtration column chromatography

6. Adsorption column chromatography for purification of amino acids

Biometry

1.Computation of measures of central tendency and dispersion
2.Application of probability distributions
3.Application of standard tests (z-test, t-test, x2 test)
4.Analysis of variance
5.Regression analysis and correlation analysis
6.Calculation of mean, standard deviation and standard error using computer
7.Calculation of Coefficient of correlation using computer
8.Conduct of 't', F and x2 test s using computer software

ZOO1&2PO3: Environmental biology and Systematic Zoology

(Credits-3)

1.Identification,qualitative and quantitative estimation of plankton(marine and freshwater).

2.Estimation of BOD in pond, sea and polluted water.

3.Determination of transparency of water samples.

4.Estimation of chloride of water samples.

5.Estimation of nitrate of water samples.

6.Estimation of silicate of water samples.

7.Estimation of phosphate of water samples.

8.Estimation of primary productivity using light and dark bottle method.

9.Study of a pond ecosystem.

10.Study of intertidal sandy, muddy and rocky shores-observation of fauna and adaptations.

11.Determination of biodiversity index.

12.Study of museum specimens of ecological importance.

13..Preparation of simple dichotomous key to identify common genera of fishes.

SEMESTER III

ZOO3C10: Animal Physiology

(Theory-70 hrs- Credits- 4)

1. Nutrition: Intracellular and extra- cellular digestion, regulation of digestion- hormonal and neuronal; absorptive areas and mechanism of absorption- absorption of monosaccharides, amino acids, lipids, vitamins and iron. **5 Hours**

2. Muscle physiology: Proteins of contractile system; structure and physiology of vertebrate skeletal muscles, smooth muscles and cardiac muscles, twitch muscles and tonic muscles; mechanism of muscle contraction, molecular basis of muscle contraction, energetics of muscle contraction**.** **8 Hours**

3. Respiration: Fundamentals of gas exchange, respiratory pigment- structure and distribution in animal kingdom, biological properties, functions, oxygen and carbon dioxide transport, respiratory mechanism in invertebrates and vertebrate, regulation of respiration**.** **8 Hours**

4. Body fluids and Circulation: General plan of circulatory system, functional morphology of heart, haemopoesis, haemodynamics, cardiac reflexes, cardiac cycle and its regulation, electrical characters of heart- normal and abnormal; lymphatic system. **8 Hours**

5. Homeostasis: Regulation of body fluid composition in invertebrates and vertebrates- in different habitats- hyposmotic, hyperosmotic, terrestrial; renal function- ultra- filtration, absorption, secretion, plasma clearance; counter current mechanism; factors regulating homeostasis. **8 Hours**

6. Thermoregulation: Thermal relation with the environment- Comfort zone, Normal body temperatures,(oral,skin and core),heat production and heat loss, factors affecting body temperature, lethal temperature. Temperature regulating mechanisms(hot and cold) mention the role of hypothalamus , thyroid and adrenal glands. Acclimatization

9 Hours

7. Nervous system: Action potential- general factors, ionic mechanism, conduction, giant

nerve fibers; myelination of neurons, synapses- electrical and chemical transmissions,

synaptic potential, synaptic polarity; neurotransmitter in invertebrates and vertebrateschemical nature, classification, synthesis, transport and function, vertebrate braincerebral cortex, epilepsy, sleep emotion, limbic system and hypothalamus. **12 Hours**

8. Excretory system: A brief account of different types of excretory organs . Urine

formation (glomerular filtration, tubular reabsorption and tubular secretion) ; Regulation

of water balance- mechanism of concentration of urine, counter current system(counter

current multiplier)- renal regulation of acid base balance. Composition (normal and

abnormal); characteristics of urine; physiology of micturition ; Renal clearancedefinition, concept and significance. **12 Hours**

References:

Bruce M Koeppen, and Bruce A Station, 2009. Brene and Levy Physiology. (6th editin). Elseiver publishers.

Clancy, and Mc vicar, A.J. (1995) physiology and Anatomay. Edward Arnold, London.

Cyril A. Keel e, Eric Neil and Norman joels. Samson wrights Appled physiology. (13th Edition) Oxford University Press NewDelhi.

David Randall, Warren burggrom, Katheleen

French, 2002, Eckert Animal Physiology Physiology- Mechanisms and Adaptations. (5th dediiton). W.H Freeman and company.

Ecker, R, Animal physiology, Mechanisms and adaptation, W.H Freeman & company.

Gerard j tortora 2006, A brief atlas of the skelection, surface anatomy and selected medical images. John wiley and sons, Inc

Gerard J Tortora, Bryan H Derrickson, 2009, Principles of Anatomy and Physiology, (12th edition) volumr- I John Willey and sons, INC

Gerard J Tortora, Bryan H Derrickson, 2009, Principles of Anatomy and physiology, (12th edition) Volumr-2 john willey and sons. INC

Gillian pocock and chistopher D Richards, 2001, Human physiology- The basis of medicine. Oxford university press.

Guyton and hall, 2007, Text book of medical physiology. (11th edition). Elsevier publisher.

Guyton, a.C and Hall, J.E (2001) Text Book of Medical Physiology, 10th edn. Prism Books, Pvt., ltd Harcourt Asia Ltd., India Edn.

Hoar, W.S (1966) General and Comparative Animal physiology, prentice hall Inc, USA

Jain A.K (2009): Text Book of Physiology (Vol . I & II), Avichal Publishing Company ,New Delhi.

Jan kay, 2000, Introduction to animal physiology, Viva book private limited.

Jensen, D (1976) The principles of physiology, Appleton-Century- Crofts, New York.

K. Sembulingam, prema sembulingam, 2008 Essentials of Mdeical physiology, (4th edition) Jaypee brothers medical publishers (P) Ltd.

Knut Schmidt- Nielson, 2007. animals physiology- Adaptation and environment. (5th edition) Cambridge university press.
Lauralee Sherwood, Hillar kaladrof, and paul H Yancey . 2005 Animal physiology from genes to organisms, Thomson books publishers.
Pat Willmer, Grashan stone and lan Johnston. 2005. Environmental physiology of animals. (2nd edition) Black well publishing.
Prosser, C.L., (1973) Comparative Animals Physiology, W. B Saunders & co.
Prosser, C.L Environment and Metabolic Physiology, Wiley- Liss
R.C Sobti , 2008. Animal physiology, Narosa publishing house.
Randall,D, Burgrenn, W. and French, K (1997), Animal Physiology, W.H Freeman & Co., New York.
Schiemdt- Neilsen, K.K (1994) Animal Physiology, Adaptation and Environment, Cambridge.
Sperelakis, N. and Banks, R.O. eds. (1993) Physiology, Little, Brown & Co., London
Strand, F. L (1978) Physiology: A regulatory systems Approach, 4th Ed. Mamcmillan Publishing Co., New York.
Stuart Ira fox, 2006 Human physiology. (9th edition). Mc Graw hill higher education press.
William S hoar, 2004. General And comparative Physiology. (3rd edition). Prentice hall and India Private Limited.
William F. Ganong(1999): Review of Medical Physiology, Lange Medical Publications(Appleton & Lange)

ZOO3C11: Developmental Biology and Endocrinology

(Theory- 70hrs: Credits-4)

A-Developmental biology (45 hrs)

I. Basic concepts of development

1. Gametogenesis, factors influencing gametogenesis, gamete specific gene expression and genomics.

2. Role of hormones in Gametogenesis, biology of sex determination and differentiation.

3. Biochemistry and physiology of fertilization, egg-sperm interactions, role of species specific surface molecules in egg-sperm interactions, polyspermy and prevention of polyspermy.

4. Gene targeting (Knock out) experiments; gene activities in insects, amphibians and human. Transgenic animals and knock- outs.

10 Hours

II.Cleavage Blastulation and Gastrulation

5. Cleavage and role of yolk in cleavage formation chemical and cyto-physiology of cleavage, cyto-skeletal mechanism in cleavage.

6. Mid blastula transition, genomic equivalence and the cytoplasmic determinants.

7. Gastrulation and metabolic events in cells. Effects of foreign nucleus of early development. Problems of arrested gastrulation

10 Hours

III.Cell interaction

8. Primary organizer, embryonic induction, competence neural induction, regional specificity and double gradient model.

9. Molecular correlation in neural induction, Nieukoop centre default model of neurulation, inductive cascades

10. Mesodermal induction and growth factors.

11. Stem cells; embryonic stem cells, creating new cell types- basic evolutionary mystery;

imprinting; mutants and transgenics in analysis of development. Potency, commitment, specification.

13 Hours

IV.Morphogenesis and Organogenesis in animals

12. Cell aggregation, differentiation, axes and pattern formation in Drosophila, amphibian and chick.

13. Organogenesis- vulva formation in Caenorhabditis elegans

14. Eye lens induction, limb development and regeneration in vertebrates, differentiation of neurons, post embryonic development- larval formation

15. Metamorphosis; environmental regulation of normal development; sex determination.

12 Hours

B-Endocrinology (25 hrs)

I Invertebrate Endocrinology

Aim and scope of endocrinology

1. Concept of Neurosecretion and Neuro-endocrine system in invertebrate groups

2. Neuro-endocrine mechanisms of moulting and growth in crustaceans

3. Hormonal control of reproduction and moulting in insects

5 Hours

II.Vertebrate Endocrinology

4. General principles of hormone action

5. Concept of hormone receptors

6. Nature of hormone action, Steroid and protein hormones

7. 1st messenger, 2nd messenger concept **6 Hours**

III.Hormone, Structure and Synthesis

8. Hormone structure

9. Chemical nature and gross features of hormones

10. Hormone levels in circulation and other body fluids

11. Biosynthesis of steroid hormones de novo

12. Bio synthesis of amino acid derivatives, small sized hormones

(eg: T4, Epinephrine, etc.)

13. Biosynthesis of simple peptide hormones: Pre- and Prohormones

14. Co-translational and post-translational modifications of hormone structure.

15. Hormonal control of growth and reproduction in vertebrates **11Hours**

IV.Neuroendocrinology

16.Neuro-endocrine Integration in vertebrates

17. Abnormality in hormone secretion and its effect on development

3 Hours

References:

Scott F. Developmental Biology 7th ed/ 8th ((2006) 9th ed (2010). Gilbert Sinauer Associates, Inc
Walbot Holder. Developmental Biology Random House USA Inc in 1987
Browder. Development Biology Crashing rocks Books Punta Crashing Rocks Books Punt Gorda, FL, U.S.A
John W. Saunders. Jr. Development Biology Patterns, Problems and Principles Elsenhower Stacks, USA
Mc Even. Vertebrate Embryology Tata Mc-Graw-Hill Publishing
B1 Balinsky. An Introduction to Embryology 5th edition 2004- W.B . Saund E.J.W. Barrington, General and Comparative Endocrinology, Oxford,
Clarendon Press.
P.J. Bentley, Comparative Vertebrate Endocrinology, Cambridge University Press
R.H. Williams, Textbook of Endocrinology, W.B. Saunders
C.R..Martin, Endocrine Physiology, Oxford University Press
A Gorbman et. Al. Comparative endocrinology, John Wiley & Sons
Tembhare D B. Invertebrate Endocrinology . Himalaya Publishing.

ZOO3E 01: ANIMAL FORM AND FUNCTION

(Theory 70 hrs; Credits-4)

(70 Hours)

Comparative Structure, Function and Evolution of Metazoa (20 Hours)

Metazoa, eumetazoa and bilateria

Metazoan ground plan, cells tissues and skeleton, reproduction and development, functional consequences of body size: size and compartmentalization, size surface area and volume, size and transport, size and metabolism, advantages of large body size; Origin of metazoa, origin of polarity and cell specialization, origin of complexity;

Invertebrate epithelial tissue, epidermis, gastrodermis and gut, connective tissues, skeletons - fluid and solid skeleton; Eumetazoa: movement and body size, musculature, nervous system, sense cells and organs, development and growth. Cephalization in bilateria, compartmentalization - physiological regulation and specialization of radiata and bilateria; internal transport, gas exchange and excretion in bilateria; phylogeny of bilateria - consensus and conflicts, hierarchy based on molecules and morphology, correlations of bilaterian body size with function and structure. Animal Body Planes.

Vertebrate Diversity, Function and Evolution

Diversity and classification of vertebrates, Evolution of vertebrates with emphasis on phylogenetic systematics, Problem with fossil crown and stem groups, different evolutionary hypothesis, Vertebrate relation to other animals, characteristics of chordates, chordate relationships, duterostomes, extant non-vertebrate chordates, definition of vertebrate, unique embryonic features of vertebrates, comparison of features in nonvertebrate chordates and ancestral vertebrates, basic vertebrate structure: embryonic development, adult tissue types, bone, teeth, skeletomuscular system, energy acquisition and support of metabolism, coordination and integration

Traits and Diversity (5 Hours)

Natural selection as a driver of acquiring traits; body size in relation to other traits; Role of genomics, proteomics and transcriptomics in study of physiological variations; Epigenetics and developmental programming, phenotypic plasticity during development of physiological systems.

Specialized Animal function and Physiology Animal navigation (5 Hours)

Adaptive significance, mechanoreception and magnetoreception, innate and learned components of navigation.

Biological clock (5 Hours)

Biological clock: endogenous rhythms, adaptive advantages, Clock mechanisms based on rhythms of gene expression, loci of clock, different types of clocks in animals,

Metabolism and Energetics (5 Hours)

Metabolic rate - meaning and measurement, factors affecting metabolic rate, Metabolic scaling. Responses to Impaired O2 Influx from the Environment, Energetics of long distance-migration, Ecological energetics.

Circulation (7 Hours)

Comparison of closed and open circulation: closed circulation in mammals and birds, circulation in air-breathing fishes, advantages of incompletely divided circulation in amphibians and reptiles, open circulation in invertebrates with crustaceans as example, how open and closed circulation compare to each other. Diving in marine mammals: types of dives, circulatory adjustments, metabolism during dives, decompression sickness, Pulmonary O2 sequestration.

The Nervous System (8 Hours)

Signaling in cells of the nervous system (transmitter receptors and ion channels, second messenger regulation). Plasticity of the Nervous System (long term potentiation; glutamate receptors; learning and memory). Introduction to electrophysiology, Optogenetics, Chemogenetics.

Sensory Systems (10 Hours)

Organisation of sensory systems, mechanoreception and touch, vestibular organs and hearing, chemoreception, olfaction, photoreception, visual sensory processing, .

Water and Salt Physiology (5 Hours)

Importance of animal body fluids, regulation and conformity, Metabolic water, Case studies of Kangaroo, Xeric invertebrates, Mammals of deserts and dry savannas - Oryxes, Gazelles, and Camels

References

1. Hill, R. W., Wyse, G. A., Anderson, M., & Anderson, M. (2004). *Animal physiology* (Vol. 2). Sunderland, MA: Sinauer Associates.
2. Ruppert, E. E., Barnes, R. D., & Fox, R. S. (2004). *Invertebrate zoology: a functional evolutionary approach*, Cengage publishing Pp 1016.
3. Pough, F. H., Janis, C. M., & Heiser, J. B. (2013). *Vertebrate life*. Pearson Higher Ed.
4. Brusca, R. C., & Brusca, G. J. (2003). *Invertebrates* (No. QL 362. B78 2003). Basingstoke.
5. Barrett, K. E., Barman, S. M., Boitano, S., & Brooks, H. L. (2016). Ganong's review of medical physiology.
6. Avissar, Y., Choi, J., DeSaix, J., Jurukovski, V., Wise, R., & Rye, C. (2018). Biology: OpenStax.
7. Kaiser, C. A., Krieger, M., Lodish, H., & Berk, A. (2007). Molecular Cell Biology.
8. Calow, P. (2012). *Invertebrate biology: a functional approach*. Springer Science & Business Media.

SEMESTER IV

ZOO4C12: Biotechnology and Bioinformatics

(Theory-70 hrs- Credits-4)

A. Biotechnology (55 hrs)

1 . Fundamentals of biotechnology: History- emergence of Molecular Biotechnology revolution **3 Hours**

2. Genetic engineering: (a) Enzymes in genetic engineering- restriction enzymes, ligases, enzymes to modify the ends of DNA molecules: alkaline phosphates, polynucleotide kinase, terminal transferase, polymerases, reverse transcriptase etc.

(b) Gene cloning vectors: plasmids- pBR 322, Col E1, Ti plasmids- bacteriophageslambda phage, M13, charon phages- cosmids – viral vectors for animal and plant cells – SV 40, Cauliflower mosaic virus; phagemids – BAC - special vectors - shuttle vectors, expression vectors, yeast artificial chromosomes, MAC etc.

(c) Gene isolation, identification and synthesis; Construction of chimeric DNA- cohesive end ligation- use of linkers- blunt end ligation; construction and screening of cDNA and genomic libraries- colony hybridization - plaque hybridization – chromosome walking. Chromosome jumping.

(d) polymerase chain reaction and gene amplification. (e) Microarray and gene expression analysis. **20 Hours**

3. **Gene transfer in animals and plants:** Gene transfer methods (transfection) direct gene transfer - Ti plasmid - electroporaion - uptake by protoplast - microinjection – liposome mediated DNA delivery - Transgenic animals and plants. **8 Hours**

4. DNA sequencing: Maxam and Gilbert's chemical methods, Sanger's enzymatic chain termination method and automated DNA sequencing. **8 Hours**

5. General applications: Tissue culture; DNA finger printing; Gene therapy- somatic and germ line therapy- future prospects of gene therapy: RNAi and gene silencing: Terminator

genes. **8 Hours**

6. Biotechnology- hazards and impacts on society- Biological risks- safety and regulatory arrangement- ethical issues- economic issues- legal issues- intellectual property rights.

8 Hours

B. Bioinformatics (15 hrs)

1. Bioinformatics: Introduction – genomics – transcriptome - proteome. **4 Hours**

2. Biological databases: Generalized and specialized databases- premier institutes for database- nucleic acid codes used in database formats; collection and down loading of information from databases- literature search. **5 Hours**

3. Sequence alignment and its evolutionary basis: Simple alignment and multiple sequence alignment- searching the database for sequence similarity- search programmes with special reference to FASTA, BLAST, CLUSTAL W. Application of bioinformatics in phylogenetic analysis. **6 Hours**

References:

Brown T A, Gene Cloning and DNA Analysis Balackwell Science.
Click B R and pasternack J J Molecular Biotechnology: principles and Applications of Reobmbinant DNA. Panima.
James D Watson et al., Recombinant DNA: A short Course. Scientific American Books, W H Freeman & Co.
Old R W & Primrose S B, Principles of Gene Manipulations, Black Well Science
Winnaker E L, From Genes to Clones: Introduction to Gene Technology. VCH Publications.
Purohit S S & Mathur S.K Biotechnology: Fundamental and Application. Agrobios.
Eric Grace, Biotechnology Unzipped: promises and Realities. University Press.
Fumento Michael, Biotechnology demystifying the concepts.
Meyers Roberts A, Molecular Biology Biotechnology, John Wiley.
Young, Computerized Data Acquisition and Analysis For Sciences. Cambridge University Press.
Xiong, Essential Bioinformatics, Cambridge University Press.
Marketa J Zvelebil, Understading Bioinformatics. Garland Science.
Shhui Quing Ye, Bioinformatics: A practical Approach.
Anna Tremontano, Introduction to Bioinformatics.
David W Mount, Bioinformatics. CBS
Mani K and Vijayaraj N, Bioinformatics, Kalaikathir Achchagam.
Augen Jeff, Bioinformatics in the post genomic cra. Addison Wesley.
Thieman, William J and Palladino Michael A. Introduction to Biotechnology. Pearson Education

ZOO4E 02: Animal Systematics and species interactions

(Theory 70 hrs; Credits-4)

(70 Hours)

Taxonomic Characters and species description (12 Hours).

Characters in cladistics: apomorphic character, plesiomorphic character; homoplasy; synapomorphy, symplesiomorphy. International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Nomenclature; species and subspecies nomenclature. Formation of Scientific names of various Taxa; Principles of nomen availability, nomen validity; Principle of homonymy; principle of synonymy; Invalid name types: nomen nudum, nomen oblitum; Principle of nomen allocation: type concept: holotype, paratype, lectotype, neotype, syntype, paralectotype, topotype.

Molecular Markers (14 Hours)

allozymes, RFLPs, DNA sequences, SNPs, Microsatellites, RAPDs, AFLPs. Quantifying genetic diversity; Hardy-Weinberg equilibrium; Estimate of genetic diversity, Haploid diversity, Choice of marker; Factors influencing genetic diversity: Genetic drift, natural selection; Genetic distance; F-Statistics; Factors influencing gene flow: Barriers to dispersal. Neodarwinism: spontaneous mutation controversy, neutral theory of Kimura, effects of natural selection on populations, stabilizing and dispersing selections, Levels of selection, group selection controversy, selfish gene theory

Molecular Taxonomy (7 Hours)

Molecular taxonomy. DNA barcoding and barcoding of life, integrative taxonomy. Concept of non-invasive and minimally invasive sampling. Phylogenetics : Principles and applications, account of phylogenetics using morphological characters, DNA sequences and protein sequences, Concept of polyphyly, paraphyly and monophyly; define - clades, nodes, branches and root of a phylogenetic tree.

Animal diversity and genomic tools (8 Hours)

Metagenomics - definition and scope, sequencing platforms - sequencing, annotation and assembly, rDNA analysis and metagenomics, other methods to analyse environmental microbiome, gut microbiome and human health, co-evolution of microbiome, antibiotic resistance, symbiosis between bacteria and eukaryotes, mention *Wolbachia*. eDNA for animal diversity studies.

Population and species interactions (15 Hours)

Species interactions-competition-exploitation, interference, apparent competition lotka-Volterra model of competition, competitive exclusion principle. Facilitation, mutualism, commensalism. Predation-antipredator adaptations, prey predator lotka-Volterra model. Herbivory-plant defense against herbivores. Parasitism-microparasites, macro parasites, parasitoids, kleptoparasites, host defense against parasites. Population regulation-bottom up and top down effect. Key factor analysis and indispensable mortality analysis.

Community and ecosystem (14 Hours)

Rank abundance and log normal distribution. Niche apportionment models, community similarity indices-Jaccard, Sorenson, simple matching index. Species richness and community services-linear, rivet, keystone, redundancy, idiosyncratic. Habitat conservation - megadiversity, biodiversity hotspot, crisis ecoregion, last of the wild. Succession- primary, secondary. Facilitation, inhibition and tolerance models of succession. Island biogeography-mc Arthur Wilson model, species area, species distance and species time hypothesis. Food web and energy flow-ecological efficiencies-consumption efficiency, assimilation efficiency,

production efficiency and trophic level transfer efficiency. Species in food webs- keystone, dominant, indicator, ecosystem engineers, umbrella and flagship species. Connectance in food web, primary production- NPP and GPP.

References:

1. Peter Stiling, Ecology Global Insights And Investigations,2nd Edition,Mcgrawhill Education.
2. Thomas M Smith, Robert Leo Smith,Elements Of Ecology, 9th Edition,Pearson
3. Manuel C Molles, Ecology Concepts and Applications,8th Edition, Mcgrawhill Education.
4. William D. Bowman, Sally D. Hacker, And Michael L. Cain, Ecology, 4th Edition, Sinuaer Associates.
5. Douglus J Futuyma, Evolution, 4th Edition, Sinuaer Associates.
6. Shawn E Nordell, Animal Behaviour,International 2nd Edition,Oxford University Press.
7. John Alcock, Animal Behaviour,9th Editon, Sinuaer Associates.
8. Wiley, E. O., & Lieberman, B. S. (2011). Phylogenetics: theory and practice of phylogenetic systematics. John Wiley & Sons.
9. Kitching, I. J., Forey, P., Forey, P. L., Humphries, C., & Williams, D. (1998). Cladistics: the theory and practice of parsimony analysis (No. 11). Oxford University Press, USA.
10. Hennig, W. (1999). Phylogenetic systematics. University of Illinois Press.
11. De Queiroz, K., & Donoghue, M. J. (1988). Phylogenetic systematics and the species problem. Cladistics, 4(4), 317-338.
12. Farris, J. S., Kluge, A. G., & Eckardt, M. J. (1970). A numerical approach to phylogenetic systematics. Systematic Zoology, 19(2), 172-189.
13. Lewis, P. O. (2001). Phylogenetic systematics turns over a new leaf. Trends in Ecology & Evolution, 16(1), 30-37.
14. Valentini, A., Pompanon, F., & Taberlet, P. (2009). DNA barcoding for ecologists. Trends in ecology & evolution, 24(2), 110-117.
15. Moritz, C., & Cicero, C. (2004). DNA barcoding: promise and pitfalls. PLoS Biol, 2(10), e354.

ZOO4E 03: Molecular developmental biology

(Theory 70 hrs; Credits-4)

(70 Hours)

Basic Approaches In Developmental Biology (2 hours)

Direct Observation Of Living Embryos- Fate Maps, Dye Marking, Genetic Labelling, Transgenic DNA Chimeras.

Mechanisms Of Developmental Patterning (5 Hours)

Levels Of Commitment-Cell Differentiation, Cell Fate Maturation. Autonomous Specification, Conditional Specification, Syncytial Specification With Examples.

Differential Gene Expression In Development (5 Hours)

Differential gene expression in development, transcription regulation of genes, translation regulation of genes-mRNA longevity, selective inhibition and activation of mRNA, miRNA and siRNA regulation level regulation

Postembryonic Development (15 Hours)

Changes of organization during metamorphosis, causation of metamorphosis in amphibian tissue, reactivity in amphibian metamorphosis, process of induction during metamorphosis of amphibians

Regeneration - different types of regeneration; Histological processes during Regeneration; Polarity and Metaplasia in regeneration; Lens regeneration in amphibian.

Fate of Ectoderm endoderm and mesoderm-neural tube formation and patterning, brain growth-cells and tissues. neurogenesis, neural crest and axonal specificity, axonal guidance, ectodermal placodes and epidermis. cells of somites, somitogenesis. Sclerotome development- tendon and vertebrae formation, dermomyotome development, kidney and heart development, blood vessel formation-vasculogenesis, angiogenesis and hematopoiesis

Cell Culture (10 Hours)

Cell culture requirements: Culture hood, Growth media, CO 2 incubator; Basic techniques: Disaggregation, Passaging; Primary culture, Cell lines; Cryopreservation of cells; Uses of cell culture

Development In Health And Disease (13 Hours)

Infertility-causes of infertility in man and woman, Test tube babies (IVF) process of IVF. Nuclear transplantation experiments in Amphibians and Mammals.

Genetic Errors In Human Development-Developmental Nature Of Human Syndromes, Genetic and Phenotypic Heterogeneity. Embryonic Origins Of Adult Disease.Development Based Therapies Of Cancer.

Development And Environment (10 hours)

Developmental Plasticity-Diet Induced Polyphenisms, Predator Induced Polyphenism, Temperature As An Environmental Agent, Stress As An Agent, Developmental Symbiosis In Mammalian Intestine. Environmental disruptions of normal development (Teratogenesis) Teratogenic agents - Alcohol, retinoic acid, bisphenol, heavy metals, pathogen, Environmental oestrogens

Development And Evolution (10 Hours)

Gene Duplication And Divergence-Gene Families, Orthologous, Paralogous Genes. Homologous Structures And Analogous Structures, Molecular Parsimony. Mechanisms Of Evolutionary Changes-Heterotopy, Heterochrony, Heterometry, Heterotypy. Developmental Constrains- Physical, Morphogenetic, Pleiotropic And Redundancy.

References:

1. Barresi and Gilbert,Developmental Biology,12th Edition,Sinauer Oxford University Press.
2. Lewis Wolpert,Cheryl Tickle, Essential Principles Of Development,4th Edition,Oxford University Press.
3. J.M.W Slack,Essential Developmental Biology,3rd Edition,Wiley Blackwell.
4. Gilbert And David Epel,Ecological Developmental Biology,3rd Edition. Sinuaer Associates.
5. Leonard Roosevelt,Developmental Biology Evolution And Growth,Callisto Reference.
6. Adam S. Wilkins, The Evolution Of Developmental Pathways,Sinuaer Associates.
7. Indebir Singh,Human Embryology,11nth Edition, J P Medical Limited.
8. Watson, Molecular Biology Of Gene,6th Edition,Pearson.
9. Robert F Weaver.Molecular Biology,5th Edition.Mcgrawhill.
10. Benjam A Pierce.Genetics A Conceptual Approach,Macmillan.

PRACTICALS

(Third and Fourth Semester)

ZOO 3 & 4 P 04: Animal Physiology

(Credits – 3)

1. Determination of effect of PH, substrate concentration, Temperature on salivary amylase activity

2. Detection of digestive enzymes in the hepatopancreas of crabs

3. Detection of digestive enzymes in the vertebrate pancreas fibrinogen

5. Demonstration of osmotic haemolysis

6 . Determination of vertebrate haemoglobin using colorimetry

7 . Determination of blood pressure and pulse rate

8 Enumeration of RBC of human blood

9. Total and Differential count of WBC

10. Determination of chloride regulation of esturine crab.

11. Estimation of the rate of oxygen consumption of a Fish

12. Demonstration of cell forms from invertebrate blood smear preparation

13. Determination of blood pressure and pulse rate

14.Demonstration of buffering capacity of body fluids

15. Effect of Osmotic stress on the rate of respiration

ZOO 3 & 4 P 05: Developmental Biology, Histology and Histochemistry

(Credits – 3)

Developmental Biology

1. Induced ovulation and fertilization in frog

2. Hormonal control of amphibian development –effect of thyroxin/iodine

3. Regeneration studies in frog tadpole

4. Vital staining of chick embryo – window method

5. Preparation of permanent stained whole mounts of chick embryo

6. Preparation and study of permanent stained whole mounts of larval forms

7. Ovarian index under eyestalk ablation of a crustacean

8. Total sperm count of crab using haemocytometer

9. Experimental analysis of insect development of Drosophila, Housefly.

Histology and Histochemisty

10. Study of prepared permanent slides of mammalian tissue sections

11. Preparation of microscopic slides of stained sections of tissues(such as liver ,

kidney, lung, intestine, pancreas, testis, ovary etc.)

12. Histochemical staining for carbohydrates, proteins and DNA

ZOO 3&4P 06: Systematics, Physiology, development & animal interactions

(Credits – 3)

1. Preparation of a Multiple Sequence Alignment (Major)
2. Preparation of a Phylogenetic tree (R, MEGA or Online resources) (Major)
3. Length-Weight relationship and calculation of condition factor of fish
4. Determination of primary productivity using dark and light bottle method
5. Hematocrit and ESR value of human blood
6. Angiogenesis in chick embryo
7. Mark and recapture method
8. Life table construction
9. Ecological foot print calculation
10. Community similarity indies
11. Identification of crustacean larvae in Freshwater or marine water sample.
12. Sperm count using haemocytometer
13. DNA isolation and confirmation
14. Oxygen consumption in fish (normal and stressed) Graphical representation and interpretation.

Preparation of two whole mount slides of invertebrate larvae / Submission of 2 DNA barcodes of specimens collected by the student, voucher specimens preserved in ethanol and NCBI accession numbers to be presented. This has to be submitted during the practical examination

SEMESTER I

KANNUR UNIVERSITY

M.Sc. Zoology Programme

Pattern of Question Papers

1.ZOO1C01: Cell Biology and Genetics

Time: 3 Hrs. **Maximum: 60Marks**

Part. A. Cell biology

1. Answer any ONE out of two questions - 1x 12 = 12 Marks

2. Answer any ONE out of two questions - 1x 8 = 8 Marks

3. Answer any TWO out of three questions - 2x 5 = 10 Marks

Part B. Genetics

1. Answer any ONE out of two questions - 1x 12 = 12 Marks

2. Answer any ONE out of two questions - 1 x 8 = 8 Marks

3. Answer any TWO out of three questions - 2 x 5 = 10 Marks

ZOO1C01: Cell Biology and Genetics (Part A +Part B)

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of Four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of Four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (First Semester) Zoology

Model Question Paper

ZOO1C01: Cell Biology and Genetics

Time: 3 Hours **Maximum: 60 Marks**

Part. A- Cell Biology

I. Answer any ONE of the following

1. Give a detailed account on synthesis, transport and post translational

modification of organelle and membrane protein.

2. With suitable diagram, explain the organization and architecture of chromatin and chromosome. **(1x12= 12Marks)**

II. Answer any ONE of the following

3. .Explain the mechanism of active transport, citing examples.

4. Give an account on the mechanism involved cell cycle regulation.

(1x8 = 8 Marks)

III. Write short notes on any two of the following

5. Apoptosis

6. Modifications of cell membrane

7. Structure on unclear pore **(2x5 = 10 Marks)**

Part- B - Inheritance Science

IV Answer any one of the following

8. Explain the different mechanisms of genetic transfer in bacteria

9. Give a detailed account on the molecular mechanisms involved in recombination of DNA **(1X12 = 12 Marks)**

V. Answer any one of the following

10. Discuss the genetic basis of cancer.

11. Give an account on transposable elements in bacteria (1 x 8 = 8 Marks)

VI. Write short notes on any two of the following

12. BRCA genes

13. Retroviruses

14. Oncogenes **(2 x 5 = 10 Marks)**

2 ZOO1C02 :Biological Chemistry

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of Four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of Four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M. Sc.(First Semester)Zoology

Model Question Paper

ZOO1C02 :Biological Chemistry

Time: 3 Hours **Maximum: 60Marks**

I. Answer any TWO of the following:

1. Describe the stepwise reaction involved in purine metabolism.

2. Describe the fatty acid oxidation with suitable example.

3. Explain the biosynthesis of phospholipids

4. Give an account of factors affecting enzyme catalysed reactions.

(2×12 =24 Marks)

II. Answer any TWO of the following:

5 Explain the hormonal regulation of glycogen metabolism.

6 Comment on the quaternary structure of proteins with suitable examples.

7 Discuss vitamins as co-enzymes

8 Give an account of methionine metabolism.

(2×8=16 Marks)

III. Answer any FOUR of the following:

9 Carbohydrate derivatives

10 Chemiosmotic coupling hypothesis

11 Michaelis-Menten Equation
12 HDL and LDL
13 Urea cycle
14 Standard free energy **(4×5=20 Marks)**

3. ZOO1C03: Systemic Zoology and Behaviour Science

Time 3hrs **Maximum 60 Marks**

Part. A. Systemic Zoology

1. Answer any ONE out of two questions - 1x 12 = 12 Marks

2. Answer any ONE out of two questions - 1x 8 = 8 Marks

3. Answer any TWO out of three questions - 2x 5 = 10 Marks

Part B. Behaviour Science

1. Answer any ONE out of two questions - 1x 12 = 12 Marks

2. Answer any ONE out of two questions - 1 x 8 = 8 Marks

3. Answer any TWO out of three questions - 2 x 5 = 10 Marks

ZOO1C03: Systemic Zoology and Behaviour Science

Time : 3 Hours (Part A +Part B) **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (First Semester) Zoology

Model Question Paper

ZOO1CO3: Systematic Zoology and Behavioural Science

Time: 3 hrs **Maximum: 60 Marks**

Part A – Systematic Zoology

I. Answer any ONE of the following

1. Explain various kinds of taxonomic characters
2. Give a critical account on the various taxonomic procedure

(1 x12 = 12Marks)

II Answer any ONE of the following

3. Explain different types of species concept
4. Write an account on the importance of taxonomy

(1 x 8 = 8 Marks)

III Answer any TWO of the following:

5. Type method
6. Molecular taxonomy
7. Intraspecific catagories

(2x 5 = 10Marks)

Part B -Behavioural Science

IV Answer any ONE of the following

8. Explain the methods of communication systems in animals
9. Comment on the various strategies used by birds in navigation

(1x12 = 12Marks)

V. Answer any ONE of the following

10. Write briefly on the genetics of behavior
11. Give a brief account on the reproductive behavior of animals

(1 x 8 = 8Marks)

VI. Answer any TWO of the following:

12. Cultural transmission of behaviour
13. Sex stimuli and releasers
14. Displacement activities

(2x 5 = 10Marks)

4. ZOO1C04: Microbial Science

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of Four questions - 2 x 12 = 24 Marks
2. Answer any TWO out of Four questions - 2 x 8 = 16 Marks
3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (First Semester) Zoology

Model Question Paper

ZOO1C04: Microbial Science

Time: 3 Hours **Maximum: 60 Marks**

I. Answer any TWO of the following

1. Discuss the criteria involved in the classification of microorganisms.

2. Give a detailed account on the structural organization of bacteria.

3. Write the causative agent, symptoms and prophylaxis of Antrax and leprosy.

4. Write an essay on various methods of sterilization of microorganisms.

(2x12 = 24 Marks)

II. Answer any TWO of the following

5.Give an account on management of pollution problems using microorganisms.

6. Write short essay on microbial toxins.

7. Explain the basis of viral classification

8.Give an account on various types and mode of action of antibiotics.

(2 x 8 = 16 Marks)

III. Write short notes on any FOUR of the following

9. Chicken pox

10.Microbial disinfectants

11.Gram's staining

12.Bacterial growth curve

13.AIDS

14.Transport of microbes

(4 x 5 = 20 Marks)

SEMESTER II

5, ZOO2C05: Molecular Biology & Molecular Evolution

Time: 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of two questions - 2 x 12 = 24 Marks

2. Answer any TWO out of two questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (Second Semester) Zoology

Model Question Paper

ZOO2C05: Molecular Biology and Molecular Evolution

Time: 3 Hours **Maximum: 60 Marks**

I. Answer any TWO of the following

1. Discuss on the enzymology and the steps involved in the faithful replication of DNA
2. Explain the different steps involved in the translation of mRNA.
3. Define operon. Describe lac operon of E.coli explaining both negative and positive control mechanisms operating on it.
4. Explain the various mechanisms involves in the repair of DNA

(2 x 12 = 24 Marks)

II. Answer any TWO of the following

5. Give an account on the various steps involved in the processing of mRNA
6. Explain re-association kinetics and various kinetic classes of eukaryotic DNA.
7. Explain the origin and formation of macromolecules leading to the development of prokaryotic cell.
8. Narrate the evolutionary history of haemoglobin and cytochrome C.

(2 x 8 = 16 Marks)

III. Write short notes on any FOUR of the following

9. Triplex DNA
10. Z DNA
11. tRNA
12. Role of introns in the evolution of genome.
13. Genetic drift.
14. C-value paradox

(4 x 5 = 20 Marks)

6. ZOO2C06 – Biophysics and Biometry

Part. A. Biophysics

1. Answer any TWO out of four questions - 2x 12 = 24 Marks

2. Answer any ONE out of two questions - 1x 8 = 8 Marks

3. Answer any TWO out of three questions - 2x 5 = 10 Marks

Part B. Biophysics

1. Answer any ONE out of two questions - 1 x 8 = 8 Marks

2. Answer any TWO out of three questions - 2 x 5 = 10 Marks

ZOO2C06 – Biophysics and Biometry (Part A +Part B)

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (Second Semester) Zoology

Model Question Paper

ZOO2C06 – Biophysics and Biometry

Time: 3 Hours **Maximum: 60Marks**

Part- A. Biophysics

I. Answer any TWO of the following

1. Define half life of isotopes. Give an account of source of ionizing radiation and use of X- ray in biomedical application

2. Explain the physical organization of ear and the physical aspects of hearing

3 Describe the principle, method and application of scanning electron microscopy

4. Discuss Principle and application of tracer techniques in biological fields.

(2×12= 24Marks)

II. Answer any ONE of the following:

5. Give a critical account of eye as an optical instrument

6. Comment on biophysics of photosynthesis

(1×8= 8 Marks)

III. Write briefly on any TWO of the following:

8. Biomagnetism

9. NMR

10.Ultracentrifugation **(2×5= 10Marks)**

Part – B. Biometry

IV. Answer any ONE of the following:

11. Explain binomial, Poisson and normal distribution. Add a note on their applications in Biology.

12. a) Define correlation. Explain briefly the comncept of positive and negative correlation with examples

b) The following data corresponds to the number of species(Y) and dissolved oxygen ml/g(X) calculate correlation coefficient between Y and X

X 12 10 9 7 6 7 6 5

Y 5.2 4.7 4.5 3.6 3.4 3.1 2.7 1.8

(1×8= 8 Marks)

V. Answer any TWO of the following

1. Chi-square test and its applications

2. Probability

3. ANOVA **(2×5 =10Marks)**

7. ZOO2C07 – Environmental Biology

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out off our questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (Second Semester) Zoology

Model Question Paper

ZOO2C07 – Environmental Biology

Time:3hrs. **Maximum: 60 Marrks**

I. Answer any TWO of the following:

1.Explain the importance of wetland ecosystems. What are the threats encountered by these ecosystems. Suggest management strategies.

2.Explain the various ecosystem processes which adversely affect biodiversity.

3.Describe the various aspects of evolutionary ecology.

4.Explain how biotechnology can be effectively applied to achieve a clean environment.

(2X12=24marks)

II.Answer any TWO of the following.

5.Explain the various biodiversity indices.

6.Comment on global climate change.

7.Explain ecological foot printing.

8.Comment on the various aspects of population growth.

(2X8=16 marks)

III.Answer any FOUR of the following:

9.What is ecological modelling?

10.Explain the concept of metapopulation.

11.Briefly comment on the human population growth trend.

12.Explain the ecological importance of coral reefs.

13.What do you mean by priority conservation area recognition?

14.Explain the procedures involved in environmental impact assessment.

(4X5=20marks)

8. ZOO2C08- Immunology

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (Second Semester) Zoology

Model Question Paper

ZOO2C08- Immunology

Time: 3 Hours **Maximum: 60 Marks**

I. Answer any TWO of the following

1. Describe classical complement pathway. What is MAC?

2.Write an essay on gene rearrangement of antibody diversity.

3. Write an essay on different types of autoimmune diseases

4. Describe the T cell activation and proliferation and their control

(2x12= 24 Marks)

II. Answer any TWO of the following

5.Write an account on attenuated whole organisms and purified macromolecules as vaccines.

6.Explain different modes of active immunization.

7. Give an account on primary and secondary lymphoid organs and their role in immunity

8. Write an essay on immunological basis of graft rejection

(2x 8= 16Marks)

III Answer any FOUR of the following

9. B lymphocyte

10. ELISA

11. Epitope

12. IgE

13. Interferon

14. Phagocytosis **(4x 5= 20 Marks)**

SEMESTER III

9. ZOO3C10: Animal Physiology

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (Third Semester) Zoology

Model question Paper

ZOO3C10: Animal Physiology

Time: 3 Hrs. **Maximum 60 Marks**

I. Answer any TWO of the following

1 Describe the role of blood in O2 and CO2 transport

2 Give an account of the molecular basis of muscle contraction.

3 Give an account of urine formation and the physiology of micturition.

4 Write explanatory notes on generation of action potential in a nerve cell.

(2x12=24 Marks)

II Answer any TWO of the following:

5 Give an account of the composition and the characteristics of urine.

6 How is body heat generated in homeotherms?

7 Explain the functional morphology of vertebrate heart.

8 Discuss the steps involved in synaptic transmission.

(2x8=16 Marks)

III Write short notes on any FOUR of the following

9. Intracellular and extra cellular digestion.

10. Structure of a sarcomere.

11. Regulatory mechanisms of respiration.

12 Osmoregulation in hyperosmotic conditions.

13. Temperature regulating mechanisms.

14. Mechanism of nerve conduction.

(4x5=20 Marks)

10. ZOO3C11 : Developmental Biology and Endocrinology

Time : 3 Hours **Maximum 60 Marks**

Part A -Developmental Biology

1. Answer any ONE out of two questions - 1x 12 = 12 Marks

2. Answer any TWO out of four questions - 2x 8 = 16 Marks

3. Answer any TWO out of three questions - 2x 5 = 10 Marks

Part B- Endocrinology

1. Answer any ONE out of two questions - 1x 12 = 12 Marks

2. Answer any TWO out of three questions - 2 x 5 = 10 Marks

ZOO3C11 : Developmental Biology and Endocrinology(Part A +B)

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

M.Sc. (Third Semester) Zoology

Model question paper

ZOO3C11 : Developmental Biology and Endocrinology

Time : 3 Hrs **Maximum: 60Marks**

Part A: Developmental Biology

I. Answer any ONE of the following:

1. Comment on Stem cells from embryo. “They are the first solution to organ transplantation”- comment on the statement with its pros and cons. Write briefly on latest development in stem cell research

2. Explain the biochemistry and physiology of fertilization

(1x 12 = 12 Marks)

II. Answer any TWO of the following:

3. Explain the role of genes in gametogenesis

4. Write an account on Morphogenetic movements

5. Explain the steps in organogenesis of Caenorrhabditis elegans

6. Explain the role of genes in insect development **(2 x8= 16 Marks)**

III. Answer any TWO of the following:

7. Primary organizer

8. Metamorphosis

9. Metaplasia **(2 x5 =10 Marks)**

Part B: Endocrinology

IV.Answer any ONE of the following:

10. Comment Neuro-endocrine mechanism involved in moulting and growth in Crustaceans.

11. Comment on types of hormones in vertebrates and their role in growth and maturity

(1 x12 =12 Marks)

V. Answer any TWO of the following

12. Write an account on the synthesis of prohormones

13. Comment on Messenger and their role in gene regulation

14. Comment on hormone receptors in cells.

(2 x 5= 10Marks)

11. ZOO3E 01: ANIMAL FORM AND FUNCTION

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks
2. Answer any TWO out of four questions - 2 x 8 = 16 Marks
3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

Model Question Paper
ZOO3E 01: ANIMAL FORM AND FUNCTION

Time: 3 Hours **Maximum Marks:60**

I. Answer any two of the following

1. What is cell signalling, elaborate with any one suitable example.
2. What is biological clock?
3. Write and essay on animal navigation
4. Photoreception and its sensory processing.

marks) (2x12=24

II. Answer any two of the following

5. Metabolic scaling
6. challenges of a diving mammal
7. Systems of gas exchange in animals
8. Reception and processing of taste and smell

rks) (2x8=16ma

III. Write short notes on any four of the following

9. Nuclear receptors
10. Transcriptomics
11. phenotypic plasticity

12. genes involved in biological clock and their expression
13. open circulatory system of crustacea
14. Epigenetics and developmental programming

(4x5=20marks)

SEMESTER IV

12. ZOO4C012: Biotechnology and Bioinformatics

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks

2. Answer any TWO out of four questions - 2 x 8 = 16 Marks

3. Answer any FOUR out of six questions -4 x 5 = 20 Marks

M.Sc. (Fourth Semester) Zoology

Model Question Paper

ZOO4C012: Biotechnology and Bioinformatics

Time: 3 Hours **Maximum: 60 Marks**

I. Answer any TWO of the following

1. Give and account on gene cloning vectors employed in a genetic engineering laboratory.

2. Explain the various gene transfer methods. Add a note on transgenic organisms.

3. Write and essay on the hazards and impact of biotechnology on society.

4. Explain the various methodologies involved in DNA sequencing.

(2 X 12 = 20 Marks)

II Answer any TWO of the following

5. Explain microarray and gene expression analysis.

6. Describe the various methods employed in screening of recombinant DNA clones.

7. Give an account on biological databases and downloading of information from databases.

8. Write a short essay on the application of bioinformatics in phylogenetic analysis

(2 x 8 = 16 Marks)

III. Write short notes on any FOUR of the following

9. Gene therapy

10. Restriction endonuclease

11. Intellectual property right

12. Transcriptome

13. Simple sequence alignment

14. Chromosome walking

(4 x 5 = 20 Marks)

13. ZOO4E 02: ANIMAL SYSTEMATICS AND SPECIES INTERACTIONS

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks
2. Answer any TWO out of four questions - 2 x 8 = 16 Marks
3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

Model Question Paper
ZOO4E 02: ANIMAL SYSTEMATICS AND SPECIES INTERACTIONS

Time: 3 Hours **Maximum Marks:60**

I. Answer any two of the following

1. Explain mathematical modelling in species interactions.?
2. What are the molecular methods used in taxonomy
3. Explain the different molecular markers useful for studying populations and species
4. Write and essay on phylogenetic systematics/cladistics

(2x12=24 marks)

II. Answer any two of the following

5. Write on different types of population growths.?
6. Write notes on island biogeography models.?
7. Elaborate on the type concept and comment on different types used in animal nomenclature
8. Write notes on Kimura's Neutral theory and effect of selection on a population

(2x8=16marks)

III. Write short notes on any four of the following

9. Succession and models of succession.
10. Life history strategies.
11. Ecological efficiencies.
12. Write note on ICZN and the code, with emphasis on animal species descriptions and nomenclature
13. Explain the different types of phylogenetic trees and their uses
14. DNA barcoding

(4x5=20marks)

ZOO4E 03: MOLECULAR DEVELOPMENTAL BIOLOGY

Time : 3 Hours **Maximum 60 Marks**

1. Answer any TWO out of four questions - 2 x 12 = 24 Marks
2. Answer any TWO out of four questions - 2 x 8 = 16 Marks
3. Answer any FOUR out of six questions - 4 x 5 = 20 Marks

Model Question Paper
ZOO4E 03: MOLECULAR DEVELOPMENTAL BIOLOGY

Time: 3 hours **Maximum marks:60**

I. Answer any two of the following

1.write on gene regulations in development.?
2.comment on molecular mechanisms in mesoderm induction in amphibians.?
3.explain the stages of cell differentiation.?
4.write notes on amphibian metamorphosis.?

(2x12=24marks)

II. Answer any two of the following

5.Briefly describe cell culture techniques?
6.What are the different types of regeneration in animals.?
7. Cancer and development
8. Sclerotome development

(2x8=16marks)

III. Write short notes on any four of the following

9. IVF
10.Methods of observation of living embryos.
11.Genetic errors in human development.
12.Polyphenisms.
13.Gene duplication.
14.Apoptosis.

(4x5=20marks)

(4x5=20marks)

……