

**Department of Zoology
School of Life Sciences
Mizoram University**

**I Semester – Syllabus and Time table
Syllabus – I Semester 2015**

Course structure of M.Sc. Zoology – I Semester

	Course Code	Name of Course	Type of course	Credit distribution			Total Credits
				L	T	P	
FIRST SEMESTER: 22 CREDITS (Foundation Courses = 4 Credits; Core Course = 18 Credits)							
1 SEMESTER	ZOO/1/FC/01	*Animal Behaviour	FC	2	0	0	2
	ZOO/1/FC/02	*Biosystematics	FC	2	0	0	2
	<i>* Two FC courses can be selected from the pool of courses offered by the School</i>						
	ZOO/1/CC/03	Non-Chordata & Chordata	CC	4	1	0	5
	ZOO/1/CC/04	Cell Biology	CC	4	1	0	5
	ZOO/1/CC/05	Biochemistry	CC	4	1	0	5
	ZOO/1/CC/06	Lab Course on CC/03-05	CC	0	0	3	3

Time table – I Semester 2015

Time Table for I Semester 2015

Day	10:00 - 11:00	11:00 - 12:00	12:00 – 13:00	13:00 – 13:30	13:30 – 14:30	14:30 – 15:30	15:30 – 16:30
Monday	(3) AKT Non-Chordata & Chordata	(4) ES Cell Biology	(2) HT Biosystematics	Lunch Break	(6 – 3) VKR & AKT Non Chordata & Chordata	(2) HT Biosystematic	
Tuesday	(5) ES Biochemistry	(4) ZTS Cell Biology	(5) AKT Biochemistry		(6 – 4) ES & ZTS Cell Biology	ZTS Biochemistry	
Wednesday	(3) AKT Non-Chordata & Chordata	(4) ES Cell Biology	Tutorial -Non-Chordata and Chordata		(6 – 5) AKT, HT & ZTS Biochemistry	Tutorial Biochemistry	
Thursday	(5) AKT Biochemistry	(3) VKR Non-Chordata & Chordata	(4) ZTS Cell Biology		(1) AKT Animal Behaviour	Seminar/ Tutorial Cell biol.	
Friday	Test	(3) VKR Non-Chordata & Chordata	Presentation		Library/Student club		

Course Distribution For I Semester

	Course Code	Name of Course	Course Distribution		
FIRST SEMESTER: 22 CREDITS (Foundation Courses = 4 Credits; Core Course = 18 Credits)					
1 SEMESTER	ZOO/1/FC/01	Animal Behaviour	AKT		
	ZOO/1/FC/02	Biosystematics	HT		
	ZOO/1/CC/03	Non-Chordata & Chordata	AKT & VKR		
	ZOO/1/CC/04	Cell Biology	ES & ZTS		
	ZOO/1/CC/05	Biochemistry	AKT, ES & ZTS		
	ZOO/1/CC/06	Lab Course based on CC/03, CC/04 and CC/05	VKR & AKT CC/03	ES & ZTS CC/04	AKT, HT & ZTS CC/05

Faculty	ZOO/1/FC 01	ZOO/1/FC 02	ZOO/1/CC/ 03	ZOO/1/CC/ 04	ZOO/1/CC/ 05
GCJ	NIL	NIL	NIL	NIL	NIL
GSS	NIL	NIL	NIL	NIL	NIL
GG	NIL	NIL	NIL	NIL	NIL
HT	NIL	UNIT I & II	NIL	NIL	NIL
ES	NIL	NIL	NIL	UNIT I & II	UNIT I
VKR	NIL	NIL	UNIT III & IV	NIL	NIL
ZTS	NIL	NIL	NIL	UNIT III & IV	UNIT II
AKT	UNIT I & II	NIL	UNIT I & II	NIL	UNIT III & IV

ANIMAL BEHAVIOUR

ZOO/1/FC/01

Marks Scaled – 100

Credit =2

(L:T:P-2:0:0)

Lecturer Hrs – 30

UNIT – I

Concept and scope of ethology. Types of behaviour: innate and learned behavior. Learning and instincts: different types of learning behavior, habituation, conditioning-classical and instrumental, imprinting, and insight learning.

UNIT-II

Communication: chemical, visual, and acoustic. Parental care: pattern and types. Biological rhythms and Biological clocks. Hormonal and Pheromones: their effect in control of behavior.

Suggested Readings : ZOO/1/FC/01

1. Reena Mathur. (2009)Animal Behaviour. Rastogi Publications. 3rd revised and enlarge edition.
2. Alcock J. Animal Behaviour : An Evolutionary approach. Sinauer Assoc.Sunderland. Mass. USA.

BIOSYSTEMATICS

ZOO/1/FC/02

Marks Scaled – 100

Credit =2

(L:T:P-2:0:0)

Lecturer Hrs – 30

UNIT I

Basic concepts, importance and applications of Biosystematics. Trends in Biosystematics: conventional and current approaches (chemotaxonomy, cytotaxonomy and molecular taxonomy). Theories of biological classification and its importance; hierarchy of categories.

UNIT II

Taxonomic procedures: Taxonomic collections, preservation, curating, process of identification. Typification: Details of different zoological types. Taxonomic keys: Different kinds of taxonomic keys, their merits and demerits. International code of zoological Nomenclature (ICZN): principles, interpretation and application of important rules, formation of scientific names of various taxa.

Suggested Readings : ZOO/1/FC/02

1. Mayr E: Principles of Systematics Zoology. Tata McGraw Hill Pub. Company Ltd. 1980
2. Minelli A: Biological Systematics. Chapman and Hall. 1993
3. Alfred J R B, Das A K and Sanyal A K; Faunal Diversity in India. Zoological Survey of India. 1998

Non-Chordata and Chordata

ZOO/1/CC/03

Marks Scaled – 100

Credit =5

(L:T:P-4:1:0)

Lecturer Hrs – 75

UNIT – I

Protozoa: Nucleus and reproduction. Colonial protozoans and theories of the origin of metazoans. Porifera: canal system, Cnidaria: Nematocysts. Annelida: Adaptive radiation in polychaetes. Trochophore larva: structure and significance.

UNIT – II

Mollusca: Modifications of foot. Arthropoda: Affinities of trilobites, Crustacean larvae and their significance. Echinodermata: larval forms and their significance. Salient features and affinities of Placozoa, Mesozoa, Rotifera and Phoronida.

UNIT – III

Characteristic features and affinities: Protochordata, Hemichordata, Urochordata, Cephalochordata, Cyclostomes. Transition from agnatha to gnathostomata.

UNIT – IV

Adaptive radiation in vertebrates: Aquatic, Terrestrial, Aerial, Arboreal, Fossorial. Parental care in amphibians. Egg lying mammals.

Suggested readings: (ZOO/1/CC/03)

1. Barnes: Invertebrate Zoology (4th ed 1980, Holt-Saunders International)
2. Barnes: The Invertebrates – A synthesis (3rd ed 2001, Blackwell)
3. Hunter: Life of Invertebrates (1979, Collier Macmillan)
4. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)

CELL BIOLOGY

ZOO/1/CC/04

Marks Scaled 100

Credit – 5

(L:T:P-4:1:0)

Lecturer Hrs – 75

UNIT - I

Structure of model membrane, lipid bilayer. Structural organization and function of intracellular organelles (nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes).

UNIT – II

Membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes). Cell division and cell cycle, regulation of cell cycle.

UNIT – III

Structure & function of cytoskeleton and its role in motility. Cellular communication. Cell signaling: JAK-STAT signaling pathway, Receptor protein tyrosine phosphatase (PTP), Signaling by nitric oxide and carbon monoxide. Bacterial chemotaxis.

UNIT – IV

Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons). Polytene and lampbrush chromosomes.

Suggested readings:ZOO/1/CC/04

1. Alberts et.al (2002) Molecular Biology of the cell (4th Ed.,) Garland.
2. Lodish et.al (2004) Molecular Cell Biology (5th Ed.,) Freeman.
3. Friedfelder, D (1998) Molecular Biology, Jones and Bartlett Publication.
4. Gardner, E.J. and Snustad D.P (2000) Principles of Genetics, John Wiley and Sons.

BIOCHEMISTRY

ZOO/1/CC/05

Marks Scaled – 100

Credit =5

(L:T:P-4:1:0)

Lecturer Hrs – 75

UNIT – I

Structure of atoms, molecules and chemical bonds. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction).

UNIT – II

Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics: enthalpy and entropy, colligative properties). Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).

UNIT – III

Classification and properties of enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis. Enzyme inhibition, allosteric enzymes. Isozymes, ribozymes and abzymes.

UNIT IV

Glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

Suggested Readings: ZOO/1/CC/05

1. Nelson, D.L. and Cox, M.M.(2008) Lehninger Principle of Biochemistry, 3rd Ed Worth Pub.
2. Stryer, I. (2004). Biochemistry 4th edition, H. Freeman and Company.
3. Murray, R.K. et.al (1999) Harper's Biochemistry 25th ed. Prentice-Hall International
4. Plummer, L. (1989). Practical Biochemistry, Tata McGraw-Hill
5. Rawn, J.D. (1989) Biochemistry, North Carolina Biol, Supply Co.

LAB COURSE ON ZOO/1/CC/03 - 05

ZOO/1/CC/06

Marks Scaled – 100

Credit =3

(L:T:P-0:0:3)

Hrs –60

Non- Chordata and Chordata

1. Preparation of permanent slides: Principles and procedure.
2. Preparation of Museum specimens: Principles and procedure.
3. Study of salient features of museum specimens: Protozoa, Porifera, Cnidaria, Annelida, Arthropoda, Mollusca and Echinodermata.
4. Study of salient features of museum specimens: Fish, Amphibia, Reptiles, Birds and Mammals.
5. Study the digestive, excretory, nervous and reproductive systems.

Cell biology:

1. Micrometry
2. Study of sex chromatin in human female from buccal epithelial cells.
3. Polytene chromosome preparation.
4. Study of bacterial growth curve.
5. Metaphase preparation of mouse.

Biochemistry:

1. Buffer preparations.
2. Quantitative estimation of protein.
3. Estimation of enzymes.
4. Quantitative estimation of Carbohydrate.
5. Estimation of nucleic acid.

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**III Semester – Syllabus and Time table
Syllabus – III Semester 2015**

Semester III 22 credits (CC=10, SC=8, OE=4)					
Course code	Title of the course	L	T	P	Credits
ZOO/3/CC/13	Molecular Biology	3	1	1	5
ZOO/3/CC/14	Immunology and Development Biology	3	1	1	5
ZOO/3/SC/15(A-C)	Soft Course Any one course out of A-C# A. Cancer and Radiation Biology-III B. Wildlife and Conservation Biology -III C. Molecular Entomology-III	2	1	1	4
ZOO/3/SC/16(A-C)	Soft Course Any one course out of A-C# A. Cancer and Radiation Biology-IV B. Wildlife and Conservation Biology-IV C. Molecular Entomology-IV	2	1	1	4
ZOO/3/OE/17	Reproductive Health	2	0	0	2
ZOO/3/OE/18	Aquaculture and Integrated Fish Farming	2	0	0	2
Total Credits of Semester III		14	4	4	22

Time table – III Semester 2015

Day	10:00 - 11:00	11:00 -12:00	12:00 – 13:00	13:00 – 13:30	13:30 – 14:30	14:30 – 15:30	15:30 – 16:30
Monday	OE (17) VKR Reproductive Health		(13) ZTS Molecular Biology	Lunch Break	(13) PRACTICAL ES & ZTS		(13) Tutorial
Tuesday	OE (18) HT Aquaculture and Integrated Fish Farming		(16) ABC		(14) PRACTICAL GG, HT & VKR		(14) Tutorial
Wednesday	(13) ZTS Molecular Biology	(14) VKR Developmental Biology	(16) ABC		(15) GCJ/GSS/GG		(13) ES Molecular Biology
Thursday	(15) ABC		(15) (15) ABC		(13) ES Molecular Biology	(14) ZTS Immunology	(14) HT Developmental Biology
Friday	Test/presen tation	(14) HT Immunology	(16) ABC		(16) GCJ/GSS/GG or Library or Students club		

Course Distribution and course incharge of III Semester

	Course Code	Name of Course	Course Distribution and Course incharge
THIRD SEMESTER: 22 CREDITS (Core course=10 Credits: Soft Course=8 Credits; Open elective=4 Credits)			
3 SEMESTER	ZOO/3/CC/13	Molecular Biology	ES & ZTS
	ZOO/3/CC/14	Immunology & Developmental Biology	HT, VKR & ZTS
	ZOO/3/CC/15	Soft Course ABC	GCJ/GGS/GG
	ZOO/3/CC/16	Soft Course ABC	GCJ/GGS/GG
	ZOO/3/OE/17	Reproductive Health	VKR
	ZOO/3/OE/18	Aquaculture	HT

Faculty	ZOO/3/CC /13	ZOO/3/CC /14	ZOO/3/CC /15 (ABC)	ZOO/3/CC /16 (ABC)	ZOO/3/OE /17	ZOO/3/OE /18
GCJ	NIL	NIL	FULL	FULL	NIL	NIL
GSS	NIL	NIL	FULL	FULL	NIL	NIL
GG	NIL	NIL	FULL	FULL	NIL	NIL
HT	NIL	UNIT I & IV	NIL	NIL	NIL	FULL
ES	UNIT II & III	NIL	NIL	NIL	NIL	NIL
VKR	NIL	UNIT III	NIL	NIL	FULL	NIL
ZTS	UNIT I & IV	UNIT II	NIL	NIL	NIL	NIL
AKT	NIL	NIL	NIL	NIL	NIL	NIL

MOLECULAR BIOLOGY

ZOO/3/CC/13

Marks Scaled – 100
Credit=5 (L:T:P-3:1:1)

UNIT - I

Organisation of prokaryotic and eukaryotic genome. DNA as Genetic material; types of DNAs & RNAs, Structure of DNA. DNA Replication: Mechanisms of replication in prokaryotes & eukaryotes, and replicons. Problems associated with linear replicons.

UNIT – II

Transcription: RNA polymerases in prokaryotes & eukaryotes. Promoters & regulatory coding units. Transcription factors. Genetic code, deciphering of genetic code, characteristics features, universality & exceptions. Translation, initiation, elongation, termination, and post-translation modification. Regulation of gene expression in prokaryotes and eukaryotes.

UNIT - III

Molecular control of lysogeny & lytic cycles in lambda phage. Molecular basis of genetic Recombination: Types of recombination, breakage and rejoining and heteroduplexes, recombination in bacterial transformation and models of recombination. Transposable elements, retroposons, transposons. Molecular basis of mutagenesis, mutations, and mutants- terminology; types of mutations and their notation, biochemical basis of mutants, mutagenesis, mutational hot spots, reversion.

UNIT – IV

DNA damage: DNA Repair and its mechanisms. Restriction endonucleases, DNA polymerases, reverse transcriptase, & ligases and other modifying enzymes. Construction of cDNA genomic library. Cloning vectors: expression, and shuttle vectors. Reporter genes – Commonly used reporter genes, analysis of gene regulation. RNA interference.

Practicals ZOO/3/CC/13

1. Electrophoresis – Agarose and PAGE.
2. Isolation of genomic DNA and plasmid DNA
3. Restriction Digestion.
4. Quantitation of DNA
5. PCR and RAPD

Suggested Readings ZOO/3/CC/13

1. Brown T.A. 2006 Genomes-3. John Wiley & Sons, Bios Scientific Publishers.
2. Bruce, Alberts., Bray., Lewis, Raff, Roberts, Watson: Molecular Biology of the Cell, Garland Publishing
3. Daniel L., Hartl, Elizabeth W. Jones : Genetic-Principles and analysis, Jones and Bartlett Pub.
4. Gibson, Muse: A Primer to Genome Science. Sinauer Associates Inc. Pub.
5. Lewin B : Genes VIII, John Wiley and sons.
6. Lodish, berk, Zipursky, Matsudaira : Molecular Cell Biology. W.H. Freeman & Baltimore, Darnell Company
7. Sambrook, Fritsch, Maniatis 2004. Molecular Cloning, Vol I-III Cold Spring Harbor,
8. Watson, J.D., Baker, T.A. Levine, M. Steohen, P.B. Gann, A. & Losick, R. Roberts & Steitz, Weiner Cummings : Molecular Biology of the Gene (5th Ed), Pearson education.

IMMUNOLOGY AND DEVELOPMENTAL BIOLOGY

ZOO/3/CC/14

Marks Scaled – 100
Credit =5 (L:T:P-3:1:1)

UNIT – I

Immune system: Innate and acquired immunity; cells and organs of the immune system. Structure, classes and function of immunoglobulins; antibody-mediated effector functions; monoclonal antibodies, antibody engineering. Antigens: Antigenicity and immunogenicity, factors influencing immunogenicity, epitopes and haptens. Antigen- antibody interactions; generation of antibody diversity. Major histocompatibility complex in mouse and human: MHC haplotypes; structure and functions of class-I and class-II MHC molecules, graft types and transplantation.

UNIT-II

Complements: Features, classical and alternative pathways of complement activation. Cytokines and interferons: Types, structure and functions. Hypersensitivity: Types and features; mechanism of immediate hypersensitive reaction, AIDS (Acquired immunodeficiency syndrome) - retrobiology, T cells, NK cells. Types of vaccines. Active & passive immunizations.

UNIT- III

Development and differentiation of gonads in mammals. Gametogenesis: Spermatogenesis and oogenesis. ovulation and ovum transport in mammals. Fertilization: molecular events during pre- and post-fertilization, prevention of polyspermy, fetal membranes. Types of eggs, and cleavage- patterns; reorganization of embryonic cells- blastulation, gastrulation and fate of germinal layers.

UNIT- IV

Neural tube formation; organogenesis – development of brain and eye; concepts of embryonic induction, competence and organizer. Genetic regulations of early embryonic development in *Drosophila*; Homeotic genes; hox genes in vertebrates. Nuclear transplantation. Metaplasia and transdetermination.

Practicals: ZOO/3/CC/14

1. Study of frog and mouse sperm and sperm smear preparation.
2. Study of developmental stages of frog and chick embryos from permanent slides.
3. Enzyme Immunoassay for the detection of antigen.
4. In vitro detection of specific antibodies to *Salmonella* present in serum by tube and slide (WIDAL) tests.
5. Observation of chick embryo.

Suggested Readings: ZOO/3/CC/14

1. Thomas J Kindt, Barbara A Osborne and Richard A Goldsby (2006) Kuby Immunology 6th Edn. WH Freeman Publication.
2. Roitt IM, Martin SJ, Delves PJ and Burton D, Roitt's (2006) Essential Immunology, Blackwell Science Publishing.
3. Balinsky, B.I (1981) Introduction to Embryology. Hall Saunders, Philadelphia.
4. Gilbert S.F (2006) Developmental Biology. 7th Edition Sinauer Associated Inc.
5. Joel D. Richter (2005) A comparative Methods Approach to the study of Oocyte. Oxford University Press.
6. Ralf R and Kagufman T C (1983) Embryos, genes and evolution. Mac Millan.
7. Sadler TW and Jan Langman (2003) Langman's Medical Embryology, Lippincott Williams and Wilkins.

CANCER AND RADIATION BIOLOGY-III

ZOO/3/SC/15A

Marks Scaled – 100
Credit =4 (L:T:P-2:1:1)

UNIT I

Radioactivity: α , β , γ rays, neutron and protons. Decay schemes/decay charts. Radioisotopes: Isotopes and Isobars. Half-life. Interaction of ionizing radiation with matter; Concept of LET.

UNIT II

Radiation detection and measurement: Ionization chambers, proportional counters, Geiger Müller counters, scintillation counters and solid state counters.

UNIT III

Inverse square law. Units and measurements. Concept of ALARA, radiation protection and shielding. Exposure limits; Half value layer. Production of radioisotopes.

UNIT IV

Direct and indirect effects: radiolysis of water and free radical induction. Stochastic and non-stochastic effect of radiation. Effect of radiation on macromolecules.

Practicals ZOO/3/SC/15A

1. Geiger Muller counters.
2. Decay schemes/charts
3. Half-life measurement.
4. Inverse square law determination.

Suggested Readings: ZOO/3/SC/15A

1. James E. Martin (2006) Physics for Radiation Protection Wiley-VCH Verlag GmBh and Weinheim
2. Herman Cember and T.E. Johnson (2009) Introduction to Health Physics: Fourth Edition McGraw Hill Co. New York, New Delhi
3. Glen F. Knoll (2012) Radiation Detection and Measurement. VP and Publisher.
4. Eric J. Hall and Amato Giaccia (2011) Radiobiology for the Radiologist. 7th edition. Lippincott Williams and Wilkins.
5. A.P. Casarett (1968) Radiation Biology . Prentice Hall
6. Forshier Steven (2002) Essentials of Radiation Biology and Protection. Delmar

WILDLIFE AND CONSERVATION BIOLOGY –III

ZOO/3/SC/15B

Marks Scaled – 100
Credit =4 (L:T:P-2:1:1)

UNIT I Habitat- Definition, role of in wildlife conservation. Composition and characteristics of major habitats viz; Marine, Estuarine, Fresh water, and terrestrial.

UNIT II Temperate and tropical habitats- tropical habitats are more diverse than temperate. Vertebrate habitat selection- Hierarchical selection, density dependent selection..

UNIT III Component of a generalized habitat- food, water, cover, shelter and their function. Concepts of Niche, Edges, Ecotone, juxtaposition, interspersion and role in biodiversity enrichment.

UNIT IV Habitat management practices and procedure for evaluation. Study of signs and symptoms as evidence for utilization of habitat by different category of animals.

Practicals ZOO/3/SC/15B

1. Estimation of plant density in natural habitat.
2. Foliage/crown cover and crown density estimation.
3. Vegetation analysis for dominant plant species.
4. Food category analysis.
5. Observations of different animal signs.

Suggested Readings: ZOO/3/SC/15B

1. Smith, R.L and Smith, T.M. (1998) Elements of Ecology. Benjamin/Cummings Science Publishing. 4th edition.
2. Stiling Peter. (2002) Ecology: Theories and Application. Prentice-hall of India Private Limited, New Delhi. 4th edition.
3. McComb, Brenda C.(2008). Wildlife Habitat Management: Concepts and Applications in Forestry. CRC press, Taylor and Francis Group, New York
4. Patton, David R. (2011). Forest Wildlife Ecology and Habitat management. CRC press, Taylor and Francis Group, New York
5. Pianka, Eric R. (2003). Evolutionary Ecology. Harper and Row Publishers, New York,US.
6. Berwick, S.H. and Sahara, V.B. (1995). Wild life research and management – Asian and American approaches. Oxford University Press, Delhi

MOLECULAR ENTOMOLOGY-III

ZOO/3/SC/15C

Scaled Mark – 100
Credit =4 (L:T:P-2:1:1)

UNIT I

Insect Genomics: Genome structure and organization, RNAs, Pseudogenes, processed genes, repetitive elements and transposable elements. Insect genomic resources: status, availability, analysis and future.

UNIT II

Molecular marker systems in insects: Conventional marker systems, major applications of molecular markers in studying insect ecology, novel marker systems and concerns on marker applications in insect research.

UNIT III

Physico-chemical and functional characterization of proteins and secondary structure prediction. Sequence alignment and analysis. Homology modeling and Molecular docking.

UNIT IV

Physico-chemical and functional characterization of proteins and secondary structure prediction. Sequence alignment and analysis. Homology modeling and Molecular docking.

Practicals ZOO/3/SC/15C

1. DNA isolation, quantification, PCR analysis, electrophoresis and purification using a DNA marker.
2. Primer Design, OligoAnalyzer, DNA sequencing software, sequence Assembly CAP3, NEBcutter2, BLAST, vecscreen, Genome annotation, Open Reading Frame Search, Gene Prediction Tools, ProtParam, Sequence analysis, submission and retrieval.
3. Multiple Sequence Alignment and phylogenetic analysis using ClustalX and MEGA 4.0.
4. Homology modelling.
5. Docking studies.

Suggested Readings ZOO/3/SC/15C

- 1 Gilbert, L.I., Iatrou, K. and Gill, S.S. (eds.) (2005) Comprehensive Molecular Insect Science, Vol. 4 (pp. 1–77, Elsevier, Oxford press.
- 2 Hoy, M.A. (2003) Insect molecular genetics: an introduction to principles and applications. 2nd edition, Academic Press, San Diego, California,
- 3 Avise JC (2004) Molecular Markers, Natural History, and Evolution, 2nd edn, pp. 684. Sinauer Associates, Sunderland, Massachusetts.
- 4 Epperson B (2003) Geographical Genetics. Princeton University Press, Princeton, New Jersey.
- 5 Grimaldi, D. and Engel, M. (2005) Evolution of the Insects, Cambridge University Press.
- 6 Atkinson P W, Pinkerton A C & O'Brochta D A, (2001) Genetic transformation systems in insects, Annual Review of Entomology, 46: 317-346.
- 7 Nei M (1987) Molecular Evolutionary Genetics. Columbia University Press, New York.
- 8 Weir B (1996) Genetic Data Analysis II. Sinauer & Associates, Massachusetts.
- 9 Durbin, R, S Eddy, A Krogh, G Mitchison (1998) Biological Sequence Analysis. Cambridge University Press: Cambridge.

CANCER AND RADIATION BIOLOGY-IV

ZOO/3/SC/16A

Marks Scaled – 100
Credit =4 (L:T:P-2:1:1)

UNIT I

Effect of radiation, Dose effect relationship, histopathology of salivary glands, tooth. Hematopoietic system, blood, and intestine.

UNIT II

Effect of radiation. Dose effect relationship, histopathology of liver, kidney, bone and male and female reproductive system.

UNIT III

Radiation syndromes. Radiation-induced chromosome damage .DNA repair mechanisms. DNA repair defects and correlation to cancer

UNIT IV

Radiosensitization and radioprotection. Application of radioisotopes in medicine and biology, safe handling of radioisotopes. Design of radioisotope laboratory

Practicals ZOO/3/SC/16A

1. Geiger Muller counter.
2. Decay schemes/charts
3. Half-life measurement.
4. Inverse square law determination.

Suggested Readings: ZOO/3/SC/16A

1. James E. Martin (2006) Physics for Radiation Protection Wiley-VCH Verlag GmBh and Weinheim
2. Herman Cember and T.E. Johnson (2009) Introduction to Health Physics: Fourth Edition McGraw Hill Co. New York, New Delhi
3. Glen F. Knoll (2012) Radiation Detection and Measurement. VP and Publisher.
4. Eric J. Hall and Amato Giaccia (2011) Radiobiology for the Radiologist. 7th edition. Lippincott Williams and Wilkins.
5. A.P. Casarett (1968) Radiation Biology . Prentice Hall
6. Forshier Steven Forshier (2002) Essentials of Radiation Biology and Protection. Delmar

WILDLIFE AND CONSERVATION BIOLOGY –IV

ZOO/3/SC/16B

Marks Scaled – 100
Credit =4 (L:T:P-2:1:1)

- UNIT I** Introduction and scope of conservation biology; Value of biodiversity: ecological, economic, ethical and social value; Concept and categories of threatened species..
- UNIT II** Patterns, processes, and levels of biodiversity; Cause and factor of mass extinctions; Hot spots and mega biodiversity centres; Conservation of rare, long lived, keystone species and mutualistic species..
- UNIT III** Management of species: Ecological, biological and sociological approach. Nation level conservation projects; Project Tiger, conservation of Asiatic Lions, Conservation of Indian Rhino and Brow antler deer.
- UNIT IV** Conservation strategies: *in-situ*, *ex-situ*, *in-vitro*; Protected areas: categories, protected area network; role of protected area in conservation.

Suggested readings ZOO/3/SC/16B

1. Rajesh Gopal: Fundamentals of wildlife management. Justice Home Publications. 1993.
2. Agrawal, K.C. Global biodiversity. Nidhi Publications. 2002.
3. Groombridge. Global biodiversity-status of earth's living resources. Chapman & Hall, London. 1992.
4. Gary, K.M. & Caroll, R.C. Principles of Conservation Biology. Sinauer Associates, Inc. Publishers, Sunderland, USA. 1994
5. Primack, Richard B. Essentials of Conservation Biology. Sinauer Associates, Inc. Publishers, Sunderland, USA. 2002.
6. Berwick, S.H. and Sahara, V.B. Wild life research and management – Asian and American approaches. Oxford University Press, Delhi. 1995.
7. Rodgers, W.A. and H.S. Panwar 1998. Planning a Protected Area Network in India. Wildlife Institute of India, Dehra Dun.
8. Southwood, T.R.E and P.A. Henderson 2000. Ecological Methods. Blackwell Science. Oxford. 575p.

MOLECULAR ENTOMOLOGY-IV

ZOO/3/SC/16C

Scaled Mark – 100
Credit =4 (L:T:P-2:1:1)

UNIT I

Development of RNAi in Insects and RNAi-based pest Control, Insect antimicrobial peptides: structures, properties and gene regulation and insect neuropeptides and their potential application for pest control.

UNIT II

Growth and Maintenance of Insect Cell Lines: Insect cell lines, characteristics, baculovirus expression systems, media, cell handling techniques, adherent vs. suspension culture, freezing, lepidopteran and mosquito cell lines, methods for maintaining insect cell cultures and their applications.

UNIT III

Plant resistance and jasmonic acid pathway. Insect resistant transgenic crops: crops with *Bt* gene, protease inhibitors, alpha amylase inhibitors, plant lectins, enzymes, vegetative insecticidal proteins, toxins from predators, secondary plant metabolites, gene pyramiding.

UNIT IV

Insect transgenesis: insect gene transfer, selection of transgenic insects, resistance genes as candidates for insect transgenesis, transposable elements for insect transformation, genetic engineering of insects with mariner transposons, *Wolbachia* as a vehicle to modify insect populations, genetic modification of mosquitoes, deploying transgenic arthropods in pest management programs and regulation of GM insects.

Practicals ZOO/3/SC/16C

1. Insect cell line handling techniques.
2. Media preparation.
3. Adherent cell cultures.
4. Suspension cell cultures.
5. Determination cell density and cell viability.

Suggested readings ZOO/3/SC/16C

1. Handler, A. M. and A. A. James, Eds. 2000. Insect Transgenesis: Methods and Applications. CRC Press, Boca Raton, FL.
2. Handler, A. M. and D. A. O'Brochta. 1991. Prospects for gene transformation in insects. *Annu. Rev. Entomol.* 36: 159-183.
3. Mitsuhashi J (ed.). (1989) *Invertebrate Cell System Applications*, vol. II. Boca Raton, FL: CRC Press.
4. Granados RR, McKenna KA. (1995) Insect Cell Culture Methods and Their Use in Virus Research. In: Schuler ML, Wood HA, Granados RR, Hammer DA, editors. *Baculovirus Expression Systems and Biopesticides* p. 13-39. New York: Wiley-Liss.
5. James, A. A. 2000. Control of disease transmission through genetic modification of mosquitoes. pp. 319-333. In: *Insect Transgenesis. Methods and Applications*. A. M. Handler and A. A. James, Eds, CRC Press, Boca Raton, FL.
6. Alphey L. 2007. Engineering insects for the Sterile Insect Technique. In: *Area-wide control of insect pests: from research to field implementation* (Vreysen, M, Robinson, A and Hendrichs, J, eds.). pp. 51-60. Springer, Dordrecht, The Netherlands.

REPRODUCTIVE HEALTH

ZOO/3/OE/17

Marks Scaled – 100
Credit – 2 (L:T:P-2:0:0)

UNIT-I

Concept of reproduction and reproductive health, Reproductive organs: male and female, Pregnancy- Nutrition needs, Common problems associated with pregnancy, precaution and care, Gestation and critical period, Birth-defects. Ectopic pregnancy.

UNIT-II

Fertility and sterility; Family planning methods for Male (surgical and barrier), and Female- Natural Method, Barrier Method, Hormonal Contraceptives; Intra-Uterine Contraceptive Devices; Sexually transmitted diseases-Prevention and remedy; Polycystic ovary syndrome.

Suggested Readings:

1. Knobil and Neill's Physiology of Reproduction. Elsevier Science.
2. Kulczycki, A. (2014) Critical issues in reproductive health. Springer Series.
3. Fertility and sterility: A current Overview, J bringer and B. Hedon, CRC Press.

AQUACULTURE & INTEGRATED FISH FARMING

ZOO/3/OE/18

Marks Scaled – 100
Credit – 2 (L:T:P-2:0:0)

UNIT-1

Concept of aquaculture. Types of aquaculture: pearl culture, prawn culture, algal culture, fish culture; Economic importance of aquaculture; Edible fresh water fishes and their identification.

UNIT-2

Fish farming : qualities of cultivable fishes, major cultivable fishes. Management of fish culture program; Types of ponds and their management.

Principle and scope of integrated fish farming with special reference to NE region; Important integrated fish farming systems.

Suggested Readings:

1. Economic Zoology, author G.S. Shukla & V.B. Upadhyay, 2011 Rastogi Publications, Meerut
2. Fish & Fisheries, author K. Pandey & J.P. shukla, 2010, Rastogi Publications, Meerut
3. Fish & Fisheries, author Santoh Kumar & Manju Tembhre, 2011, New Central Book Agency, Kolkata