

SACRED HEART COLLEGE (AUTONOMOUS)

Department of Zoology

Master of Zoology

Course plan

Academic Year 2018-19

Semester 1

COURSE PLAN FOR MASTER OF SCIENCE PROGRAMME IN ZOOLOGY

SACRED HEART COLLEGE(AUTONOMOUS), THEVARA	
DEPARTMENT OF ZOOLOGY	
COURSE PLAN FOR ACADEMIC YEAR 2019-2020	
PROGRAMME	M.Sc. Zoology
COURSE CODE AND TITLE	P1ZOOT02 EVOLUTIONARY BIOLOGY AND ETHOLOGY
HOURS/SEM	72
FACULTY NAME	Raagam P M and Dr. Moncey Vincent
PROGRAMME OUTCOMES	
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employment.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO5	Explore new knowledge independently for the development of the nation and the world and are able to apply the learning process.
PROGRAMME SPECIFIC OUTCOMES (PSOs)	
1	At the end of the programme, the students will Understand the advanced concepts of life at different levels of biological organization, from gene to genome, organ-systems and whole organisms; and drawing upon this knowledge, understand physiological adaptation, reproduction, behaviour and evolution of different forms of life.
2	Understand the ecological interconnectedness of life on earth; to relate the physical features of the environment of populations, communities and ecosystems; and analyse the various environmental issues for providing socially acceptable solutions.
3	Demonstrate proficiency in experimental techniques and methods of analysis appropriate for different branches of zoology, scientific temperament and problem-solving attitude.
4	Develop aptitude and skills in research in different branches of Zoology and in careers related to teaching in zoology, having innovative ideas and necessary training to initiate unique start-ups and entrepreneurship in the real world.
COURSE OUTCOMES (COs)	
1	Understand the concepts of organic evolution
2	Understand and Analyze the evidences of biological evolution

3	Understand the process of animal evolution through studying the population genetics and ontogeny				
4	Understand the theories regarding human evolution and analyze the molecular evidences of our phylogeny				
5	Understand the significance of studying Ethology				
6	Understand the causal factors of behaviour and different types of behaviour				
7	Understand the Neurophysiological aspects of behaviour				
8	Understand the processes underlying the expression of behaviour patterns by animals				
Sl.No	Session	Topic	Method of Teaching	Value Additions	CO
1	1	Historical background, Stimulus-Response, Causal factors, Quantitative aspects - Duration, interval frequency. Behaviour bouts.	Lecture with Power Point Presentation and Video show		CO1, CO2
2	2	Scope of ethology.	Lecture with Power Point Presentation and Video show		CO1
MODULE II- Neurophysiological Aspects of Behaviour					
3	1	Reflex action, Kinesis, Taxes	Lecture with Power Point Presentation		CO3
	2	Sherrington's neuro-physiological concepts in behaviour - Latency, summation, fatigue.	Lecture with Power Point Presentation		CO3
4	3	Fixed action patterns.	Lecture with Power Point Presentation		CO3
MODULE III- Motivation					

5	1	Definition- Goal oriented drive, internal causal factor, Homeostatic and Non-homeostatic drives.	Lecture with Power Point Presentation	Physiology of Behaviour	CO2
6	2	Hormones and behaviour, Psycho-hydrologic model of motivation.	Lecture with Power Point Presentation	Physiology of Behaviour	CO4
MODULE IV- Learning					
7	1	Short and long term memory, Habituation	Lecture with Power Point Presentation		CO4
8	2	Classical conditioning (Pavlov's experiments), Instrumental conditioning,	Lecture with Power Point Presentation		CO4
9	3	Latent learning, Trial and error learning, Instinct, Imprinting.	Lecture with Power Point Presentation		CO4
MODULE V- Communication					
10	1	Evolution of communication	Lecture with Power Point Presentation and Video show		CO4
11	2	Sensory mechanisms: Electrical	Lecture with Power Point Presentation and Video show		CO4
12	3	Sensory Mechanisms: Chemical, Olfactory	Lecture with Power Point Presentation and Video show		CO4
13	4	Sensory Mechanisms: Auditory and Visual.	Lecture with Power Point Presentation and Video show		CO4
14	5	Dance language of honey bees, Pheromonal communication (Ants and mammals).	Lecture with Power Point Presentation and Video show		CO4
MODULE VI- Reproduction and Behaviour 4 hrs.					
15	1	Reproductive strategies and Mating systems	Lecture with Power Point Presentation and Video show		CO4
16	2	Courtship behaviour	Lecture with Power Point Presentation and Video show		CO4
17	3	Sexual selection- patterns	Lecture with Power Point Presentation and Video show		CO4
18	4	Parental care and investment.	Lecture with Power Point Presentation and Video show		CO4
ASSIGNMENTS AND SEMINARS					
Sl No	Module	Topic	Nature of Assignment	Alignment with POs, PSOs and	
1	1	Scope of Ethology	Descriptive	PSO1, CO1	

2	4	Animal Communication through Electric impulses	Descriptive	PSO1, CO4
3	4	Examples for Acoustic communication in Mammals	Descriptive	PSO1, CO4
4	4	Examples for Pheromonal communication in Mammals	Descriptive	PSO1, CO4
5	4	Examples for Visual communication in Mammals	Descriptive	PSO1, CO4

TEXTBOOKS AND REFERENCES

1	Alcock John.2009. Animal Behaviour: An Evolutionary Approach (8th edn). Sinauer Associates Inc.Sunderland, U.K.
2	Aubrey Manning and Mariam Stamp Dawkins. 2000. An Introduction to Animal Behaviour (5th Edn).Cambridge University Press, U.K.
3	Judith Goodenough, Betty McGuire .2010. Perspectives of Animal Behaviour. John Wiley & Sons Inc. USA,
4	Krebs, J. R. and N.B. Davis.2000. An Introduction to Behavioral Ecology. Blackwell Scientific Publications, Oxford, U.K.

S. No	Topic	Method of Teaching	Value Added
1	Module I. Concepts in Evolution Concepts of variation, adaptation, struggle, fitness and natural selection-spontaneity of mutation and the evolutionary synthesis	Lecture with Power Point Presentation	Video
2	Contributions of Margulis, Eldredge and Gould (Punctuated equilibrium),	Lecture with Power Point Presentation	Video
3	Rose Mary and Peter Grant (Molecular evolution in Darwinian finches).	Lecture with Power Point Presentation	Video
4	Module II. Origin and Evolution of Life The RNA world. Idea of Panspermia. The First Cell.	Lecture with Power Point Presentation	
5	Evolution of Prokaryotes- origin of eukaryotic cells	Lecture with Power Point Presentation	
6	evolution of unicellular eukaryotes, genome evolution	Lecture with Power Point Presentation	
7	Anaerobic metabolism- origin of photosynthesis	Lecture with Power Point Presentation	
8	Aerobic metabolism	Lecture with Power Point Presentation	

FIRST INTERNAL EXAMINATION

9	Module III. Evidences of Evolution Evidences from morphology and comparative anatomy - homologous structures, vestigial organs,	Lecture with Power Point Presentation	Video
---	---	---------------------------------------	-------

	analogous structures, adaptive radiation, atavism, connecting links		
10	Evidences from embryology – egg and developmental stages, similarity of embryos	Lecture with Power Point Presentation	Vide
11	Baer's law, recapitulation theory.	Lecture with Power Point Presentation	
12	Physiological and biochemical evidences – protoplasm, chromosomes, DNA, enzymes, hormones	Lecture with Power Point Presentation	
13	Physiological and biochemical evidences – blood groups, excretory products, biochemical recapitulation, comparative serology	Lecture with Power Point Presentation	
14	Palaentological evidences – fossils and fossil formation	Lecture with Power Point Presentation	Vide
15	conditions essential for fossil formation, types of fossils, dating of fossils	Lecture with Power Point Presentation	Vide
16	Significance of fossils, geological time scale.	Lecture with Power Point Presentation	
17	Module IV. Population Genetics Gene pool, gene frequency, Hardy-Weinberg Law	Lecture with Power Point Presentation	
18	Rate of change in gene frequency through natural selection, migration and random genetic drift	Lecture with Power Point Presentation	
19	Founder effect. Isolating mechanisms and speciation	Lecture with Power Point Presentation	
20	Micro evolution	Lecture with Power Point Presentation	
21	Macro evolution	Lecture with Power Point Presentation	
22	Mega evolution.	Lecture with Power Point Presentation	
23	Co-evolution	Lecture with Power Point Presentation	
24	Module V. Developmental and Evolutionary Genetics The idea of Evo-Devo	Lecture with Power Point Presentation	
25	Heterochrony	Lecture with Power Point Presentation	
26	Heterotopy	Lecture with Power Point Presentation	
27	Heterometry and Heterotypy	Lecture with Power Point Presentation	
28	Developmental genes	Lecture with Power Point Presentation	

29	Gene co-option	Lecture with Power Point Presentation	
30	Evolution of plasticity	Lecture with Power Point Presentation	
31	Evolution of complexity	Lecture with Power Point Presentation	
32	Evolution of Sex	Lecture with Power Point Presentation	
33	SECOND INTERNAL EXAMINATION		
34	Stages in primate evolution	Lecture with Power Point Presentation	Vide
35	Prosimii, Anthroidea, Hominids	Lecture with Power Point Presentation	Vide
36	Factors in human origin	Lecture with Power Point Presentation	Vide
37	hominid fossils	Lecture with Power Point Presentation	Vide
38	Cytogenetic basis of origin of man	Lecture with Power Point Presentation	Vide
39	Molecular basis of origin of man	Lecture with Power Point Presentation	Vide
40	African origin of modern man	Lecture with Power Point Presentation	Vide
41	Mitochondrial Eve	Lecture with Power Point Presentation	Vide
42	Y Chromosomal Adam	Lecture with Power Point Presentation	Vide
43	Evolution of Human Brain	Lecture with Power Point Presentation	Vide
44	Communication	Lecture with Power Point Presentation	Vide
45	Speech	Lecture with Power Point Presentation	Vide
46	Language	Lecture with Power Point Presentation	Vide
47	Revision I	Lecture with Power Point Presentation	
48	Revision II	Lecture with Power Point Presentation	

SACRED HEART COLLEGE (AUTONOMOUS)**Department of Zoology****COURSE PLAN**

PROGRAMME	M.SC. ZOOLOGY	SEMESTER	1
COURSE CODE AND TITLE	16P1ZOOT01 ANIMAL DIVERSITY AND BIOSYSTEMATICS	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	DR. SMITHA S		

Programme Outcomes

	Programme Outcomes
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

MASTER OF SCIENCES IN ZOOLOGY

PROGRAM SPECIFIC OUTCOMES	
PSO 1	Understand the advanced concepts of life at different levels of biological organization, from gene to genome, cell, tissue, organ, organ-systems and whole organisms; and

	drawing upon this knowledge, understand physiological adaptations, development, reproduction, behaviour and evolution of different forms of life.
PSO 2	Understand the ecological interconnectedness of life on earth; to relate the physical features of the environment to the structure of populations, communities and ecosystems; and analyse the various environmental issues for providing scientifically sound and socially acceptable solutions.
PSO 3	Demonstrate proficiency in experimental techniques and methods of analysis appropriate for different branches of biology with scientific temperament and problem-solving attitude.
PSO 4	Develop aptitude and skills in research in different branches of Zoology and in careers related to teaching in Zoology; as well as in having innovative ideas and necessary training to initiate unique start-ups and entrepreneurship in the realm of life sciences

CO	CO Statement	PO/PSOs	CL	KC	Class sessions
CO1	Understand the basic concepts of systematics and taxonomy	PO1, PO4, PO5 PSO3, PSO4	U	C	14
CO2	Understand the procedures in taxonomy and ethics in publications	PO1, PO3, PO4 PSO3, PSO4	U	C	10
CO3	Appreciates the contributions made by scientists and organisations towards conservation of animal diversity	PO3, PSO4	U	C	5
CO4	Understand the present status of Indian fauna and the role played by ZSI for conservation of Indian fauna	PO2, PO3 PSO2, PSO4	U	C	10
CO5	Appreciates the diversity of Palaeofauna	PO1 PSO1, PSO4	U	C	5

CO6	Understands the animal architecture	PO1, PO2, PO5 PSO1, PSO2	A	C	3
CO7	Differentiates the invertebrate fauna by their characteristics	PO1, PO2, PO5 PSO2, PSO4	A	C	15
CO8	Differentiates the vertebrate animals by their characteristics	PO1, PO2, PO5 PSO2, PSO4	A	C	10

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
BIOSYSTEMATICS MODULE I				
1	Systematics and Taxonomy. Levels of Taxonomy - alpha, beta and gamma taxonomy	PPT	video	CO 1
2	Microtaxonomy – pheneon, taxon, category	Lecture		CO 1
3	Macrotaxonomy; Importance of Taxonomy.	Lecture		CO 1
4	Three Domain Concept in Systematics, two, five and six kingdom classification.	PPT/Lecture		CO 1
5	Hierarchy of categories and higher taxa	PPT/Lecture		CO 1
6	Concept of species	PPT/Lecture		CO 1
7	Intraspecific Catagories	Lecture		CO 1
8	Revision	Questioning		CO 1
BIOSYSTEMATICS MODULE II				
9	Typological, Phenetics	PPT/Lecture		CO 1
10	Evolutionary, Phylogenetic	Lecture		CO 1
11	Taxonomic characters of different kinds	Lecture		CO 1
BIOSYSTEMATICS MODULE III				
12	Taxonomic Procedures	Lecture		CO 2
13	Taxonomic Keys	Lecture		CO 2
14	Different types of keys, merits and demerits.	Lecture		CO 2
15	Process of typification	Lecture		CO 2
16	Use of computer softwares in taxonomic identification.	Lecture		CO 2
17	Taxonomic nomenclature	Lecture		CO 2
18	Importance principles of Zoological Nomenclature	Lecture		CO 2

19	Taxonomic publications	Lecture		CO 2
20	Taxonomic revisions, monographs, atlases, field guides and manuals, catalogs and checklists.	Lecture		CO 2
21	Ethics in taxonomy	Lecture		CO 2
BIOSYSTEMATICS MODULE IV				
22	Molecular Taxonomy	Lecture		CO 1
23	Tree of Life	Lecture		CO 1
24	Bar-coding of Life	Lecture		CO 1
CIA- I				
ANIMAL DIVERSITY MODULE I				
25	Contributions from British period	PPT/Lecture		CO 3
26	Organizations	PPT/Lecture		CO 3
27	Publication	Lecture		CO 3
28	Contributors to the research on Indian Fauna	Lecture		CO 3
29	Contributors to the research on Indian Fauna	Lecture		CO 3
ANIMAL DIVERSITY MODULE II				
30	An overview of Animal Diversity in India	PPT/Lecture	Seminar	CO 4
31	Corals of India, Earthworm diversity of India	PPT/Lecture	Seminar	CO 4
32	Commercial Shrimps and Prawns of India	PPT/Lecture	Seminar	CO 4
33	Insect fauna of India, Butterflies of India, Indian Arachnids.	PPT/Lecture	Seminar	CO 4
34	Indian molluscs, Echinoderms of India	PPT/Lecture	Seminar	CO 4
35	Major fishes of India, Amphibian diversity of India	PPT/Lecture	Seminar	CO 4
36	Major fishes of India, Amphibian diversity of India	PPT/Lecture	Seminar	CO 4
37	Indian mammals, Diversity of domesticated animals of India,	PPT/Lecture	Seminar	CO 4
38	Endangered animals of India, Endemic animals of Kerala.	PPT/Lecture	Video	CO 4
39	Western Ghats – Geography, Faunal diversity, endemism	PPT/Lecture	Video	CO 4
40	Revision	Discussion		CO 4
ANIMAL DIVERSITY MODULE III				
41	Fossil records of prokaryotes, fossil protists, Edicaran and Burgess Shale fauna. Cambrian explosion- causes and consequences	PPT/lecture		CO 5
42	Fossil arthropods - Trilobites, Extinct molluscs, Fossil Echinoderms, Fossil records of Fishes,	PPT/Lecture		CO 5
43	Mesozoic world of reptiles and their extinction	PPT/Lecture		CO 5
44	Fossil record of birds, Mammalian ancestral forms, Animal fossil records from India.	Discussion	Group activity	CO 5
45	Revision	Quiz		CO 5
ANIMAL DIVERSITY MODULE IV				
47	Animal complexity	PPT/Lecture		CO 6
48	Symmetry and its embryonic origin	PPT/Lecture		CO 6
49	Metamerism, cephalisation, complexity and body size	PPT/Lecture		CO 6
ANIMAL DIVERSITY MODULE V				

50	Diversity of protists	PPT/Lecture		CO 7
51	Recent trends in the classification of protists.	Lecture		CO 7
52	Body architecture of sponges	PPT/Lecture		CO 7
53	Diversity of Cnidaria	PPT/Lecture		CO 7
54	Acoelomata	PPT/Lecture		CO 7
55	Pseudocoelomata	PPT/Lecture		CO 7
56	Phylogeny of Arthropod	Lecture		CO 7
57	Revision		Group discussion	CO 7
CIA II				
58	Diversity of arthropod larvae; Adaptive Radiation in Molluscs	PPT/Lecture	Discussion	CO 7
59	Larval forms of Molluscs	PPT/Lecture	Discussion	CO 7
60	Lesser Protostomes	PPT/Lecture		CO 7
61	Brachipoda, Onychophora and Chaetognatha	PPT/Lecture		CO 7
62	Echinoderms - Adaptive radiation, Larval forms of Echinoderms	PPT/Lecture		CO 7
63	Hemichordates – Taxonomic position	PPT/Lecture		CO 7
ANIMAL DIVERSITY MODULE VI				
64	Lower Chordates	PPT/Lecture		CO 8
65	Chondrichthyes and Osteichthyes	PPT/Lecture		CO 8
66	Modern Amphibians, diversity, distribution, status and threats	PPT/Lecture		CO 8
67	Reptiles – origin and adaptive radiation	PPT/Lecture		CO 8
68	Birds - Structural and functional modifications for aerial life	PPT/Lecture		CO 8
69	Adaptive radiation in mammals	PPT/Lecture		CO 8
70	Revision	Questioning		
71	Revision	Quiz		
72	Revision	Discussion		

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Course Outcome
1	4/1/2019	Indian Fauna- Present Status	CO 4

GROUP ASSIGNMENTS/ACTIVITIES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Couse Outcome
1	2/2/2019	Animal fossil records from India.	CO 5

2			
---	--	--	--

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 Publishing Co., 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.
- Narendran, T.C. 2008. *An introduction to Taxonomy*. Zoological survey of India.
- 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. Strickberger, M.W. 2005. *Evolution*. Jones and Bartett Publishers, London.

T.K. PAL. R.VENKATACHALAPATHY. B. BARAIK. *Animal Fossils of Nagaland*. OCCASIONAL PAPER NO. 338. *Records of the Zoological Survey of India*.

Winston, J.E.2000. *Describing species: Practical Taxonomic Procedures for Biologists*. Columbia University Press,Columbia, USA.Administrator BNHS 2002. *The Book of Indian Birds* (13th Edn.) Bombay Natural History Society (BNHS) Publications, Mumbai, India.

Administrator BNHS 2014.*Threatened Birds of India - Their Conservation Requirements*. Bombay Natural History Society (BNHS) Publications, Mumbai, India.

Asad R. Rahmani & Gayatri Ugra. *Birds of Wetlands and Grasslands* Bombay Natural History Society (BNHS) Publications, Mumbai, India.

Daniel J.C.2002. *The Book of Indian Reptiles and Amphibians*. Bombay Natural History Society (BNHS) Publications, Mumbai, India.

Isaac Kehimkar 2008. *The Book of Indian Butterflies*. Bombay Natural History Society (BNHS) Publications, Mumbai, India. Prater S.H. 2005. *The Book of Indian Animals* (12th Edn.) Bombay Natural History Society (BNHS) Publications, Mumbai, India.

Ranjit Manakadan, J.C. Daniel, and Nikhil Bhopale *Birds of the Indian Subcontinent - A Field Guide*. Bombay Natural History Society (BNHS) Publications, Mumbai, India.

SACRED HEART COLLEGE (AUTONOMOUS)

Department of Zoology

COURSE PLAN FOR MASTER OF SCIENCE PROGRAMME IN ZOOLOGY (2020-2021)

PROGRAMME	MASTER OF ZOOLOGY	SEMESTER	1
COURSE CODE AND TITLE	16P1ZOOT03 BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES	CREDIT	3
HOURS/WEEK	4	HOURS/SEM	54
FACULTY NAME	Dr. MONCEY VINCENT		

Programme Outcome

	Programme Outcome
PO 1	The students are capable of exercising their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability
PO 2	The students are able to effectively communicate the knowledge of their study and research in their respective disciplines to their employers and to the society at large.
PO 3	The students are able to make choices based on the values upheld by the college, and have the readiness and know-how to preserve environment and work towards sustainable growth and development
PO 4	The students possess an ethical view of life, and have a broader (global) perspective transcending the provincial outlook
PO5	The students possess a passion for exploring new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process.

MASTER OF ZOOLOGY

PROGRAM SPECIFIC OUTCOMES	
1	At the end of the programme, the students will Understand the advanced concepts of life at different levels of biological organization, from gene to genome, cell, tissue, organ, organ-systems and whole organisms; and drawing upon this knowledge, understand physiological adaptations, development, reproduction, behaviour and evolution of different forms of life.

2	Understand the ecological interconnectedness of life on earth; to relate the physical features of the environment to the structure of populations, communities and ecosystems; and analyse the various environmental issues for providing scientifically sound and socially acceptable solutions.
3	Demonstrate proficiency in experimental techniques and methods of analysis appropriate for different branches of biology with scientific temperament and problem-solving attitude.
4	Develop aptitude and skills in research in different branches of Zoology and in careers related to teaching in Zoology; as well as in having innovative ideas and necessary training to initiate unique start-ups and entrepreneurship in the realm of life sciences.

BIOPHYSICS, INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

	COURSE OUTCOMES	PO/ PSO	CL
CO 1	Understand the biophysical principles that govern the functioning of life processes.	PO1/PSO3	U
CO 2	Understand the interactions of electromagnetic radiations with matter.	PO1/PSO3	U
CO 3	Understand the techniques for studying live cells and preserved cells under the microscope.	PO1/PSO3	U
CO 4	Understand the principles of chromatographic and electrophoretic separation and characterisation of biomolecules.	PO1/PSO3	U
CO 5	Understand the technique of centrifugation and its multiple uses in studying cells and biomolecules.	PO1/PSO3	U
CO6	Understand the physics behind radioactivity measurement for medical as well as environmental dosimetry.	PO1/PSO3	U
CO7	Understand the basic principles of bionanotechnology and its potential in biomedical applications	PO1/PSO3	U
CO8	Understand the principles of colorimetric, spectroscopic, and biochemical assay techniques for monitoring physico-chemical perturbations of life processes.	PO1/PSO3	U

CL* Cognitive Level

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
Module I. Diffusion and Osmosis-4 hrs.				
1	Diffusion -Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient	PPT/Lecture	Video demonstration	CO1
2	Biological significance in animals and plants, Facilitated diffusion, Gibbs-Donnan equilibrium.	PPT/Lecture		CO1
3	Osmosis- osmotic concentration and osmotic pressure, Van't Hoff's laws.	PPT/Lecture		CO1
4	Biological significance of osmosis in animals and plants.	PPT/Lecture		CO1
Module II. Biophysics of Cell Membrane 5 hrs.				
5	Membrane Transport - endocytosis, exocytosis,	PPT/Lecture	Video	CO1
6	Nutrient transport across membranes, porins	PPT/Lecture	Video	CO1
7	facilitated diffusion, porter molecules	PPT/Lecture		CO1

8	Facilitated transport: symport, antiport, uniport, anion porter, glucose porter	PPT/Lecture	Animation	CO1
9	Active transport: proton pumps, Na ⁺ K ⁺ pumps and Ca ⁺⁺ pumps, ionic channels. Artificial membranes.	PPT/Lecture		CO1
	Module III. Bioenergetics 4 hrs.			
10	Reversible thermodynamics and irreversible thermodynamics; Systems - open, closed and isolated.			CO1
11	Redox couple and redox potential.	PPT/Lecture		CO1
12	Chemo-bioenergetics: electron transport and oxidative phosphorylation,	PPT/Lecture		CO1
13	Chemiosmotic theory and binding change mechanism of ATP synthesis	PPT/Lecture	Animation video	CO1
	Module IV. Radiation Biophysics - 4 hrs.			
14	Interaction of radiation with matter - Photoelectric effect, ion pair production, absorption and scattering of electrons.	PPT/Lecture	Video	CO2
15	Biological effects of radiation: effect on nucleic acids, proteins, enzymes and carbohydrates.	PPT/Lecture		CO2
16	Biological effects of radiation: effect on enzymes and carbohydrates.	PPT/Lecture		CO2
17	Cellular effects of radiation: somatic and genetic.	PPT/Lecture		CO2
	INSTRUMENTATION & BIOLOGICAL TECHNIQUES			
	Module I. Microscopy	4 hrs.		
18	Differential Interference contrast (Nomarsky) microscopy,	PPT/Lecture		CO3
19	Confocal microscope, Electron microscope - TEM,	PPT/Lecture		CO3
20	SEM, Scanning Tunnelling Microscope	PPT/Lecture		CO3
21	Atomic Force Microscopes	PPT/Lecture	Animation	CO3
	Module II. Chromatography	6 hrs.		
22	Paper chromatography, Thin layer chromatography,	PPT/Lecture	Model	CO4
23	Ion exchange chromatography.	PPT/Lecture		CO4
24	Gel permeation chromatography,	PPT/Lecture		CO4
25	Affinity chromatography, Gas chromatography	PPT/Lecture		CO4
26	High pressure liquid chromatography (HPLC),	PPT/Lecture		CO4
27	Brief description of Fast protein liquid chromatography (FPLC).	PPT/Lecture		CO4
	Module III. Electrophoresis	4 hrs		
29	Paper electrophoresis, Gel electrophoresis	PPT/Lecture	Model	CO4
30	Polyacrylamide gel electrophoresis (PAGE) - SDS and non SDS	PPT/Lecture		CO4
31	Disc electrophoresis, High voltage electrophoresis, immunoelectrophoresis	PPT/Lecture		CO4
32	Capillary gel electrophoresis, Electrophoretic mobility shift assay (EMSA).	PPT/Lecture		CO4

	Module IV. Colorimetry, Spectrophotometry and Spectroscopy	5 hrs.		
33	Principle and applications of colorimetry and spectrophotometry.	PPT/Lecture	Demonstration	CO8
34	Spectroscopy: Flame emission spectroscopy,	PPT/Lecture		CO8
35	Atomic absorption spectroscopy,	PPT/Lecture		CO8
36	Nuclear Magnetic- resonance spectroscopy (NMR).	PPT/Lecture		CO8
37	Brief account on Fourier-Transform infrared spectroscopy (FTIR)	PPT/Lecture		CO8
	Module V. Centrifugation	3 hrs		
38	Basic principles of sedimentation Types of centrifuges	PPT/Lecture		CO5
39	Analytical and Preparative centrifugation	PPT/Lecture	Demonstration	CO5
40	Differential and density gradient centrifugation.	PPT/Lecture		CO5
	Module VI. Radioisotope Detection and Measurement	4 hrs.		
41	Dosimetry: Ionization chamber	PPT/Lecture		CO6
42	GM counter, Solid and liquid scintillation counters	PPT/Lecture		CO6
43	Autoradiography. Nuclear medicine: Internally administered radioisotopes.	PPT/Lecture		CO6
44	Radioiodine in thyroid function analysis.	PPT/Lecture		CO6
	Module VII. Nanotechnology	2 hrs.		
45	Introduction to Nanobiology. Nanosensors and Nanomedicines.	PPT/Lecture	Video	CO7
46	Bio-Nanorobotics, Artificial muscles using Electroactive polymers, Multifunctional materials	PPT/Lecture	Animation video	CO7
	Module VIII. Assays	2 hrs.		
47	Radio Immuno-Assay, Enzyme Linked Immuno Sorbant Assay (ELISA).	PPT/Lecture	Video	CO8
48	Sandwich ELISA	PPT/Lecture		CO8
	Module IX. pH meter	1 hr.		
49	Principle and working. Types of pH meters.	PPT/Lecture		CO8
	Module X. Biological and Histological Techniques	5 hrs.		
50	Fixation, preparation of temporary and permanent slides, whole mounts, smears, squashes and sections.	PPT/Lecture	Example illustration	CO8
51	Specimen preparation for TEM, SEM, shadow casting,	PPT/Lecture		CO8
52	freeze fracturing, freeze etching, negative staining. Microphotography.	PPT/Lecture	Animation	CO8
53	Cytochemical and histological methods- Microtome techniques, fixation, staining.	PPT/Lecture		CO8
54	Cytochemistry of nucleic acids, detection of carbohydrates, proteins and lipids.	PPT/Lecture		CO8

Assignments

Sl. No.	Title	Submission Date
1 2 3	Applications of Colorimetry Applications of RIA Applications of HPLC	16-August 2018
4 5	Technique of HPLC Applications of Gas Chromatography	
6 7	Methodology of GC Radiation and matter interactions	
8 9 10	Applications of NMR Methodology of ELISA Applications of AAS	

References

TEXTBOOKS AND REFERENCES	
1 2 3	Ackerman, E. 1962. <i>Biophysical Science</i> . Prentice Hall Inc. NJ, USA Alonso, A., and Arrondo, J.L.R. 2006. <i>Advanced Techniques in Biophysics</i> . Springer, UK Arora, M. P. 2007. <i>Biophysics</i> . Himalaya Publishing House, New Delhi
4 5	Baker, E.J. and Silverton R.E. 1978. <i>Introduction to Medical Laboratory Technology</i> . ELBS. London, UK Das, D. 1991. <i>Biophysics and Biophysical Chemistry</i> . Academic Publishers, Calcutta
6 7	Edward, A.L. 1997. <i>Radiation Biophysics</i> . Academic Press, NY, USA. Ernster, L. (Ed.). 1985. <i>Bioenergetics</i> . Elsevier, New York, USA.
8 9	Ghatak K.L. 2011. <i>Techniques and Methods in Biology</i> . PHI Learning Pvt. Ltd. New Delhi Gupta A. 2009. <i>Instrumentation and Bio</i>

SACRED HEART COLLEGE (AUTONOMOUS)

Department of Zoology

COURSE PLAN

PROGRAMME	MASTER OF ZOOLOGY	SEMESTER	1
COURSE CODE AND TITLE	16P1ZOOT04: BIostatISTICS, COMPUTER APPLICATION AND RESEARCH METHDOLOGY	CREDIT	4
HOURS/WEEK	2	HOURS/SEM	36
FACULTY NAME	JOBIN C THARIAN, GISHA SIVAN, MATHEW M J		

Programme Outcome

	Programme Outcome
PO 1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability
PO 2	Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	Make choices based on the values upheld by the institution, and have the readiness and know-how to preserve the environment and work towards sustainable growth and development.
PO 4	Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO5	Explore new knowledge independently for the development of the nation and the world and are able to engage in a lifelong learning process

MASTER OF ZOOLOGY

PROGRAM SPECIFIC OUTCOMES	
PSO 1	Understand the advanced concepts of life at different levels of biological organization, from gene to genome, cell, tissue, organ, organ-systems and whole organisms; and drawing upon this knowledge, understand physiological adaptations, development, reproduction, behaviour and evolution of different forms of life.
PSO 2	Understand the ecological interconnectedness of life on earth; to relate the physical features of the environment to the structure of populations, communities and ecosystems; and analyse the various environmental issues for providing scientifically sound and socially acceptable solutions.
PSO 3	Demonstrate proficiency in experimental techniques and methods of analysis appropriate for different branches of biology with scientific temperament and problem-solving attitude.
PSO 4	Develop aptitude and skills in research in different branches of Zoology and in careers related to teaching in Zoology; as well as in having innovative ideas and necessary training to initiate unique start-ups and entrepreneurship in the realm of life sciences.

CO	CO Statement	POs/PSOs	CL	KC
CO1	Understand basics of statistics and measures of central tendency and dispersion	PO1, PO5 PSO3	U	C
CO2	Understand correlation and regression analysis	PO1, PO5 PSO3	U	C
CO3	Understand probability, hypothesis testing and vital statistics	PO1, PO5 PSO3	U	C
CO4	Understand the basics of computer application and software	PO1, PO5 PSO3	U	C
CO5	Understand the application of SPSS	PO1, PO5 PSO3	U	C

CO6	Understand the basic concepts of research	PO1, PO2, PO5 PSO1, PSO2	A	C
CO7	Understand research formulation and design	PO1, PO2, PO5 PSO2, PSO4	A	C
CO8	Understand information, documentation and communication	PO1, PO2, PO5 PSO2, PSO4	U	C

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
MODULE I				
1	Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources).	Lecture		CO 1
2	Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias.	Lecture		CO 1
3	Organization of Data - Editing, Classification, Tabulation (forming a frequency distribution from raw data and types and characteristics of a Frequency table).	Lecture		CO 1
4	Presentation of Data - Types and Characteristics of Tables and Visual aids – Graphs, Charts, Diagrams, Flow charts, Cartographs.	Lecture		CO 1
5	Statistical Analysis Tools - Parametric and Non-Parametric	Lecture		CO 1
6	Bivariate and Multivariate Analysis. Interpretation and Forecasting	Lecture		CO 1
7	Introduction, Characteristics	Lecture		CO 1
8	Merits and Demerits of Mean	Lecture		CO 1
9	Merits and Demerits of Median	Lecture		CO 1
10	Merits and Demerits of Mode	Lecture		CO 1
11	Calculations/Problems for different data (raw, frequency table).	Lecture		CO 1
12	Geometric Mean	Lecture		CO 1
13	Introduction, Characteristics	Lecture		CO 1

14	Merits and Demerits of Range			
15	Merits and Demerits of Quartile deviation			
16	Merits and Demerits of Mean deviation	Lecture		CO 2
17	Merits and Demerits of standard deviation	Lecture		CO 2
18	Calculations/Problems for frequency table.	Lecture		CO 2
19	Standard Error and Relative Measures of Dispersion, Skewness and Kurtosis	Lecture		CO 2
20	Correlation - types and methods of correlation analysis	Lecture		CO 2
21	Problems for Karl Pearson's correlation coefficient	Lecture		CO 2
22	Spearman's rank correlation	Lecture		CO 2
23	Regression and Line of Best Fit	Lecture		CO 2
24	Types and methods of regression analysis.	Lecture		CO 2
25	Graphic Methods (Scatter method, Curve fitting).	Lecture		CO 2
26	Algebraic method (Fitting of strait line through regression Equation)	Lecture		CO 2
27	Probit Analysis (Brief account only).	Lecture		
28	Sampling, Methods and Errors	Lecture		CO 3
29	Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small Samples)	Lecture		CO 3
30	Chi- Square Test	Lecture		CO 3
31	Student's 't' test (Problem for small samples comparing mean of two variable	Lecture		CO3
32	F-test and Analysis of Variance (ANOVA - One way)	Lecture		CO 3
33	Non-parametric tests: Mc Nemar and Mann Whitney U test	Lecture		CO 3
34	Introduction, uses, records and system of classification of vital statistics.	Lecture		
35	Sample registration system, Sample design, Survey of causes of death and Age classification	Lecture		CO 3
36	Measures of Vital Statistics and Measures of Population	Lecture		CO 3
37	Scientific temper, Empiricism, Rationalism	ICT Enabled (ppt); discussion		CO6
38	Basic concepts of research -Meaning, Objectives, Motivation and Approaches.	ICT Enabled (ppt); discussion		CO6
39	Types of Research (Descriptive/Analytical Applied/ Fundamental, Quantitative/ Conceptual/ Empirical	ICT Enabled (ppt); discussion		CO6

40	Research methods versus Methodology, Research and scientific method. Research Process.	ICT Enabled (ppt); discussion		CO6
41	Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction	ICT Enabled (ppt); discussion		CO7
42	Defining and formulating the research problem, Selecting the problem and necessity of defining the problem.	ICT Enabled (ppt); discussion		CO7
43	Literature review -Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review	ICT Enabled (ppt); discussion		CO7
44	Hypothesis -Null and alternate hypothesis and testing of hypothesis	ICT Enabled (ppt); discussion		CO7
45	Research Design -Basic principles, Meaning, Need and features of good design, Important concepts. Types of research designs.	ICT Enabled (ppt); discussion		CO7
46	Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs.	ICT Enabled (ppt); discussion		CO7
47	Data collection techniques.	ICT Enabled (ppt); discussion		CO7
	CIA 2			
48	Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).	ICT Enabled (ppt); discussion		CO8
49	Impact factor, Citation index,H- index Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference.	ICT Enabled (ppt); discussion		CO8
50	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		CO8
51	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, <u>animal</u> houses, radiation hazards	ICT Enabled (ppt); discussion		CO8

52	Extension: Lab to Field, Extension communication, Extension tools. Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution. Revision & Evaluation of the course	ICT Enabled (ppt); discussion		CO4
53	Scientific temper, Empiricism, Rationalism	ICT Enabled (ppt); discussion		CO4
54	Module II. Concepts of Research	ICT Enabled (ppt); discussion		CO4
55	Basic concepts of research -Meaning, Objectives, Motivation and Approaches.	ICT Enabled (ppt); discussion		CO4
56	Types of Research (Descriptive/Analytical, Applied/ Fundamental, Quantitative/Qualitative, Conceptual/ Empirical	ICT Enabled (ppt); discussion		CO4
57	Research methods versus Methodology, Research and scientific method. Research Process	ICT Enabled (ppt); discussion		CO4
58	Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction	ICT Enabled (ppt); discussion		CO4
59	Defining and formulating the research problem, Selecting the problem and necessity of defining the problem.,	ICT Enabled (ppt); discussion		CO5
60	Literature review -Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review	ICT Enabled (ppt); discussion		CO5
61	Hypothesis -Null and alternate hypothesis and testing of hypothesis	ICT Enabled (ppt); discussion		CO5
62	Research Design -Basic principles, Meaning, Need and features of good design, Important concepts. Types of research designs.	ICT Enabled (ppt); discussion		CO5
63	Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs.	ICT Enabled (ppt); discussion		CO5
64	Data collection techniques.	ICT Enabled (ppt); discussion		CO5
65	Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).	ICT Enabled (ppt); discussion		CO5

66	Impact factor, Citation index, H-index Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference	ICT Enabled (ppt); discussion		CO5
67	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		CO5
68	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, <u>animal</u> houses, radiation hazards	ICT Enabled (ppt); discussion		CO8
69	Extension: Lab to Field, Extension communication, Extension tools. Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution. Revision & Evaluation of the course	ICT Enabled (ppt); discussion		CO8

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Couse Outcome
1		Harmonic mean	CO 2
2		Research process	CO 5

GROUP ASSIGNMENTS/ACTIVITES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Couse Outcome
1		Generation of computers	CO 6
2			

References

Web resource references:

Ahuja, V.K. 2010. Law of Copy Rights and Neighbouring Rights : National and International

Perspectives..Lexis Nexis- Butterworths Wadhwa, Nagpur

Ahuja,V.K. 2007. Law Relating to Intellectual Property Rights. Lexis Nexis-Butterworths Wadhwa, Nagpur.

Anitha Goel.2010. Computer Fundamentals. Pearson Education India.

Bailey,N.T.J. 1994. Statistical Methods in Biology (3rdedn). Cambridge University Press.

Bright Wilson. 1990. An Introduction to Scientific Research. Dover Publications. NY.

Chap T.Le.2003.Introductory Biostatistics. John Wiley &Sons, NJ, USA.

Clough,P.and C.Nutbrown.2002. A Student's Guide to Methodology: Justifying Enquiry. Sage, London.

Daniel, W.W. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7th edn). John Wiley & Sons, New York.

Dharmapalan, Biju. 2012. Scientific Research Methodology. Narosa Publishing House, New Delhi

Finney ,D.J. 1980.Statistics for Biologists. Chapman and Hall, London

Frank, Harry and Steven C. Althoen, 1995. Statistics: Concepts and Applications. Cambridge University Press

Glenn McGee.2003. Pragmatic Bioethics. The MIT Press, MA, USA

Jeremy R. Garret.2012. The Ethics of Animal Research. The MIT Press, MA. USA

Kothari C.R., 2009. Research Methodology: Methods and Techniques (2ndedn.). NewAge

International Publishers, New Delhi.

Pagano, M and K.Gauvreau. 2000. Principles of Biostatistics. Brooks/Cole, CA, USA