Sacred Heart College (Autonomous)

Department of Zoology

MASTER OF SCIENCE [ZOOLOGY]

Course plan

Academic Year: 2016 - 17

Semester I

COURSE 1: 16P1ZOOT01 - BIOSYSTEMATICS AND ANIMAL DIVERSITY

PROGRAMME	**Master of Science [Zoology]**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1ZOOT01 - BIOSYSTEMATICS AND ANIMAL DIVERSITY**	**CREDIT**	**4**
HOURS/WEEK	**4**	**HOURS/SEM**	**72**
FACULTY NAME	**SMITHA S**		

COURSE OBJECTIVES
To understand the basic concepts of systematics and taxonomy
To discuss the procedures in taxonomy and ethics in publications
To appreciate the contributions made by scientists and organisations towards conservation of animal diversity
To analyze the present status of Indian fauna and the role played by ZSI for conservation of Indian fauna
To examine the diversity of Palaeofauna
To discuss the animal architecture
To compare the invertebrate fauna by their characteristics
To compare the vertebrate animals by their characteristics

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
BIOSYSTEMATICS				
Module I. Concepts in Biosystematics				
1	Systematics and Taxonomy. Levels of Taxonomy - alpha, beta and gamma taxonomy	ICT Enabled (ppt&images, video clippings)	e-resource	
2	Microtaxonomy – pheneon, taxon, category	ICT Enabled (ppt&images, charts)		
3	Macrotaxonomy; Importance of Taxonomy.	ICT Enabled (ppt & Images, video clippings)		
4	Three Domain Concept in Systematics, two, five and six kingdom classification.	ICT Enabled (ppt& animations, images)	e-resource	
5	Hierarchy of categories and higher taxa – Linnaean Hierarchy. Higher categories – Genus, family, order, class and phylum (brief account only)	ICT Enabled (ppt& animations, images)	e- resource	
6	Concept of species - Typological, Nominalistic, Biological and Evolutionary	ICT Enabled (ppt& animations, images,)		
7	Intraspecific Catagories; Variety, Subspeicies, Race, Cline.	ICT Enabled (ppt& animations, images,)		
Module II. Methods of Biosystematics				
8	Typological, Phenetics, Evolutionary, Phylogenetic, Different kinds of taxonomic characters.	ICT Enabled (ppt & images); discussion	e-resource	
9	CIA I	1 hr; descriptive answers only		
Module III. Practice of Taxonomy				
10	Taxonomic Procedures - collection, different types of taxonomic collections, preservation, curetting and identification	ICT Enabled (ppt & images); discussion	e-resource	
11	Taxonomic Keys as tool of identification, different types of keys, merits and demerits.	ICT Enabled (ppt & images); discussion		
12	Process of typification, different zoological types and their significance.	ICT Enabled (ppt & images); discussion	e- resource	

13	**Use of computer softwares in taxonomic identification.**	**ICT Enabled (ppt & images); discussion**		
14	**Taxonomic nomenclature - International Code of Zoological Nomenclature (ICZN), Rules and formation of scientific names of different taxa.**	**ICT Enabled (ppt & images); discussion**		
15	**Importance principles of Zoological Nomenclature - Law of priority, Homonymy and Synonymy.**	**ICT Enabled (ppt & images); discussion**	**e- resource**	
16	**Taxonomic publications – description of new taxa, synopses and reviews**	**ICT Enabled (ppt & images); discussion**		
17	**Taxonomic revisions, monographs, atlases, field guides and manuals, catalogs and checklists.**	**ICT Enabled (ppt & images); discussion**		
18	**Ethics in taxonomy - authorship, suppression of data, undesirable practices in taxonomy (brief description only).**	**ICT Enabled (ppt & images); discussion**		
Module IV. Modern systematics				
19	**Molecular Taxonomy - use of Proteins, DNA and RNA. Molecular Phylogeny, Phylogenetic trees, Phylocode,**	**ICT Enabled (ppt & images); discussion**		
20	**Tree of Life. Cladistic analysis and cladograms. Bar-coding of Life – merits and demerits**	**ICT Enabled (ppt & images); discussion**		
21	**CIA 2**	**2 Hrs**		
ANIMAL DIVERSITY				
Module I. Studies on Indian Fauna – from the past				
22	**Contributions from British period**	**ICT Enabled (ppt&images, charts, video clippings)**		
23	**Organizations - Bombay Natural History Society, The Asiatic Society of Bengal**	**ICT Enabled (ppt&images, video clippings)**		
24	**Publication - *The Fauna of British India, Including Ceylon and Burma***	**ICT Enabled (ppt, images, animations & video clippings)**		
25	**Contributors to the research on Indian Fauna - Patrick Russell, Sir Francis Day, Ferdinand Stoliczka, Jim Corbet**	**ICT Enabled (ppt, images, animations & video clippings)**	**e-resource**	

26	**Contributors to the research on Indian Fauna- Salim Ali, Sunder Lal Hora, Wynter-Blyth, Romulus Whitaker.**	**ICT Enabled (ppt&images, charts, video clippings)**	**e-resource**	
Module III. Diversity of Palaeofauna				
27	**Fossil records of prokaryotes, fossil protists, Edicaran and Burgess Shale fauna. Cambrain explosion- causes and consequences**	**ICT Enabled (ppt, images, animations & video clippings)**		
28	**Fossil arthropods - Trilobites, Extinct molluscs, Fossil Echinoderms, Fossil records of Fishes,**	**ICT Enabled (ppt, images, animations & video clippings)**		
29	**Mesozoic world of reptiles and their extinction. Fossil record of birds, Mammalian ancestral forms, Animal fossil records from India.**	**ICT Enabled (ppt, images, animations & video clippings)**	**e-resource**	
Module II. Indian Fauna-Present status				
30	**An overview of Animal Diversity in India**	**ICT Enabled (ppt&images, video clippings)**	**e-resource**	
31	**Corals of India, Earthworm diversity of India**	**ICT Enabled (ppt&images, charts, video clippings)**		
32	**Commercial Shrimps and Prawns of India**	**ICT Enabled (ppt&images, video clippings)**	**e-resource**	
33	**Insect fauna of India, Butterflies of India, Indian Arachnids.**	**ICT Enabled (ppt) Lecture**		
34	**Indian molluscs, Echinoderms of India**	**ICT Enabled (ppt) Lecture**		
35	**Major fishes of India, Amphibian diversity of India**	**ICT Enabled (ppt) Lecture**		
36	**Indian snakes, Survey of Indian Bird fauna**	**ICT Enabled (ppt) Lecture**		
37	**Indian mammals, Diversity of domesticated animals of India,**	**ICT Enabled (ppt) Lecture**		
38	**Endangered animals of India, Endemic animals of Kerala.**	**ICT Enabled (ppt) Lecture**		
39	**Western Ghats – Geography, Faunal diversity, endemism**	**ICT Enabled (ppt) Lecture**		

40	**Zoological Survey of India and the role in the conservation of Indian Fauna.**	**ICT Enabled (ppt) Lecture**		
41	**Major fishes of India, Amphibian diversity of India**	**ICT Enabled ppt & images, video clippings)**		
42	**Indian snakes**	**ICT Enabled (ppt&images, charts, video clippings)**	**e-resource**	
43	**Survey of Indian Bird fauna**	**ICT Enabled (ppt&images, charts, video clippings)**	**e-resource**	
44	**Indian mammals, Diversity of domesticated animals of India,**	**ICT Enabled (ppt & images, video clippings)**		
Module IV. Animal architecture				
45	**Animal complexity – acellular/unicellular grade, cellular grade, tissue grade, organ grade and organ system grade. Animal body plans.**	**ICT Enabled (ppt) Lecture**	**Video**	
46	**Symmetry and its embryonic origin, body cavities, metamerism, cephalisation, complexity and body size.**	**ICT Enabled (ppt) Lecture**		
Module V. Animal Diversity – Invertebrates				
47	**Diversity of protists with reference to body structure, nutrition, reproduction and life history.**	**ICT Enabled (ppt) Lecture**	**video**	
48	**Recent trends in the classification of protists.**	**ICT Enabled (ppt) Lecture**		
49	**Body architecture of sponges, Diversity of Porifera with reference to body structure.**	**ICT Enabled (ppt) Lecture**		
50	**Diversity of Cnidaria with reference to body organization and morphology. Ctenophoran diversity.**	**ICT Enabled (ppt) Lecture**		
51	**Acoelomata**	**ICT Enabled (ppt) Lecture**		
52	**Pseudocoelomata;**	**ICT Enabled (ppt) Lecture**		
53	**Phylogeny of Arthropod -**	**ICT Enabled (ppt) Lecture**		

54	**Phylogeny of Arthropod - Monophyly and Polyphyly,**	**ICT Enabled (ppt) Lecture**		
55	**Reasons for the success of Arthropods.**	**ICT Enabled (ppt) Lecture**		
56	**Diversity of arthropod larvae; Adaptive Radiation in Molluscs**	**ICT Enabled (ppt) Lecture**		
57	**Larval forms of Molluscs**	**ICT Enabled (ppt) Lecture**		
58	**Lesser Protostomes (Brief account only) – Sipuncula, Echiura, Phoronida**	**ICT Enabled (ppt) Lecture**		
59	**Lesser Protostomes**	**ICT Enabled (ppt) Lecture**		
60	**Brachipoda, Onychophora and Chaetognatha**	**ICT Enabled (ppt) Lecture**		
61	**Echinoderms - Adaptive radiation**	**ICT Enabled (ppt) Lecture**		
62	**Larval forms of Echinoderms.**	**ICT Enabled (ppt) Lecture**		
Module VI. Animal Diversity – Vertebrates				
63	**Lower Chordates**	**ICT Enabled (ppt) Lecture**		
64	**Chondrichthyes and Osteichthyes**	**ICT Enabled (ppt) Lecture**		
65	**Reptiles – origin**	**ICT Enabled (ppt) Lecture**		
66	**Reptiles - adaptive radiation**	**ICT Enabled (ppt) Lecture**		
67	**Birds - Structural modifications for aerial life**	**ICT Enabled (ppt) Lecture**		
68	**Birds - functional modifications for aerial life**	**ICT Enabled (ppt) Lecture**		

69	Adaptive radiation in mammals	ICT Enabled (ppt) Lecture		
70	Modern Amphibians, diversity, distribution	ICT Enabled (ppt) Lecture		
71	Modern Amphibians, status and threats	ICT Enabled (ppt) Lecture		
72	Revision			

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	9/7/2016	Ethics in taxonomy
2	21/7/2016	Adaptive radiation in mammals

GROUP ASSIGNMENTS/ACTIVITES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	4/9/2016	Reptiles – origin and adaptive radiation
2	11/9/2016	Taxonomic publications

References

- **Alfred, J.R.B and Ramakrishna. 2004. Collection, Preservation and Identification of Animals. Zoological Survey of India Publications, Kolkata, India.**
- **Anderson,T.A.2001. Invertebrate Zoology (2nd edn). Oxford University Press, New Delhi.**
- **Barnes, R. D.1982. Invertebrate Zoology (6th edn). Toppan International Co.,NY**
- **Barrington, E. J. W. 1969. Invertebrate Structure and Functions. English Language Book Society.**
- **Benton,M.J.2005. Vertebrate Paleontology Blackwell PublishingCom.Oxford,UK.**
- **David, M. H, Craig Moritz and K.M. Barbara.1996. Molecular Systematics. Sinauer Associates, Inc.**
- **Fauna of India (Formerly Fauna of British India). Zoological Survey of India (ZSI) Publications, Kolkata, India.**
- **Hickman Jr., Cleveland, Larry Roberts, Susan Keen, Allan Larson, and David Eisenhour .2011. Animal Diversity. McGraw-Hill Companies, Inc. NY**
- **Hyman, L. H. 1940 –1967. The Invertebrates (6 vols). McGraw-Hill Companies Inc. NY**
- **K.A.Subramanian and K.G.Sivaramakrishnan Aquatic Insects of India-A fieldguide Ashoka Trust for Research in Ecology and the Environment, Bengaluru, India.**

- **Kapoor, V.C. 1991.Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.**
- **Margulis,Lynn and M.J.Chapman 2001. Kingdoms and Domains: An Illustrated Guide to the Phyla of Life on Earth(4th edn.). W.H.Freeman &Company,USA**
- **Mayr, E .1969. Principles of Systematic Zoology. McGraw Hill Book Company, Inc., NY.**
- **Mayr, E and Ashlock P.D. 1991. Principles of Systematic Zoology. McGraw Hill Book Company, Inc., NY.**
- **Niles, E. 2000.Life on earth: an Encyclopedia of Biodiversity, Ecology and Evolution (Vol.1&II).ABCCLIO, Inc.CA,USA**
- **Priyadarsanan D. R., S. Devy, Aravind N. A., Subramanian, K. A., and S. Narayanan 2012. Invertebrate diversity and conservation in the Western Ghats Ashoka Trust for Research in Ecology and the Environment, Bengaluru, India.**
- **Romer, A.S. and T.S. Parsons. 1985. The Vertebrate Body. (6th edn.) Saunders, Philadelphia.**
- **State Fauna Series - Zoological Survey of India (ZSI) Publications, Kolkata, India.**

COURSE 02: 16P1ZOOT02: EVOLUTIONARY BIOLOGY AND ETHOLOGY

PROGRAMME	**MASTER OF SCIENCE [ZOOLOGY]**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1ZOOT02: EVOLUTIONARY BIOLOGY AND ETHOLOGY**	**CREDIT**	**4**
HOURS/WEEK	**4**	**HOURS/SEM**	**72**
FACULTY NAME	**RAAGAM PM & MONCEY VINCENT**		

COURSE OBJECTIVES
To describe the concepts of organic evolution
To comprehend and analyse the evidences of biological evolution
To discuss the process of animal evolution through studying the population genetics and ontogeny
To describe the theories regarding human evolution and analyse the molecular evidences of our phylogeny
To analyze the significance of studying Ethology
To describe the causal factors of behaviour and different types of behaviour
To analyze the Neurophysiological aspects of behaviour
To discuss the processes underlying the expression of behaviour patterns by animals

Sessions	Topic	Method of Teaching	Value Additions	Remarks
EVOLUTIONARY BIOLOGY				
Module I. Concepts in Evolution				
1	**Concepts of variation, adaptation, struggle, fitness and natural selection-spontaneity of mutation and the evolutionary synthesis.**	**ICT enabled with ppt and related videos**		
2	**Contributions of Margulis, Eldredge and Gould (Punctuated equilibrium)**	**ICT enabled with ppt and related videos**		
3	**Rose Mary and Peter Grant (Molecular evolution in Darwinian finches).**	**ICT enabled with ppt and related videos**		
Module II. Origin and Evolution of Life				
4	**The RNA world. Idea of Panspermia. The First Cell**	**ICT enabled with ppt and related videos**		
5	**Evolution of Prokaryotes-**	**ICT enabled with ppt and related videos**		
6	**Origin of eukaryotic cells- evolution of unicellular eukaryotes**	**ICT enabled with ppt and related videos**		
7	**Genome evolution. Anaerobic metabolism**	**ICT enabled with ppt and related videos**		
8	**Origin of photosynthesis and aerobic metabolism**	**ICT enabled with ppt and related videos**		
Module III. Evidences of Evolution				
9	**Evidences from morphology and comparative anatomy - homologous structures, vestigial organs**	**Lecture**		
10	**Analogous structures, adaptive radiation, atavism, connecting links.**	**Lecture with interaction**		
11	**Evidences from embroyology – egg and developmental stages**	**Lecture**		
12	**Similarity of embryos, Baer's law, recapitulation theory.**	**Lecture and interaction**		
13	**Physiological and biochemical evidences – protoplasm, chromosomes, DNA, enzymes, hormones**	**Lecture**		

14	**Blood groups, excretory products, biochemical recapitulation, comparative serology.**	**Lecture and inter action**		
15	**Palaentological evidences – fossils and fossil formation, conditions essential for fossil formation**	**Lecture**		
16	**Types of fossils, dating of fossils, siginifcance of fossils, geological time scale.**	**Lecture and inter action**		
Module IV. Population Genetics				
17	**Gene pool**			
18	**Gene frequency**	**Lecture**		
19	**Hardy-Weinberg Law**	**Lecture**		
20	**Hardy-Weinberg Equation with Example**	**Lecture and interaction**		
21	**Factors affecting Hardy-Weinberg Equilibrium**	**,,**		
22	**Rate of change in gene frequency through natural selection**	**,,**		
23	**Migration and random genetic drift.**	**,,**		
24	**Founder effect. Isolating mechanisms**	**Lecture and inter action**		
25	**Speciation. Micro and Macro Evolution**	**,,**		
26	**Mega evolution. Co-evolution.**	**,,**		
Module V. Developmental and Evolutionary Genetics				
27	**The idea of Evo-Devo, Heterochrony**	**ICT enabled with ppt and related videos**		
28	**Heterotopy, Heterometry and Heterotypy**	**ICT enabled with ppt and related videos**		
29	**Developmental genes**	**ICT enabled with ppt and related videos**		
30	**Gene co-option**	**ICT enabled with ppt and related videos**		
31	**Evolution of plasticity**	**ICT enabled with ppt and related videos**		
32	**Evolution of complexity. Evolution of sex.**	**ICT enabled with ppt and related videos**		
33	**I CIA**			

Module VI. Primate Evolution and Human Origins				
35	**Stages in Primate evolution- Prosimii, Anthropoidea and Hominids**	**ICT enabled with ppt and related videos**		
36	**Factors in human origin, hominid fossils**	**ICT enabled with ppt and related videos**		
37	**Cytogenetic and molecular basis of origin of man**	**ICT enabled with ppt and related videos**		
38	**African origin of modern man - Mitochondrial Eve, Y chromosomal Adam**	**ICT enabled with ppt and related videos**		
39	**Evolution of human brain- communication, speech and language.**	**ICT enabled with ppt and related videos**		
ETHOLOGY				
MODULE I- Introduction				
40	**Historical background, Stimulus-Response, Causal factors, Quantitative aspects - Duration, interval frequency. Behaviour bouts.**	**Lecture with Power Point Presentation and Video show**		
41	**Scope of ethology.**	**Lecture with Power Point Presentation and Video show**		
	MODULE II- Neurophysiological Aspects of Behaviour			
42	**Reflex action, Kinesis, Taxes**	**Lecture with Power Point Presentation**		
43	**Sherrington's neuro-physiological concepts in behavior - Latency, summation, fatigue.**	**Lecture with Power Point Presentation**		
44	**Fixed action patterns.**	**Lecture with Power Point Presentation**		
	I CIA			
MODULE III- Motivation				

45	**Definition- Goal oriented drive, internal causal factor, Homeostatic and Non-homeostatic drives.**	**Lecture with Power Point Presentation**		
46	**Hormones and behavior, Psycho-hydrologic model of motivation.**	**Lecture with Power Point Presentation**		
MODULE IV- Learning				
47	**Short and long term memory, Habituation**	**Lecture with Power Point Presentation**		
48	**Classical conditioning (Pavlov's experiments), Instrumental conditioning,**	**Lecture with Power Point Presentation**		
49	**Latent learning, Trial and error learning, Instinct, Imprinting.**	**Lecture with Power Point Presentation**		
MODULE V- Communication				
50	**Evolution of communication**	**Lecture with Power Point Presentation**		
51	**Sensory mechanisms: Electrical**	**Lecture with Power Point Presentation and Video show**		
52	**Sensory Mechanisms: Chemical, Olfactory**	**Lecture with Power Point Presentation**		
53	**Sensory Mechanisms: Auditory and Visual.**	**Lecture with Power Point Presentation and Video show**		
54	**Dance language of honey bees, Pheromonal communication (Ants and mammals).**	**Lecture with Power Point Presentation and Video show**		
55	**II CIA**			

MODULE VI- Reproduction and Behaviour 4 hrs.				
56	**Reproductive strategies and Mating systems**	**Lecture with Power Point Presentation**		
57	**Courtship behaviour**	**Lecture with Power Point Presentation and Video show**		
58	**Sexual selection- patterns**	**Lecture with Power Point Presentation**		
59	**Parental care and investment.**	**Lecture with Power Point Presentation and Video show**		
Module VII. Complex Behaviour				
60	**Orientation, Navigation**	**ICT enabled with ppt and related videos**		
61	**Migration (Fishes and birds), Navigation cues**	**ICT enabled with ppt and related videos**		
62	**Biological rhythms - Circadian**	**ICT enabled with ppt and related videos**		
63	**Biological rhythms - Circannual, Lunar periodicity**	**ICT enabled with ppt and related videos**		
64	**Biological rhythms - Tidal rhythms**	**ICT enabled with ppt and related videos**		
65	**Genetics of biological rhythms.**	**ICT enabled with ppt and related videos**		
Module VIII. Social Behaviour				
66	**Sociobiology (Brief account only) Aggregations - schooling in fishes**	**ICT enabled with ppt and related videos**		
67	**Herding in mammals, Group selection**	**ICT enabled with ppt and related videos**		
68	**Kin selection, altruism, reciprocal altruism**	**ICT enabled with ppt and related videos**		

69	Inclusive fitness, co-operation, territoriality, alarm call	ICT enabled with ppt and related videos		
70	Social organization in insects and primates	ICT enabled with ppt and related videos		
	Module IX. Stress and Behaviour			
71	Adaptations to stress- basic concept of environmental stress	ICT enabled with ppt and related videos		
72	Acclimation, acclimatization, avoidance and tolerance.	ICT enabled with ppt and related videos		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

S. No	Date of completion	Topic of Assignment & Nature of assignment (Individual – Written/Presentation – Graded or Non-graded etc)
		Assignment Topics
1	01-07-2016	Evolution of man
2	15-07-2016	Population genetics
3	10-08-2016	Neurobiology of Behaviour

Reference

EVOLUTIONARY BIOLOGY

- Arthur,W. 2011. Evolution - A Developmental Approach. Wiley-Blackwell, Oxford,UK Camilo J.Cela - Conde and Francisco J. Ayala. 2007. Human Evolution-Trails from the Past. Oxford University Press.Oxford ,UK
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- Charles W. Fox and Janson B.Wolf . 2006. Evolutionary Genetics-Concepts and Case Studies. Oxford University Press, NY. USA.
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- **West- Eberhard M.J. 2003. Developmental Plasticity and Evolution. Oxford University Press, Oxford, UK..**

ETHOLOGY

- **Alcock John.2009. Animal Behaviour: An Evolutionary Approach (8th edn). Sinauer Associates Inc.Sunderland, Massachusetts.**
- **Aubrey Manning and Mariam Stamp Dawkins. 2000. An Introduction to Animal Behaviour (5th Edn).Cambridge University Press, U.K.**
- **Eibl - Ebesfeldt, I. Hol. 1970. Ethology: The Biology of Behaviour. Reinhart & Winston. New York.**
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- **Hauser, M.1998. The Evolution of Communication. MIT Press, Cambridge, Mass. USA.**
- **Jeffrey C. Hall.2003. Genetics and Molecular Biology of Rhythms in Drosophila and other Insects. Elsevier Science, USA.**
- **Judith Goodenough, Betty McGuire .2010. Perspectives of Animal Behaviour. John Wiley & Sons Inc. USA,**
- **Krebs, J. R. and N.B. Davis.2000. An Introduction to Behavioral Ecology. Blackwell Scientific Publications, Oxford.**
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- **Lee C. Drickamer, Stephen H.Vessey, Elizabeth Jakob.2002. Animal Behaviour -Mechanisms, Ecology, Evolution (5th edn).McGraw-Hill Publishing Company, New York.**
- **Macfarland, D1998. Animal Behaviour - Psychobiology, Ethology and Evolution. Pitman publication Ltd. London.**
- **Scott,Graham.2005. Essential animal behavior. Blackwell Publications Company, Oxford ,UK Thorpe, W.H. 1979. The origins and rise of Ethology. Heinmann Educational Books, London.university press, U.K.**
- **Wilson, E.O.2000. Sociobiology: The new synthesis. Harvard Univ. Press, Cambridge, Mass. USA.**

COURSE 03: 16P1ZOOT03: BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

PROGRAMME	MASTER OF SCIENCE [ZOOLOGY]	SEMESTER	1
COURSE CODE AND TITLE	16P1ZOOT03: BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES	CREDIT	3
HOURS/WEEK	3	HOURS/SEM	54
FACULTY NAME	MONCEY VINCENT & VIDHU V.V.		

COURSE OBJECTIVES
To interpret the biophysical principles that govern the functioning of life processes.
To examine the interactions of electromagnetic radiations with matter.
To illustrate the techniques for studying live cells and preserved cells under the microscope.
To examine the principles of chromatographic and electrophoretic separation and characterisation of biomolecules.
To elaborate the technique of centrifugation and its multiple uses in studying cells and biomolecules.
To discover the physics behind radioactivity measurement for medical as well as environmental dosimetry.
To explain the basic principles of bio-nanotechnology and its potential in biomedical applications
To interpret the principles of colorimetric, spectroscopic, and biochemical assay techniques for monitoring physico-chemical perturbations of life processes.

COURSE PLAN

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	REMARKS
Module I. Diffusion and Osmosis				
1	Diffusion -Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient	PPT/Lecture	Video demonstration	
2	Biological significance in animals and plants, Facilitated diffusion, Gibbs-Donnan equillibrium.	PPT/Lecture		
3	Osmosis- osmotic concentration and osmotic pressure, Vant-Hoff's laws.	PPT/Lecture		
4	Biological significance of osmosis in animals and plants.	PPT/Lecture		
Module II. Biophysics of Cell Membrane				
5	Membrane Transport - endocytosis, exocytosis	PPT/Lecture	Video	
6	Nutrient transport across membranes, porins	PPT/Lecture	Video	
7	facilitated diffusion, porter molecules	PPT/Lecture		

8	Facilitated transport: symport, antiport, uniport, anion porter, glucose porter	PPT/Lecture	Animation	
9	Active transport: proton pumps, Na+ K+ pumps and Ca++ pumps, ionic channels. Artificial membranes.	PPT/Lecture		
Module III. Bioenergetics				
10	Reversible thermodynamics and irreversible thermodynamics; Systems - open, closed and isolated.			
11	Redox couple and redox potential.	PPT/Lecture		
12	Chemo-bioenergetics: electron transport and oxidative phosphorylation,	PPT/Lecture		
13	Chemiosmotic theory and binding change mechanism of ATP synthesis	PPT/Lecture	Animation video	
	CIA-1			
Module IV. Radiation Biophysics				
14	Interaction of radiation with matter - Photoelectric effect, ion pair production, absorption and scattering of electrons.	PPT/Lecture	Video	
15	Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates.	PPT/Lecture		
16	Biological effects of radiation: effect on enzymes and carbohydrates.	PPT/Lecture		
17	Cellular effects of radiation: somatic and genetic.	PPT/Lecture		
INSTRUMENTATION & BIOLOGICAL TECHNIQUES				
Module I. Microscopy				
18	Differential Interference contrast (Nomarsky) microscopy,	PPT/Lecture		
19	Confocal microscope, Electron microscope - TEM,	PPT/Lecture		
20	SEM, Scanning Tunnelling Microscope	PPT/Lecture		
21	Atomic Force Microscopes	PPT/Lecture	Animation	
Module II. Chromatography				
22	Paper chromatography, Thin layer chromatography,	PPT/Lecture	Model	
23	Ion exchange chromatography.	PPT/Lecture		
24	Gel permeation chromatography,	PPT/Lecture		
25	Affinity chromatography, Gas chromatography	PPT/Lecture		
26	High pressure liquid chromatography (HPLC),	PPT/Lecture		
27	Brief description of Fast protein liquid chromatography (FPLC).	PPT/Lecture		
Module III. Electrophoresis				
29	Paper electrophoresis, Gel electrophoresis	PPT/Lecture	Model	

30	Polyacrylamide gel electrophoresis (PAGE) - SDS and non SDS	PPT/Lecture		
31	Disc electrophoresis, High voltage electrophoresis, immunoelectrophoresis	PPT/Lecture		
32	Capillary gel electrophoresis, Electrophoretic mobility shift assay (EMSA).	PPT/Lecture		
	Module IV. Colorimetry, Spectrophotometry and Spectroscopy			
33	Principle and applications of colorimetry and spectrophotometry.	PPT/Lecture	Demonstration	
34	Spectroscopy: Flame emission spectroscopy,	PPT/Lecture		
35	Atomic absorption spectroscopy,	PPT/Lecture		
36	Nuclear Magnetic- resonance spectroscopy (NMR).	PPT/Lecture		
37	Brief account on Fourier-Transform infrared spectroscopy (FTIR)	PPT/Lecture		
	Module V. Centrifugation			
38	Basic principles of sedimentation Types of centrifuges	PPT/Lecture		
39	Analytical and Preparative centrifugation	PPT/Lecture	Demonstration	
40	Differential and density gradient centrifugation.	PPT/Lecture		
	Module VI. Radioisotope Detection and Measurement			
41	Dosimetry: Ionization chamber	PPT/Lecture		
42	GM counter, Solid and liquid scintillation counters	PPT/Lecture		
43	Autoradiography. Nuclear medicine: Internally administered radioisotopes.	PPT/Lecture		
44	Radioiodine in thyroid function analysis.	PPT/Lecture		
	Module VII. Nanotechnology			
45	Introduction to Nanobiology. Nanosensors and Nanomedicines.	PPT/Lecture	Video	
46	Bio-Nanorobotics, Artificial muscles using Electroactive polymers, Multifunctional materials	PPT/Lecture	Animation video	
	Module VIII. Assays			
47	Radio Immuno-Assay, Enzyme Linked Immuno Sorbant Assay (ELISA).	PPT/Lecture	Video	
48	Sandwich ELISA	PPT/Lecture		
	CIA-2			
	Module IX. pH meter			
49	Principle and working. Types of pH meters.	PPT/Lecture		
	Module X. Biological and Histological Techniques			
50	Fixation, preparation of temporary and permanent slides, whole mounts, smears, squashes and sections.	PPT/Lecture	Example illustration	

51	Specimen preparation for TEM, SEM, shadow casting,	PPT/Lecture		
52	freeze fracturing, freeze etching, negative staining. Microphotography.	PPT/Lecture	Animation	
53	Cytochemical and histological methods- Microtome techniques, fixation, staining.	PPT/Lecture		
54	Cytochemistry of nucleic acids, detection of carbohydrates, proteins and lipids.	PPT/Lecture		

Assignments

Sl. No.	Completion Date	Title
1	01-09-2016	Applications of Colorimetry
2	01-09-2016	Applications of RIA
3	01-09-2016	Applications of HPLC
4	01-09-2016	Technique of HPLC
5	01-09-2016	Applications of Gas Chromatography
6	01-09-2016	Methodology of GC
7	01-09-2016	Radiation and matter interactions
8	01-09-2016	Applications of NMR
9	01-09-2016	Methodology of ELISA
10	01-09-2016	Applications of AAS

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- **Arora, M. P. 2007.*Biophysics*. Himalaya Publishing House, New Delhi**
- **Baker, E.J. and Silverton R.E. 1978. *Introduction to Medical Laboratory Technology.* ELBS. London, UK**
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- **Roy, R.N. 1996. *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta**
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- **Srivastava,P.K. 2006. *Elementary Biophysics.An Introduction*.Narosa Publishing House, New Delhi.**
- **Varghese, T. and Balakrishna, K.M.2012. *Nanotechnology-An Introduction to***
- ***Synthesis, Properties and Applications of Nanomaterials.* Atlantic Publishers and Distributors. (P) Ltd. New Delhi**
- **Weesner, F.M. 1960. *General Zoological Microtechniques*. The Williams & Wilkins Co., Baltimore, USA**

COURSE 04: 16P1ZOOT04: BIOSTATISTICS, COMPUTER APPLICATIONS AND RESEARCH METHODOLOGY

PROGRAMME	**MASTER OF SCIENCE [ZOOLOGY]**	**SEMESTER**	**1**
COURSE CODE AND TITLE	**16P1ZOOT04: BIOSTATISTICS, DIGITAL ANALYTICS AND RESEARCH METHODOLOGY**	**CREDIT**	**4**
HOURS/WEEK	**4**	**HOURS/SEM**	**72**
FACULTY NAME	**JOBIN C THARIAN, JISHA SIVAN & MATHEW M.J.**		

COURSE OBJECTIVES
To relate basics of statistics and measures of central tendency and dispersion
To interpret correlation and regression analysis
To solve probability, hypothesis testing and vital statistics
To analyse the basics of computer application and software
To utilize the application of SPSS and Primer6
To perceive the basic concepts of research
To summarize research formulation and design
To outline the principles and practices of information documentation and communication

SESSION	**TOPIC**	**LEARNING RESOURCES**	**VALUE ADDITIONS**	**REMARKS**
	Module 1. Basics of Biostatistics			
1	**Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources).**	**Lecture**		
2	**Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias.**	**Lecture**		
3	**Organization of Data - Editing, Classification, Tabulation (forming a frequency distribution from raw data and types and characteristics of a Frequency table).**	**Lecture**		
4	**Presentation of Data - Types and Characteristics of Tables and Visual aids – Graphs, Charts, Diagrams, Flow charts, Cartographs.**	**Lecture**		

5	Statistical Analysis Tools - Parametric and Non-Parametric	Lecture		
6	Bivariate and Multivariate Analysis. Interpretation and Forecasting	Lecture		
Module II. Measures of Central Tendency				
7	Introduction, Characteristics	Lecture		
8	Merits and Demerits of Mean	Lecture		
9	Merits and Demerits of Median	Lecture		
10	Merits and Demerits of Mode	Lecture		
11	Calculations/Problems for different data (raw, frequency table).	Lecture		
12	Geometric Mean	Lecture		
Module III. Measures of Dispersion				
13	Introduction, Characteristics	Lecture		
14	Merits and Demerits of Range			
15	Merits and Demerits of Quartile deviation			
16	Merits and Demerits of Mean deviation	Lecture		
17	Merits and Demerits of standard deviation	Lecture		
18	Calculations/Problems for frequency table.	Lecture		
19	Standard Error and Relative Measures of Dispersion, Skewness and Kurtosis	Lecture		
Module IV. Correlation Analysis				
20	Correlation - types and methods of correlation analysis	Lecture		
21	Problems for Karl Pearson's correlation coefficient	Lecture		
22	Spearman's rank correlation	Lecture		
23	CIA I			
Module V. Regression Analysis				
23	Regression and Line of Best Fit	Lecture		
24	Types and methods of regression analysis.	Lecture		
25	Graphic Methods (Scatter method, Curve fitting).	Lecture		
26	Algebraic method (Fitting of strait line through regression Equation)	Lecture		
Module VI - Probability				
27	Probability distributions	Lecture		
28	Theorems of probability	Lecture		
Module VII – Testing of Hypothesis				
29	Probit Analysis (Brief account only).	Lecture		
30	Sampling, Methods and Errors	Lecture		
31	Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small	Lecture		

	Samples)			
32	Chi- Square Test	Lecture		
33	Student's 't' test (Problem for small samples comparing mean of two variable	Lecture		
34	F-test and Analysis of Variance (ANOVA - One way)	Lecture		
35	Non-parametric tests: Mc Nemar and Mann Whitney U test	Lecture		
	Module VIII – Vital Statistics			
36	Introduction, uses, records and system of classification of vital statistics.	Lecture		
37	Sample registration system, Sample design, Survey of causes of death and Age classification	Lecture		
38	Measures of Vital Statistics and Measures of Population	Lecture		
	Research methodology: Module I – Basic concepts			
39	Scientific temper, Empiricism, Rationalism	ICT Enabled (ppt); discussion		
	Module II: Concepts of Research			
40	Basic concepts of research -Meaning, Objectives, Motivation and Approaches.	ICT Enabled (ppt); discussion		
41	Types of Research (Descriptive/Analytical Applied/ Fundamental, Quantitative/ Conceptual/ Empirical	ICT Enabled (ppt); discussion		
42	Research methods versus Methodology, Research and scientific method. Research Process.	ICT Enabled (ppt); discussion		
	Module 3: Research formulation			
43	Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction	ICT Enabled (ppt); discussion		
44	Defining and formulating the research problem, Selecting the problem and necessity of defining the problem.,	ICT Enabled (ppt); discussion		
45	Literature review -Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review	ICT Enabled (ppt); discussion		
46	Hypothesis -Null and alternate hypothesis and testing of hypothesis	ICT Enabled (ppt); discussion		
	Module IV: Research designs			
47	Research Design -Basic principles, Meaning, Need and features of good design, Important concepts. Types of research designs.	ICT Enabled (ppt); discussion		

48	Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs.	ICT Enabled (ppt); discussion		
49	Data collection techniques.	ICT Enabled (ppt); discussion		
Module V: Scientific documentation and communication				
50	Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).	ICT Enabled (ppt); discussion		
51	Impact factor, Citation index,H- index Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference	ICT Enabled (ppt); discussion		
Module VI: Information science, extension and ethics				
52	Sources of Information -Primary and secondary sources. Library - books, journals, periodicals, reference sources, abstracting and indexing sources, Reviews, Treatise, Monographs, Patents. Internet -Search engines and software, Online libraries, digital libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites.	ICT Enabled (ppt); discussion		
53	Intellectual Property Rights - Copy right, Designs, Patents, Trademarks, Geographical indications. Safety and precaution - ISO standards for safety, Lab protocols, Lab animal use, care and welfare, animal houses, radiation hazards	ICT Enabled (ppt); discussion		
54	Extension: Lab to Field, Extension communication, Extension tools.	ICT Enabled (ppt); discussion		
55	Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution.	ICT Enabled (ppt); discussion		
56	CIA II			
Computer Application, Module I – Basics of computers				
57	Generations of computers, Organization of computers	ICT Enabled (ppt); discussion		
58	Binary Number System and Digital Computers. Hardware – examples	ICT Enabled (ppt); discussion		
59	Software - System Software	ICT Enabled (ppt); discussion		
60	Operating System – functions	ICT Enabled (ppt); discussion		

61	DOS, Widows,	ICT Enabled (ppt); discussion		
62	Linux and UNIX	ICT Enabled (ppt); discussion		
63	Application Softwares, Firmware, Virus and Antivirus	ICT Enabled (ppt); discussion		
64	Types of modern computing: Cluster computing, Grid computing, cloud computing	ICT Enabled (ppt); discussion		
Module II – Computer language and Programming				
65	Computer languages -Classification and types	ICT Enabled (ppt); discussion		
66	HTML, C and Java	ICT Enabled (ppt); discussion		
67	Programming concepts -Algorithm,	ICT Enabled (ppt); discussion		
Module III- Information technology and Biology				
68	Computer Networking – structure, topology, types (PAN, LAN, WAN, MAN) Wireless communication – Bluetooth /Wifi	ICT Enabled (ppt); discussion		
69	NET – Library networking et and Internet Services -World Wide Web, Uploading, Downloading, Hosting, Portal, Search Engines, Firewall.	ICT Enabled (ppt); discussion		
70	Biological Databases – Category, role in biological research, Brief account on - BIOSIS, Medline and Medlars, AGRIS	ICT Enabled (ppt); discussion		
71	nals and E Books Publishing; Cyber Crime and Cyber Laws	ICT Enabled (ppt); discussion		
72	Revision	ICT Enabled (ppt); discussion		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	8/7/2016	Harmonic mean
2	22/7/2016	Research process

GROUP ASSIGNMENTS/ACTIVITES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	22/8/2016	Research Proposal writing

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