

Sacred Heart College (Autonomous)

Department of Zoology

MASTER OF SCIENCE [ZOOLOGY]

Course plan

Academic Year: 2018-19

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 & JOBI M.J.		

Programme Outcomes

	Programme Outcome
PO 1	PO1: Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO 2	PO2: Effectively communicate the knowledge of their study and research in their respective disciplines to their stakeholders and to the society at large.
PO 3	PO3: 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	PO4: Develop an ethical view of life and have a broader (global) perspective transcending the provincial outlook.
PO 5	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 SCIENCE [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

COURSE OUTCOMES

COs	COURSE OUTCOMES	PO/PSOs	CL
CO1	Understand the basic concepts of systematics and taxonomy	PO1, PO4, PO5 PSO3, PSO4	U
CO2	Discuss the procedures in taxonomy and ethics in publications	PO1, PO3, PO4 PSO3, PSO4	D
CO3	Appreciate the contributions made by scientists and organisations towards conservation of animal diversity	PO3, PSO4	A
CO4	Analyze the present status of Indian fauna and the role played by ZSI for conservation of Indian fauna	PO2, PO3 PSO2, PSO4	A
CO5	Examine the diversity of Palaeofauna	PO1 PSO1, PSO4	E
CO6	Discuss the animal architecture	PO1, PO2, PO5 PSO1, PSO2	A
CO7	Compare the invertebrate fauna by their characteristics	PO1, PO2, PO5 PSO2, PSO4	A
CO8	Compare the vertebrate animals by their characteristics	PO1, PO2, PO5 PSO2, PSO4	A

CL* Cognitive Level

R-Remember

U- Understand

A- Apply

An- Analyze

E- Evaluate

Cr- Create

CO -PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	0	0	2	2	0	0	1	0
CO 2	3	0	2	2	0	0	0	1	1
CO 3	0	0	2	0	0	0	0	0	1
CO 4	0	1	2	0	0	0	3	0	1
CO 5	1	0	0	0	0	1	0	0	1
CO 6	1	1	0	0	2	1	2	0	0
CO 7	2	1	0	0	2	0	1	0	1
CO 8	2	1	0	0	2	0	1	0	1

Mapping Strength

- 0- No Mapping strength
- 1- Low
- 2- Medium
- 3- High

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
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	CO 1
2	Microtaxonomy – pheneon, taxon, category	ICT Enabled (ppt&images, charts)		CO 1
3	Macrotaxonomy; Importance of Taxonomy.	ICT Enabled (ppt & Images, video clippings)		CO 1
4	Three Domain Concept in Systematics, two, five and six kingdom classification.	ICT Enabled (ppt& animations, images)	e-resource	CO 1
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	CO 1
6	Concept of species - Typological, Nominalistic, Biological and Evolutionary	ICT Enabled (ppt& animations, images,)		CO 1
7	Intraspecific Catagories; Variety, Subspeicies, Race, Cline.	ICT Enabled (ppt& animations, images,)		CO 1

Module II. Methods of Biosystematics					
8	Typological, Evolutionary, Different kinds of taxonomic characters.	Phenetics, Phylogenetic,	ICT Enabled (ppt & images); discussion	e-resource	CO 1
9	CIA I		1 hr; descriptive answers only		
Module III. Practice of Taxonomy					
10	Taxonomic Procedures - collection, different types of taxonomic collections, preservation, curation and identification		ICT Enabled (ppt & images); discussion	e-resource	CO 2
11	Taxonomic Keys as tool of identification, different types of keys, merits and demerits.		ICT Enabled (ppt & images); discussion		CO 2
12	Process of typification, different zoological types and their significance.		ICT Enabled (ppt & images); discussion	e- resource	CO 2
13	Use of computer softwares in taxonomic identification.		ICT Enabled (ppt & images); discussion		CO 2
14	Taxonomic nomenclature - International Code of Zoological Nomenclature (ICZN), Rules and formation of scientific names of different taxa.		ICT Enabled (ppt & images); discussion		CO 2
15	Importance principles of Zoological Nomenclature - Law of priority, Homonymy and Synonymy.		ICT Enabled (ppt & images); discussion	e- resource	CO 2
16	Taxonomic publications – description of new taxa, synopses and reviews		ICT Enabled (ppt & images); discussion		CO 2
17	Taxonomic revisions, monographs, atlases, field guides and manuals, catalogs and checklists.		ICT Enabled (ppt & images); discussion		CO 2
18	Ethics in taxonomy - authorship, suppression of data, undesirable practices in taxonomy (brief description only).		ICT Enabled (ppt & images); discussion		CO 2
Module IV. Modern systematics					

19	Molecular Taxonomy - use of Proteins, DNA and RNA. Molecular Phylogeny, Phylogenetic trees, Phylocode,	ICT Enabled (ppt & images); discussion	17	CO 3
20	Tree of Life. Cladistic analysis and cladograms. Bar-coding of Life – merits and demerits	ICT Enabled (ppt & images); discussion	18	CO 3
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)		CO 3
23	Organizations - Bombay Natural History Society, The Asiatic Society of Bengal	ICT Enabled (ppt&images, video clippings)		CO 3
24	Publication - <i>The Fauna of British India, Including Ceylon and Burma</i>	ICT Enabled (ppt, images, animations & video clippings)		CO 3
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	CO 3
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	CO 3
Module III. Diversity of Palaeofauna				
27	Fossil records of prokaryotes, fossil protists, Edicaran and Burgess Shale fauna. Cambrian explosion- causes and consequences	ICT Enabled (ppt, images, animations & video clippings)		CO 4
28	Fossil arthropods - Trilobites, Extinct molluscs, Fossil Echinoderms, Fossil records of Fishes,	ICT Enabled (ppt, images, animations & video clippings)		CO4
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	CO 4
Module II. Indian Fauna-Present status				
30	An overview of Animal Diversity in	ICT Enabled (ppt&images,	e-resource	CO 5

	India	video clippings)		
31	Corals of India, Earthworm diversity of India	ICT Enabled (ppt&images, charts, video clippings)		CO 5
32	Commercial Shrimps and Prawns of India	ICT Enabled (ppt&images, video clippings)	e-resource	CO 5
33	Insect fauna of India, Butterflies of India, Indian Arachnids.	ICT Enabled (ppt) Lecture		CO 5
34	Indian molluscs, Echinoderms of India	ICT Enabled (ppt) Lecture		CO 5
35	Major fishes of India, Amphibian diversity of India	ICT Enabled (ppt) Lecture		CO 5
36	Indian snakes, Survey of Indian Bird fauna	ICT Enabled (ppt) Lecture		CO 5
37	Indian mammals, Diversity of domesticated animals of India,	ICT Enabled (ppt) Lecture		CO 5
38	Endangered animals of India, Endemic animals of Kerala.	ICT Enabled (ppt) Lecture		CO 5
39	Western Ghats – Geography, Faunal diversity, endemism	ICT Enabled (ppt) Lecture		CO 5
40	Zoological Survey of India and the role in the conservation of Indian Fauna.	ICT Enabled (ppt) Lecture		CO 5
41	Major fishes of India, Amphibian diversity of India	ICT Enabled ppt & images, video clippings)		CO 5
42	Indian snakes	ICT Enabled (ppt&images, charts, video clippings)	e-resource	CO 5
43	Survey of Indian Bird fauna	ICT Enabled (ppt&images, charts, video clippings)	e-resource	CO 5
44	Indian mammals, Diversity of domesticated animals of India,	ICT Enabled (ppt & images, video clippings)		CO 5
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	CO 6
46	Symmetry and its embryonic origin, body cavities, metamerism, cephalisation, complexity and body size.	ICT Enabled (ppt) Lecture		CO 6

Module V. Animal Diversity – Invertebrates				
47	Diversity of protists with reference to body structure, nutrition, reproduction and life history.	ICT Enabled (ppt) Lecture	video	CO 7
48	Recent trends in the classification of protists.	ICT Enabled (ppt) Lecture		CO 7
49	Body architecture of sponges, Diversity of Porifera with reference to body structure.	ICT Enabled (ppt) Lecture		CO 7
50	Diversity of Cnidaria with reference to body organization and morphology. Ctenophoran diversity.	ICT Enabled (ppt) Lecture		CO 7
51	Acoelomata	ICT Enabled (ppt) Lecture		CO 7
52	Pseudocoelomata;	ICT Enabled (ppt) Lecture		CO 7
53	Phylogeny of Arthropod -	ICT Enabled (ppt) Lecture		CO 7
54	Phylogeny of Arthropod - Monophyly and Polyphyly,	ICT Enabled (ppt) Lecture		CO 7
55	Reasons for the success of Arthropods.	ICT Enabled (ppt) Lecture		CO 7
56	Diversity of arthropod larvae; Adaptive Radiation in Molluscs	ICT Enabled (ppt) Lecture		CO 7
57	Larval forms of Molluscs	ICT Enabled (ppt) Lecture		CO 7
58	Lesser Protostomes (Brief account only) – Sipuncula, Echiura, Phoronida	ICT Enabled (ppt) Lecture		CO 7
59	Lesser Protostomes	ICT Enabled (ppt) Lecture		CO 7

60	Brachipoda, Onychophora and Chaetognatha	ICT Enabled (ppt) Lecture		CO 7
61	Echinoderms - Adaptive radiation	ICT Enabled (ppt) Lecture		CO 7
62	Larval forms of Echinoderms.	ICT Enabled (ppt) Lecture		CO 7
Module VI. Animal Diversity – Vertebrates				
63	Lower Chordates	ICT Enabled (ppt) Lecture		CO 8
64	Chondrichthyes and Osteichthyes	ICT Enabled (ppt) Lecture		CO 8
65	Reptiles – origin	ICT Enabled (ppt) Lecture		CO 8
66	Reptiles - adaptive radiation	ICT Enabled (ppt) Lecture		CO 8
67	Birds - Structural modifications for aerial life	ICT Enabled (ppt) Lecture		CO 8
68	Birds - functional modifications for aerial life	ICT Enabled (ppt) Lecture		CO 8
69	Adaptive radiation in mammals	ICT Enabled (ppt) Lecture		CO 8
70	Modern Amphibians, diversity, distribution	ICT Enabled (ppt) Lecture		CO 8
71	Modern Amphibians, status and threats	ICT Enabled (ppt) Lecture		CO 8
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)	Course Outcome
1	9/7/2018	Ethics in taxonomy	CO 2
2	21/7/2018	Adaptive radiation in mammals	CO 8

GROUP ASSIGNMENTS/ACTIVITIES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Course Outcome
1	4/9/2018	Reptiles – origin and adaptive radiation	CO 8
2	11/9/2018	Taxonomic publications	CO 6

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.
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- 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		

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.
PO 5	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 SCIENCE [ZOOLOGY]

PROGRAM SPECIFIC OUTCOMES

PSO 1	Demonstrate 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, relate physiological adaptations, development, reproduction, behaviour and evolution of different forms of life.
PSO 2	Interpret 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	Experiment with techniques and methods of analysis appropriate for different branches of biology with scientific temperament and problem-solving attitude.
PSO 4	Acquire techniques and skills in the design and execution of 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.

COURSE OUTCOMES

CO	CO Statement	POs/PSOs	CL
CO1	Describe the concepts of organic evolution	PO1 PSO1	U
CO2	Comprehend and analyse the evidences of biological evolution	PO1 PSO1	U
CO3	Discuss the process of animal evolution through studying the population genetics and ontogeny	PO1 PSO1	U
CO4	Describe the theories regarding human evolution and analyse the molecular evidences of our phylogeny	PO1 PSO1	U
CO5	Analyze the significance of studying Ethology	PO1 PSO1	U
CO6	Describe the causal factors of behaviour and different types of behaviour	PO1 PSO1	U
CO7	Analyze the Neurophysiological aspects of behaviour	PO1 PSO1	U
CO8	Discuss the processes underlying the expression of behaviour patterns by animals	PO1 PSO1	U

CL* Cognitive Level

R-Remember

U- Understand

A- Apply

An- Analyze

E- Evaluate

Cr- Create

CO -PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	0	0	0	0	3	0	0	0
CO 2	3	0	0	0	0	3	0	0	0
CO 3	3	0	0	0	0	3	0	0	0
CO 4	3	0	0	0	0	3	0	0	0
CO 5	3	0	0	0	0	3	0	0	0
CO 6	3	0	0	0	0	3	0	0	0
CO 7	1	0	0	0	0	3	0	0	0
CO 8	1	0	0	0	0	3	0	0	0

Mapping Strength

- 0- No Mapping strength
- 1- Low
- 2- Medium
- 3- High

Sessions	Topic	Method of Teaching	Value Additions	CO
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		CO1
2	Contributions of Margulis, Eldredge and Gould (Punctuated equilibrium)	ICT enabled with ppt and related videos		CO1
3	Rose Mary and Peter Grant (Molecular evolution in Darwinian finches).	ICT enabled with ppt and related videos		CO1
Module II. Origin and Evolution of Life				
4	The RNA world. Idea of Panspermia. The First Cell	ICT enabled with ppt and related videos		CO2
5	Evolution of Prokaryotes-	ICT enabled with ppt and related videos		CO2
6	Origin of eukaryotic cells- evolution of unicellular eukaryotes	ICT enabled with ppt and related videos		CO2
7	Genome evolution. Anaerobic metabolism	ICT enabled with ppt and related videos		CO2

8	Origin of photosynthesis and aerobic metabolism	ICT enabled with ppt and related videos		CO2
Module III. Evidences of Evolution				
9	Evidences from morphology and comparative anatomy - homologous structures, vestigial organs	Lecture		CO3
10	Analogous structures, adaptive radiation, atavism, connecting links.	Lecture with interaction		CO3
11	Evidences from embryology – egg and developmental stages	Lecture		CO3
12	Similarity of embryos, Baer's law, recapitulation theory.	Lecture and interaction		CO3
13	Physiological and biochemical evidences – protoplasm, chromosomes, DNA, enzymes, hormones	Lecture		CO3
14	Blood groups, excretory products, biochemical recapitulation, comparative serology.	Lecture and inter action		CO3
15	Palaentological evidences – fossils and fossil formation, conditions essential for fossil formation	Lecture		CO3
16	Types of fossils, dating of fossils, significance of fossils, geological time scale.	Lecture and inter action		CO3
Module IV. Population Genetics				
17	Gene pool			CO4
18	Gene frequency	Lecture		CO4
19	Hardy-Weinberg Law	Lecture		CO4
20	Hardy-Weinberg Equation with Example	Lecture and interaction		CO4
21	Factors affecting Hardy-Weinberg Equilibrium	„		CO4
22	Rate of change in gene frequency through natural selection	„		CO4
23	Migration and random genetic drift.	„		CO4
24	Founder effect. Isolating mechanisms	Lecture and inter action		CO4
25	Speciation. Micro and Macro Evolution	„		CO4
26	Mega evolution. Co-evolution.	„		CO4
Module V. Developmental and Evolutionary Genetics				
27	The idea of Evo-Devo, Heterochrony	ICT enabled with ppt and		CO4

		related videos		
28	Heterotopy, Heterometry and Heterotypy	ICT enabled with ppt and related videos		C04
29	Developmental genes	ICT enabled with ppt and related videos		C04
30	Gene co-option	ICT enabled with ppt and related videos		C04
31	Evolution of plasticity	ICT enabled with ppt and related videos		C04
32	Evolution of complexity. Evolution of sex.	ICT enabled with ppt and related videos		C04
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		C04
36	Factors in human origin, hominid fossils	ICT enabled with ppt and related videos		C04
37	Cytogenetic and molecular basis of origin of man	ICT enabled with ppt and related videos		C04
38	African origin of modern man - Mitochondrial Eve, Y chromosomal Adam	ICT enabled with ppt and related videos		C04
39	Evolution of human brain- communication, speech and language.	ICT enabled with ppt and related videos		C04
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		C05
41	Scope of ethology.	Lecture with Power Point Presentation and Video show		C05
	MODULE II- Neurophysiological Aspects of			C07

	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		C07
44	Fixed action patterns.	Lecture with Power Point Presentation		C07
	I CIA			
MODULE III- Motivation				
45	Definition- Goal oriented drive, internal causal factor, Homeostatic and Non-homeostatic drives.	Lecture with Power Point Presentation		C07
46	Hormones and behavior, Psycho-hydrologic model of motivation.	Lecture with Power Point Presentation		C07
MODULE IV- Learning				
47	Short and long term memory, Habituation	Lecture with Power Point Presentation		C06
48	Classical conditioning (Pavlov's experiments), Instrumental conditioning,	Lecture with Power Point Presentation		C06
49	Latent learning, Trial and error learning, Instinct, Imprinting.	Lecture with Power Point Presentation		C06
MODULE V- Communication				
50	Evolution of communication	Lecture with Power Point Presentation		C06
51	Sensory mechanisms: Electrical	Lecture with Power Point Presentation and Video show		C06
52	Sensory Mechanisms: Chemical, Olfactory	Lecture with		C06

		Power Point Presentation		
53	Sensory Mechanisms: Auditory and Visual.	Lecture with Power Point Presentation and Video show		C06
54	Dance language of honey bees, Pheromonal communication (Ants and mammals).	Lecture with Power Point Presentation and Video show		C06
55	II CIA			
MODULE VI- Reproduction and Behaviour 4 hrs.				
56	Reproductive strategies and Mating systems	Lecture with Power Point Presentation		C08
57	Courtship behaviour	Lecture with Power Point Presentation and Video show		C08
58	Sexual selection- patterns	Lecture with Power Point Presentation		C08
59	Parental care and investment.	Lecture with Power Point Presentation and Video show		C08
Module VII. Complex Behaviour				
60	Orientation, Navigation	ICT enabled with ppt and related videos		C08
61	Migration (Fishes and birds), Navigation cues	ICT enabled with ppt and related videos		C08
62	Biological rhythms - Circadian	ICT enabled with ppt and related videos		C08
63	Biological rhythms - Circannual, Lunar periodicity	ICT enabled with ppt and related videos		C08
64	Biological rhythms - Tidal rhythms	ICT enabled		C08

		with ppt and related videos		
65	Genetics of biological rhythms.	ICT enabled with ppt and related videos		CO8
Module VIII. Social Behaviour				
66	Sociobiology (Brief account only) Aggregations - schooling in fishes	ICT enabled with ppt and related videos		CO8
67	Herding in mammals, Group selection	ICT enabled with ppt and related videos		CO8
68	Kin selection, altruism, reciprocal altruism	ICT enabled with ppt and related videos		CO8
69	Inclusive fitness, co-operation, territoriality, alarm call	ICT enabled with ppt and related videos		CO8
70	Social organization in insects and primates	ICT enabled with ppt and related videos		CO8
	Module IX. Stress and Behaviour			CO8
71	Adaptations to stress- basic concept of environmental stress	ICT enabled with ppt and related videos		CO8
72	Acclimation, acclimatization, avoidance and tolerance.	ICT enabled with ppt and related videos		CO8

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

S. No	Date of completion	Topic of Assignment & Nature of assignment (Individual – Written/Presentation – Graded or Non-graded etc)	Course Outcome
		Assignment Topics	
1	01-07-2018	Evolution of man	CO4
2	15-07-2018	Population genetics	CO3
3	10-08-2018	Neurobiology of Behaviour	CO7

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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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.		

Programme Outcome

	PROGRAM OUTCOMES
PO1	Exercise their critical thinking in creating new knowledge leading to innovation, entrepreneurship and employability.
PO2	Effectively communicate the knowledge of their study and research in their respective disciplines, to their stakeholders and to the society at large.
PO3	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.
PO4	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 SCIENCE [ZOOLOGY]

PROGRAM SPECIFIC OUTCOMES	
PSO1	Demonstrate 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, relate physiological adaptations, development, reproduction, behaviour and evolution of different forms of life.
PSO2	Interpret 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.
PSO3	Experiment with techniques and methods of analysis appropriate for different branches of biology with scientific temperament and problem-solving attitude.
PSO4	Acquire techniques and skills in the design and execution of 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

COURSE OUTCOMES

	COURSE OUTCOMES	PO/ PSO	CL
CO1	Interpret the biophysical principles that govern the functioning of life processes.	PO1/PSO3	U
CO2	Examine the interactions of electromagnetic radiations with matter.	PO1/PSO3	U
CO3	Illustrate the techniques for studying live cells and preserved cells under the microscope.	PO1/PSO3	U
CO4	Examine the principles of chromatographic and electrophoretic separation and characterisation of biomolecules.	PO1/PSO3	U
CO5	Elaborate the technique of centrifugation and its multiple uses in studying cells and biomolecules.	PO1/PSO3	U
CO6	Discover the physics behind radioactivity measurement for medical as well as environmental dosimetry.	PO1/PSO3	U
CO7	Explain the basic principles of bio-nanotechnology and its potential in biomedical applications	PO1/PSO3	U
CO8	Interpret the principles of colorimetric, spectroscopic, and biochemical assay techniques for monitoring physico-chemical perturbations of life processes.	PO1/PSO3	U

CL* Cognitive Level

R-Remember

U- Understand

B- Apply

An- Analyze

E- Evaluate

Cr- Create

CO -PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	2	0	0	0	0	0	0	1	0
CO 2	2	0	0	0	0	0	0	2	0
CO 3	2	0	0	0	0	0	0	1	0
CO 4	2	0	0	0	0	0	0	2	0
CO 5	2	0	0	0	0	0	0	2	0
CO 6	2	0	0	0	0	0	0	1	0
CO 7	2	0	0	0	0	0	0	1	0
CO 8	2	0	0	0	0	0	0	1	0

Mapping Strength

- 0- No Mapping strength
- 1- Low
- 2- Medium
- 3- High

COURSE PLAN

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
Module I. Diffusion and Osmosis				
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, Vant-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	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				
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
	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	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				
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				
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				
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				
33	Principle and applications of colorimetry and spectrophotometry.	PPT/Lecture	Demonstration	CO8
34	Spectroscopy: Flame emission	PPT/Lecture		CO8

	spectroscopy,			
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				
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				
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				
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				
47	Radio Immuno-Assay, Enzyme Linked Immuno Sorbant Assay (ELISA).	PPT/Lecture	Video	CO8
48	Sandwich ELISA	PPT/Lecture		CO8
	CIA-2			
Module IX. pH meter				
49	Principle and working. Types of pH meters.	PPT/Lecture		CO8
Module X. Biological and Histological Techniques				
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.	Completion Date	Title	Course Outcome
1	01-09-2018	Applications of Colorimetry	CO8
2	01-09-2018	Applications of RIA	CO8
3	01-09-2018	Applications of HPLC	CO4
4	01-09-2018	Technique of HPLC	CO4
5	01-09-2018	Applications of Gas Chromatography	CO4
6	01-09-2018	Methodology of GC	CO4
7	01-09-2018	Radiation and matter interactions	CO2
8	01-09-2018	Applications of NMR	CO8
9	01-09-2018	Methodology of ELISA	CO8
10	01-09-2018	Applications of AAS	CO8

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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.		

Programme Outcome

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 SCIENCE [ZOOLOGY]

PROGRAM SPECIFIC OUTCOMES	
PSO 1	Demonstrate 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, relate physiological adaptations, development, reproduction, behaviour and evolution of different forms of life.
PSO 2	Interpret 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	Experiment with techniques and methods of analysis appropriate for different branches of biology with scientific temperament and problem-solving attitude.
PSO 4	Acquire techniques and skills in the design and execution of 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

COURSE OUTCOMES

CO	CO Statement	POs/PSOs	CL
CO1	Relate basics of statistics and measures of central tendency and dispersion	PO1, PO5 PSO2, PSO3	U
CO2	Interpret correlation and regression analysis	PO1, PO5 PSO2, PSO3	U
CO3	Solve probability, hypothesis testing and vital statistics	PO1, PO5 PSO2, PSO3	U
CO4	Analyse the basics of computer application and software	PO1, PO5 PSO2, PSO3	U
CO5	Utilize the application of SPSS and Primer6	PO1, PO5 PSO2, PSO3	U
CO6	Perceive the basic concepts of research	PO1, PO5, PSO2, PSO3	A
CO7	Summarize research formulation and design	PO1, PO5 PSO2, PSO3	A
CO8	Outline the principles and practices of information documentation and communication	PO1, PO5 PSO2, PSO3	U

CL* Cognitive Level

R- Remember

U- Understand

A Apply

An- Analyze

E- Evaluate

Cr- Create

CO - PO/PSO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	0	0	0	1	0	3	3	0
CO 2	1	0	0	0	1	0	3	3	0
CO 3	1	0	0	0	1	0	3	3	0
CO 4	1	0	0	0	1	0	3	3	0
CO 5	1	0	0	0	1	0	3	3	0
CO6	1	0	0	0	1	0	3	3	0
CO7	1	0	0	0	1	0	3	3	0
CO8	1	0	0	0	1	0	3	3	0

Mapping Strength

- 0- No Mapping strength
- 1- Low
- 2- Medium
- 3- High

SESSION	TOPIC	LEARNING RESOURCES	VALUE ADDITIONS	COURSE OUTCOME
Module 1. Basics of Biostatistics				
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.	Lecture		CO 1

	Interpretation and Forecasting			
Module II. Measures of Central Tendency				
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
Module III. Measures of Dispersion				
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
Module IV. Correlation Analysis				
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	CIA I			
Module V. Regression Analysis				
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 straight line through regression Equation)	Lecture		CO 2
Module VI - Probability				
27	Probability distributions	Lecture		CO 2
28	Theorems of probability	Lecture		CO 2
Module VII – Testing of Hypothesis				
29	Probit Analysis (Brief account only).	Lecture		
30	Sampling, Methods and Errors	Lecture		CO 3
31	Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small Samples)	Lecture		CO 3
32	Chi- Square Test	Lecture		CO 3
33	Student's 't' test (Problem for small samples)	Lecture		CO3

	comparing mean of two variable			
34	F-test and Analysis of Variance (ANOVA - One way)	Lecture		CO 3
35	Non-parametric tests: Mc Nemar and Mann Whitney U test	Lecture		CO 3
Module VIII – Vital Statistics				
36	Introduction, uses, records and system of classification of vital statistics.	Lecture		CO 3
37	Sample registration system, Sample design, Survey of causes of death and Age classification	Lecture		CO 3
38	Measures of Vital Statistics and Measures of Population	Lecture		CO 3
Research methodology: Module I – Basic concepts				
39	Scientific temper, Empiricism, Rationalism	ICT Enabled (ppt); discussion		CO6
Module II: Concepts of Research				
40	Basic concepts of research -Meaning, Objectives, Motivation and Approaches.	ICT Enabled (ppt); discussion		CO6
41	Types of Research (Descriptive/Analytical Applied/ Fundamental, Quantitative/ Conceptual/ Empirical	ICT Enabled (ppt); discussion		CO6
42	Research methods versus Methodology, Research and scientific method. Research Process.	ICT Enabled (ppt); discussion		CO6
Module 3: Research formulation				
43	Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction	ICT Enabled (ppt); discussion		CO7
44	Defining and formulating the research problem, Selecting the problem and necessity of defining the problem.,	ICT Enabled (ppt); discussion		CO7
45	Literature review -Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review	ICT Enabled (ppt); discussion		CO7
46	Hypothesis -Null and alternate hypothesis and testing of hypothesis	ICT Enabled (ppt); discussion		CO7
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		CO7
48	Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs.	ICT Enabled (ppt); discussion		CO7

49	Data collection techniques.	ICT Enabled (ppt); discussion		CO7
Module V: Scientific documentation and communication				
50	Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).	ICT Enabled (ppt); discussion		CO5
51	Impact factor, Citation index, H-index Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference	ICT Enabled (ppt); discussion		CO5
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		CO8
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, <u>animal</u> houses, radiation hazards	ICT Enabled (ppt); discussion		CO8
54	Extension: Lab to Field, Extension communication, Extension tools.	ICT Enabled (ppt); discussion		CO8
55	Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution.	ICT Enabled (ppt); discussion		CO 8
56	CIA II			
Computer Application, Module I – Basics of computers				
57	Generations of computers, Organization of computers	ICT Enabled (ppt); discussion		CO 4
58	Binary Number System and Digital Computers. Hardware – examples	ICT Enabled (ppt); discussion		CO 4
59	Software - System Software	ICT Enabled (ppt); discussion		CO 4
60	Operating System – functions	ICT Enabled (ppt); discussion		CO 4
61	DOS, Widows,	ICT Enabled (ppt); discussion		CO 4

62	Linux and UNIX	ICT Enabled (ppt); discussion		CO 4
63	Application Softwares, Firmware, Virus and Antivirus	ICT Enabled (ppt); discussion		CO 4
64	Types of modern computing: Cluster computing, Grid computing, cloud computing	ICT Enabled (ppt); discussion		CO 4
Module II – Computer language and Programming				
65	Computer languages -Classification and types	ICT Enabled (ppt); discussion		CO 4
66	HTML, C and Java	ICT Enabled (ppt); discussion		CO 4
67	Programming concepts -Algorithm,	ICT Enabled (ppt); discussion		CO 4
Module III- Information technology and Biology				
68	Computer Networking – structure, topology, types (PAN, LAN, WAN, MAN) Wireless communication – Bluetooth /Wifi	ICT Enabled (ppt); discussion		CO 4
69	NET – Library networking and Internet Services -World Wide Web, Uploading, Downloading, Hosting, Portal, Search Engines, Firewall.	ICT Enabled (ppt); discussion		CO 4
70	Biological Databases – Category, role in biological research, Brief account on - BIOSIS, Medline and Medlars, AGRIS	ICT Enabled (ppt); discussion		CO 4
71	ournals and E Books Publishing; Cyber Crime and Cyber Laws	ICT Enabled (ppt); discussion		CO 4
72	Revision	ICT Enabled (ppt); discussion		CO 4

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	8/7/2018	Harmonic mean	CO 1
2	22/7/2018	Research process	CO 5

GROUP ASSIGNMENTS/ACTIVITIES – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)	Course Outcome
1	22/8/2018	Research Proposal writing	CO 5

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