

B.C.M COLLEGE, KOTTAYAM

Affiliated to Mahatma Gandhi University, Kottayam, Kerala

B.Sc. ZOOLOGY PROGRAMME

Curriculum for undergraduate programme

Under choice based credit system

**(Based on the Syllabus of Mahatma Gandhi University for 2012
Admission onwards)**

CURRICULUM

Graduate Programme Outcomes

At the completion of the B.Sc Zoology Programme, the student will be able to accomplish the following outcomes.

GPO No.	Graduate Programme Outcomes
GPO No. 1	Disciplinary Knowledge & Critical Thinking: Articulate knowledge of one or more disciplines that form a part of UG programme. Critically think, analyse, apply and evaluate various information and follow scientific approach to the development of knowledge.
GPO No. 2	Communication Skill: Communicate thoughts and ideas clearly in writing and orally. Develop careful listening, logical thinking and proficiency in interpersonal communication.
GPO No. 3	Environmental Awareness: Sustainable approach to use of natural resources. Capable of addressing issues, promoting values and give up practices that harm the ecosystem and our planet.
GPO No. 4	Ethical Awareness: Uphold ethics/morals in all spheres of life. Identify and avoid unethical behaviour in all aspects of work.
GPO No. 5	Social Commitment: Be aware of individual roles in society as nation builders, contributing to the betterment of society. Foster social skills to value fellow beings and be aware of one's responsibilities as international citizens.
GPO No. 6	Lifelong learners: Equip students to be life long learners. Be flexible to take up the changing demands of work place as well as for personal spheres of activities.

Programme specific outcomes

PSO No.	Programme specific outcomes	GPO NO
1.	Understands the general perspectives in basic sciences, distribution and classification of animals, salient features, structure, organisation, diversity and interactions with their environment.	1
2.	Understand the internal structure of cell, functions of cell organelles and correlates the physiological and biochemical aspects of animal as well as human body.	1
3.	Understands the complex evolutionary history of origin of life, animal phylogeny, animal behaviour, ecological concepts, importance of biodiversity, environmental protection and conservation of nature and natural resources.	1,3
4.	Understands the concepts of heredity and variations, genetic disorders and its application in human traits, human reproduction and assisted reproductive technologies and reproductive health.	1
5.	Apply the knowledge of apiculture,vermicomposting,aquaculture and animal breeding to carry out self employment, entrepreneurship and development of small scale industries.	3,5,6
6.	Develops practical skills in the areas of biochemistry, physiology, biotechnology genetics, microbiology, developmental biology, bioinformatics, taxonomy, applied zoology and ecology.	1,6
7.	Apply their knowledge to carry out research in biology, biological data management and generation of data bank for uploading of nucleotide sequences.	1,2
8.	Designs and constructs novel plans for dealing emerging diseases, pollution,water scarcity,natural disasters and resource management.	3,4,5
9.	Contributes and evaluates their knowledge about environment and its sustainability, its relation to human kind ,agriculture, medicine and sociobiology in nation building.	3,4,5
10.	Understand the importance of maintaining good physical, mental and social health and to apply different strategies such as balanced diet, life skill education and safety education in day-to-day life.	2,3,4,5

COURSE DETAILS OF THE DEPARTMENT

Semester	Course Code	Course
First	ZY1B01U	General Methodology and Perspectives in Science(Core) General Methodology & Instrumentation(Practical) Animal Diversity -Non-Chordata (Complementary offered to Botany, FACS, FSQC)
	ZY1C01U	Animal Diversity -Non-Chordata (Practical)
Second	ZY2B02U	Biodiversity and Modern Systematics (Core) Biodiversity and Modern Systematics(Practical)
	ZY2C02U	Animal Diversity -Chordata (Complementary offered to Botany, FACS, FSQC) Animal Diversity -Chordata (Practical)
Third	ZY3B03U	Animal Diversity - Non Chordata (Core) Animal Diversity – Non Chordata (Practical)
	ZY3CVO3U	Human Physiology and Immunology (Complementary offered to Botany, FACS, FSQC) Human Physiology and Immunology (Practical)
Fourth	ZY4B04U	Animal Diversity - Chordata (Core) Animal Diversity – Chordata (Practical)
	ZY4CVO4U	Applied Zoology (Complementary offered to Botany, FACS, FSQC) Applied Zoology(Practical)
Fifth	ZY5B05U	Cell Biology and Molecular Biology (Core) Cell Biology and Molecular Biology (Practical)
	ZY5B06U	Environmental Biology, Toxicology and Disaster management (Core)
	ZY5B07U	Environmental Biology, Toxicology and Disaster management Evolution, Zoogeography and Ethology(Core)
	ZY5B07U	Evolution, Zoogeography and Ethology Biochemistry, Human Physiology and Endocrinology(Core)
	ZY5D02U	Biochemistry, Human Physiology and Endocrinology Human Genetics, Nutrition, Community health and Sanitation(Open course)
Sixth	ZY6B09U	Reproductive and Developmental Biology(Core) Reproductive and Developmental Biology(Practical)
	ZY6B10U	Genetics and Biotechnology (Core) Genetics and Biotechnology (Practical)
	ZY6B11U	Microbiology and Immunology(Core) Microbiology and Immunology(Practical)
	ZY6B12U	General informatics, Bioinformatics and Biostatistics (Core) General informatics, Bioinformatics and Biostatistics (Practical)

	ZY6B15U	Economic Zoology (Elective)
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Course	Details
Code	ZY1B01U
Title	General Methodology and Perspectives in Science
Degree	B.Sc.
Branch	Zoology
Year	1/1
Type	Core Course
Credits	2

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1.	Understand the relevance of Science, scope of Zoology and the various branches of Zoology.	U	1
2.	Analyze the different laws and disciplines of science.	An	1
3.	Understand the principle and uses of scientific drawing and instruments used in scientific studies.	U	1
4.	Understand the different biological collection and preservation techniques.	U	1
5.	Analyse the scientific methods used in research and how to follow an ethical approach in scientific research.	An	1
	PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create		

Module	Course Description	Hours	CO No.
	BIOLOGY - THE LIFE SCIENCE	25	
1	Science and Scientific Studies	4	
1.1	Types of knowledge: practical, theoretical, and scientific knowledge. Information.	1	1
1.2	What is science; what is not science; laws of science. Revolutions in Science and Technology	1	1,2
1.3	Basis for scientific laws and factual truths. Science as a human activity, scientific temper, empiricism.	1	1,2
1.4	Vocabulary of science. science disciplines.	1	1,2
2	What is Biology	4	
2.1	Life and its manifestations.	2	1
2.2	History of Biology: Biology in ancient times Landmarks in the progress of Biology.	1	1
2.3	Branches of Zoology, Scope of Zoology.	1	1
3	Tools and Techniques in Biology	12	3
3.1	Scientific drawing -Purpose and principle	1	3
3.2	Basic understanding on principle and uses of Microscopy (a) Light microscopy, Bright field (Compound Microscope), Phase contrast, Dark field microscopy, Fluorescence, Polorization microscopy, Video microscopy. (b) Electron - Scanning (SEM), Transmission (TEM) and STEM	4	3

3.3	Micrometry – Stage and Eyepiece micrometers, Camera Lucida	2	3
3.4	Instrumentation - pH Meter	1	3
3.5	Separation Techniques – Centrifuge, Chromatography, Electrophoresis.	2	3
3.6	Analytical techniques Colorimeter, Spectrophotometer, X-ray crystallography	2	3
4	Animal Collection techniques	5	
4.1	Collection methods, techniques and equipments- Plankton, Insects, Fish, Bird	3	4
4.2	Preservation techniques – Taxidermy, Rearing techniques, Laboratory and field.	2	4
	PART II: BIOLOGY AND RESEARCH	11	
5	Bioethics	5	
5.1	Introduction, Animal rights and animal laws in India. Prevention of cruelty to animals Act 1960, Wildlife protection act 1972 and Amendments, Biodiversity Act 2003.	3	5
5.2	Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means).Animal use in research and education. Laboratory animal use, care and welfare. Animal protection initiatives Animal Welfare, Animal Welfare Board, India CPCSEA.	3	5
5.3	Working with Humans, harm, risk, and benefits.Consent. Special Cases: Children and Vulnerable people, Equality, Anonymity, Confidentiality, Information Storage and dissemination, Human Rights Act-1995, 1998. Right to information- 2005	2	5
6	Research Methodology	5	
6.1	Scientific method, Research Projects- Steps and process.	1	5
6.2	Types. Research Communication, Research report writing (Structure of a scientific paper),	2	5
6.3	Presentation techniques, Project proposal writing, Assignment, seminar, debate, workshop, colloquium, Conferene. Brief description and major differences.	2	5
7	Units of measurements	1	
7.1	Calculations and related conversions of each: Metric system- length; surface; weight, Square measures, Cubic measures (volumetric), Circular or angular measure, Concentrations- percent volume; ppt; ppm, Chemical – molarity, normality, Temperature- Celsius, centigrade, Fahrenheit	1	5

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- Day, R.A. 1993. How to write and publish a scientific paper. Cambridge University Press. (Module VI)
- Day, R.A. 2000. Scientific English: A guide for Scientists and other Professionals. Universities Press. (Module VI)
- Debbies Holmes, Peter Moody and Diana Dine 2006 Research methods for the Biosciences. International student Edition : Oxford University Press .
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- Ernst Myer .1997. *This is Biology: The Science of the Living World*. Universities Press, Hyderabad, India
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Course	Details
Code	ZY1B01U [P]
Title	(Practical)- General Methodology & Instrumentation
Degree	B.Sc.
Branch	Zoology
Year/Semester	I/I
Type	Core Practical
Credits	1

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1	Understand the basics of microscopy and use simple and compound light microscope.	U, Ap	7
2	Calibrate, measure and draw microscopic objects and sample specimens.	Ap	7
3.	Understand the working principle of paper chromatography and various scientific instruments.	U	7
4.	Determine the Insect collection and preservation methods	Ap	7
	PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create		

Module	Course Description	Hrs	CO. No.
1	General Methodology & Instrumentation	36	
1.1	Study of simple and compound light microscopes.	4	1
1.2	Micrometry –calibration and measurement of microscopic objects –low power	6	2
1.3	Camera Lucida (draw a few diagrams using Camera Lucida)	6	2
1.4	Paper chromatography (demonstration only)	4	3
1.5	Instrumentation – demonstration (write notes on principle, equipment and its use) pH Meter, Colorimeter/ Spectrophotometer, Centrifuge, Electrophoresis	4	3
1.6	Scientific drawing (representatives from any five taxa)	6	2
1.7	Insect collection and preservation techniques (Group Activity)	6	4

COURSE	DETAILS
CODE	ZY1C01U
TITLE	ANIMAL DIVERSITY – NON CHORDATA (T)
DEGREE/YEAR	B.SC ZOOLOGY, I SEMESTER
TYPE	COMPLEMENTARY COURSE
CREDITS	36 HR

CO No.	Expected Course outcomes: ANIMAL DIVERSITY - NON CHORDATA	Cognitive level	PSO No.
1.	Understand the basics of taxonomical classification and the diversity of protozoans and higher invertebrates.	U	PSO-1, PSO-2, PAO-8
2.	Classify and describe the general features of Kingdom Protista with examples and to explain the parasitic protozoans.	U	PSO-1, PSO-2, PSO-8
3.	Classify and describe the salient features of acoelomates with examples by giving special reference to their morphological and ecological importance.	U	PSO-1, PSO-2, PSO-8
4.	Classify and describe pseudocoelomates with special reference to pathogenic nematodes.	U	PSO-1, PSO-2, PSO-8
5.	Understand and classify coelomates with interpretation of their evolutionary relationships.	U	PSO-1, PSO-2, PSO-8
6.	Understand the general features of minor phyla	U	PSO-1, PSO-2, PSO-8
7.	Instigate curiosity of students in the biota around them and to generate a positive attitude towards its conservation.	Ap	PSO-1, PSO-2, PSO-8

*PSO-Program Specific Outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

MODULE COURSE DECSRIPTION	Hrs.	CO.No.
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1.0	General Introduction: Five kingdom classification and classification in general	1	1,7
2.0	<p>Kingdom Protista: Salient features and classification upto phyla</p> <p>Phylum Rhizopoda (eg: Amoeba)</p> <p>Phylum Actinopoda (eg: Actinophrys)</p> <p>Phylum Dinoflagellata (eg: Noctiluca)</p> <p>Phylum Parabasalia (eg: Trychonympha)</p> <p>Phylum Metamonada (eg: Giardia)</p> <p>Phylum Kinetoplasta (eg: Trypanosoma)</p> <p>Phylum Euglenophyta (eg: Euglena)</p> <p>Phylum Cryptophyta (eg: Cryptomonas)</p> <p>Phylum Opalinata (eg: Opalina)</p> <p>Phylum Bacillariophyta (eg: Diatoms)</p> <p>Phylum Chlorophyta (eg: Volvox)</p> <p>Phylum Choanoflagellata (eg: Proterospongia)</p> <p>Phylum Ciliophora (eg: Paramecium)</p> <p>Phylum Sporozoa (eg: Plasmodium)</p> <p>Phylum Microsporidia (eg: Nosema)</p> <p>Phylum Rhodophyta (eg: Red algae)</p> <p>(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)</p>	6	2,7
1.2	Pathogenic Protists – Plasmodium, Entamoeba	1	1,2,7
3.0	<p>Mesozoa – eg. Rhopalura (mention 5 salient features)</p> <p>Parazoa</p> <p>Phylum Porifera – eg Leucosolenia</p> <p>Phylum Placozoa –e g. Trycoplax adherens.</p>	2	1,3,7

4.0	<p>Phylum Coelenterata: Salient features and classification upto class Class 1: Hydrozoa (eg: Physalia) Class 2: Schyphozoa (eg: Aurelia) Class 3: Anthozoa (eg: Adamsia)</p>	2	1,3,7
4.1	<p>General Topic: Corals and Coral reefs.</p>	1	1,3,7
5.0	<p>Phylum Platyhelminthes: Salient features and classification up to class. Class 1: Turbellaria (eg: Planaria) Class 2: Trematoda (eg: Fasciola) Class 3: Cestoda (eg: Taenia solium)</p>	2	1,3,7
6.0	<p>Phylum Nematoda: Salient features and classification up to class. Class 1: Phasmida (eg: Wuchereria) Class 2: Aphasmda (eg: Trichinella)</p>	2	1,4,7
7.0	<p>Phylum Annelida: Salient features and classification up to class. Class 1: Polychaeta (eg: Nereis) Class 2: Oligochaeta (eg: Pheretima) Class 3: Hirudinomorpha (eg: Hirudinaria)</p>	2	1,5,7
8.0	<p>Phylum Arthropoda: Salient features. Type study – Fenneropenaeus (Penaeus)</p>	5	1,5,7
8.1	<p>Classification up to classes</p> <p>Subphylum: Chelicerata</p> <p>Class 1: Merostoma (eg: Limulus)</p> <p>Class 2: Arachnida (eg: Spider)</p> <p>Class 3: Pycnogonida (eg: Nymphon)</p> <p>Subphylum Mandibulata</p> <p>Class 1: Crustacea (eg: Daphnia)</p> <p>Class 2: Chilopoda (eg: Centipede)</p> <p>Class 3: Symphyla (eg: Scutigerebella)</p> <p>Class 4: Diplopoda (eg: Millipede)</p> <p>Class 5: Pauropoda (eg: Pauropus)</p> <p>Class 6: Insecta (eg: Butterfly)</p> <p>(Detailed account of examples are not necessary)</p>	5	1,5,7

	<p>Phylum Onychophora – eg. Peripatus (Mention its affinities) Insect pests</p> <ol style="list-style-type: none"> 1. Pests of coconut – <i>Oryctes rhinoceros</i>, <i>Rhynchophorus ferrugineus</i>, <i>Nephantis serinopa</i>, <i>Eriophid mite</i> 2. Pests of paddy – <i>Leptocorisa acuta</i>, <i>Spodoptera mauritius</i> 3. Pests of stored grains - <i>Trogoderma granarium</i>, <i>Tribolium castaneum</i>, <i>Sitophilus oryzae</i> 		
9.0	<p>Phylum Mollusca: Salient features and classification up to class</p> <p>Class 1: Aplacophora (eg: Neomenia)</p> <p>Class 2: Monoplacophora (eg: Neopilina)</p> <p>Class 3: Polyplacophora (eg: Chiton)</p> <p>Class 4: Bivalvia (eg: Perna)</p> <p>Class 5: Gastropoda (eg: Xancus)</p> <p>Class 6: Cephalopoda (eg: Sepia)</p> <p>Class 7: Scaphopoda (eg: Dentalium)</p>	3	1,5,7
10.0	<p>Phylum Echinodermata : Salient features and classification up to class.</p> <p>Class 1: Asteroidea (eg: Astropecten)</p> <p>Class 2: Ophiuroidea (eg: Ophiothrix)</p> <p>Class 3: Echinoidea (eg: Echinus)</p> <p>Class 4: Holothuroidea (eg: Holothuria)</p> <p>Class 5: Crinoidea (eg: Antedon)</p>	3	1,5,7
11.0	<p>Phylum Hemichordata : Salient features (eg: Balanoglossus.)</p>	1	1,6,7

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COURSE	DETAILS
TITLE	ANIMAL DIVERSITY-NON CHORDATA (P)
DEGREE/YEAR	B.SC ZOOLOGY, I SEMESTER
TYPE	COMPLEMENTARY COURSE
CREDITS	36 HRS

CO.No.	Expected course outcomes	Cognitive Level	PSO.No.
1	Use scientific drawing technique	Ap	PSO-9
2	Identify common invertebrates	U	PSO-9
3	Examine microscopic organisms	An	PSO-9
4	Carry out dissections and temporary mounting	Ap	PSO-9
<p>*PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</p>			

Exp	Course Description	Hrs.	CO.No.
1	Scientific drawing - 5 specimens	10	1
2	Simple identification – 25 invertebrates (Out of which 15 by their scientific names)	6	2
3	T.S - Earthworm, T.S Fasciola	2	3
4	Dissection - Nervous system of Prawn	6	4
5	Dissection - Nervous system of Cockroach	6	4
6	Mounting - Prawn Appendages	4	4
7	Mounting - Cockroach Mouth parts	2	4

Course	Details
Code	ZY2B02U
Title	BIODIVERSITY AND MODERN SYSTEMATICS
Degree	B.Sc.
Branch	Zoology
Year/Semester	I/II
Type	Core Course
Credits	2

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1.	Develop knowledge on basic concepts of environment, biodiversity and taxonomy.	R	3
2.	To determine various threats to biodiversity.	Ap	3
3.	Analyse various Laws related to biodiversity and its conservation.	An	3
4.	Interpret the tools and techniques used in biodiversity and taxonomy.	U	3
5.	Generate ideas on taxonomical identification of animals.	C	3

***PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

Module Description	Course	Hrs	CO.No
	PART I: BIODIVERSITY	26	
1.0	Module I – Introduction to Biodiversity	2	1
1.1	Definition, Historical perspective, Concepts – Nature – environment – biodiversity	1	1
1.2	Scope and importance	1	1
2.0	Module II – Levels of biodiversity	5	1
2.1	Genetic, Species, Ecosystem	1	
2.2	Domesticated, Microbial diversity	1	1
2.3	Distribution of biodiversity on earth: Tropical, temperate and polar	1	1
2.4	Landscapes and interactions	1	1
2.5	Biodiversity hotspots	1	1
3.0	Module III – Values of biodiversity	4	1
3.1	Direct use value	1	1
3.2	Indirect use value	1	1
3.3	Non use value	1	1
3.4	Ecosystem services	1	1
4.0	Module IV – Threats to biodiversity	5	2
4.1	Types of threats		2
4.1.1	Habitat loss, man- wildlife conflict	1	2
4.1.2	Invasive species	1	2
4.1.3	Pollution	1	2
4.2	Over exploitation and human population	1	2

4.3	Climate change	1	2
5.0	Module V – Biodiversity conservation and management	6	3
5.1	Conservation strategies	1	3
5.1.1	<i>In situ, ex situ</i>		3
5.1.2	National parks, Sanctuaries and Biosphere reserves		3
5.2	International efforts	1	3
5.2.1	Convention on Biological Diversity (CBD)		3
5.2.2	IUCN- WCMC, UNEP		3
5.3	Legal measures	3	3
5.3.1	Wild life Protection Act, 1972		3
5.3.2	The Environment Protection Act, 1986		3
5.3.3	Forest (Conservation) Act 1980, 1988		3
5.3.4	Biodiversity Act 2002		3
5.3.5	Biodiversity rule 2004		3
5.3.6	National biodiversity action plan		3
5.4	People’s participation – Peoples biodiversity register (PBR), Local initiatives	1	3
6.0	Module VI – Biodiversity estimation – tools and techniques	4	4
6.1	Sampling techniques – Quadrata, Line transect.	1	4
6.2	Measurements- Density, Abundance, Frequency	1	4
6.3	Biodiversity indices – concepts, shannon-Weiner, Simpson	2	4
	PART II – MODERN TAXONOMY	10	4
7.0	Module VII – Taxonomical Principles	6	4
7.1	Brief history, Concepts and definition	1	4
7.2	Approaches of taxonomy	1	4
7.3	Molecular taxonomy	1	4
7.4	Importance of classification	1	4
7.5	Phylogeny and Taxonomy– Tree of Life, bar coding of life	1	4
7.6	Zoological nomenclature: International Code of Zoological Nomenclature (ICZN)	1	4
8.0	Module VIII – Tools and techniques	4	4,5
8.1	Identification Key		4,5
8.1.1	Dichotomous keys	1	4,5
8.1.2	Polytomous key	1	4,5
8.1.3	Multi access key	1	4,5
8.2	Advantages and disadvantages	1	4,5

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Course	Details
Code	ZY2B02U (P)
Title	BIODIVERSITY AND MODERN SYSTEMATICS
Degree	B.Sc.
Branch	Zoology
Year/Semester	I/II
Type	Core Practical
Credits	1

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1.	Interpret sampling techniques used in diversity studies.	U	6
2.	Develop ideas on identification of animals.	R	6
3.	Create love towards nature	C	6

***PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create**

Exp. No	Course Description	Hrs	CO
1	Quadrat study	4	1
2	Transect study	4	1
3	Sampling Methods	4	1
4	Species area curve	4	1
5	Identification using keys Insect, Fish, Snake	4	2
6	Taxa, identification techniques Bird body parts Butterfly/ dragonfly body parts and venation	4	2
7	Simple identification of any 20 animals	2	2
8	Field study	10	3

COURSE	DETAILS
CODE	ZY2C02U
TITLE	ANIMAL DIVERSITY – CHORDATA (T)
DEGREE/YEAR	B.SC ZOOLOGY, II SEMESTER
TYPE	COMPLEMENTARY COURSE
CREDITS	36 HRS

CO No.	Expected Course outcomes: CHORDATE DIVERSITY	Cognitive level	PSO No.
1.	Understand the diversity, classification and phylogeny of Chordates.	U	PSO-1, PSO-2
2.	Outline and parse the adaptive features exhibited by the vertebrates.	An	PSO-1, PSO-2
3.	Compare the anatomy and physiological peculiarities of Chordates through type study of <i>Rana hexadactyla</i> .	U	PSO-1, PSO-2
4.	Understand the economic importance and evolutionary significance of selected Chordate groups.	U	PSO-1, PSO-2
5.	Determine the classification category of a given chordate based on the external observable features.	Ap	PSO-1, PSO-2
*PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create			

MOD ULE	COURSE DECSRIPTION	Hrs.	CO.No.
1.0	Phylum Chordata: General characters of the Phylum Chordata Classification upto classes	1	1,2,5
1.1	Sub phylum Urochordata: General characters,	2	1,2,5

	<p>Classification:</p> <p>Class 1: Larvacea (eg: Oikopleura)</p> <p>Class 2: Ascidiacea (eg: Ascidia)</p> <p>Class 3: Thaliacea (eg: Salpa)</p> <p>Sub phylum Cephalochordata: Salient features (eg: Branchiostoma)</p>		
1.2	Subphylum III Vertebrata - General characters	1	1,2,5
1.3	Division I Agnatha - General characters	1	1,2,5
1.4	Class 1 Cyclostomata eg. Petreromyzon Class 2 Ostracodemi eg. Cephalapis	1	1,2,5
1.5	Division 2 Gnathostomata - General characters Super class Pisces and Super class Tetrapoda	1	1,2,5
2.0	Super class Pisces General characters	1	1,2,5
2.1	Class 1. Chondrichthyes eg. Narcine Class 2. Osteichthyes eg. Latimeria	1	1,2,5
2.2	Accessory respiratory organs in fishes.	1	1,2,5
3.0	Module III Super Class Tetrapoda - General characters	2	1,2,5
3.1	Class : Amphibia General characters Type : <i>Rana hexadactyla</i>	10	1,2,3,5
3.2	Order I. Urodela eg. Amblystoma Order II. Anura eg. Bufo Order III . Apoda eg. Ichthyophis	4	1,2,5
4.0	Class Reptilia – General characters	1	1,2,5
4.1	Sub class I: Anapsida Eg. Chelone Sub class II Diapsida Eg. Chameleon Subclass III Parapsida eg. Ichthyosaurus	2	1,2,5
4.2	Poisonous and non-poisonous snakes of India	1	1,2,5
5.0	Class Aves - General characters	1	1,2,5

5.1	Sub class I : Archeornithes Eg: Archaeopteryx Sub class II. Neornithes Eg: Struthio	1	1,2,4,5
5.2	Flight adaptations of birds	1	1,2,5
6.0	Class Mammalia: Salient features and classification up to subclass Sub class 1: Protheria (eg: Echidna) Sub class 2: Metatheria (eg: Macropus) Sub class 3: Eutheria (eg: Elephas)	2	1,2,5
6.1	Aquatic mammals	1	1,2,5

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COURSE	DETAILS
CODE	ZY2C02U [P]
TITLE	ANIMAL DIVERSITY – CHORDATA (P)
DEGREE/YEAR	B.SC ZOOLOGY, II SEMESTER
TYPE	COMPLEMENTARY COURSE
CREDITS	36 HRS

CO No.	Expected Course outcomes: ANIMAL DIVERSITY – CHORDATA (P)	Cognitive level	PSO No.
1.	Undersatnd and classify the local chordate diversity.	U	PSO-9
2.	Examine the morphology, anatomy and osteology of chordates.	An	PSO-9
3.	Carry out identification of snakes using taxonomic keys.	Ap	PSO-9
4.	Carry out scientific drawing and temporary mounting.	Ap	PSO-9
*PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create			

MODU LE	COURSE DESCRIPTION	Hrs.	Co No.
1.0	Morphology Scientific drawing – 5 specimens of chordates	6	2,4
2.0	Simple identification of 10 chordates, out of which 5 by their scientific names	6	1
3.0	Osteology - Vertebrae and girdles of Frog	6	2
4.0	Snake identification - 3 poisonous and 3 non poisonous snakes with key	6	3
5.0	Mounting of placoid scales of shark	4	4
6.0	Dissections: Frog: Photographs/Diagrams/ models may be used for the study. 1. Frog - Viscera 2. Frog - Digestive System 3. Frog - Arterial System 4. Frog - Brain	8	2

COURSE	DETAILS
CODE	ZY3B03U
TITLE	ANIMAL DIVERSITY – NON CHORDATA (T)
DEGREE/YEAR	B.SC ZOOLOGY, III rd SEMESTER
TYPE	CORE COURSE
CREDITS	54 HRS

CO No.	Expected Course outcomes: ANIMAL DIVERSITY - NON CHORDATA	Cognitive level	PSO No.
1.	Understand the basics of taxonomical classification	U	PSO-1, PSO-2, PSO-8
2.	Classify and describe the general features of Kingdom Protista with examples and to explain the parasitic protozoans.	U	PSO-1, PSO-2, PSO-8
3.	Organize the diverse fauna around them into three branches of Kingdom Animalia.	An	PSO-1, PSO-2, PSO-8
4.	Classify and describe the salient features of acoelomates with examples by giving special reference to their morphological and ecological importance.	U	PSO-1, PSO-2, PSO-8
5.	Classify and describe pseudocoelomates with special reference to pathogenic nematodes.	U	PSO-1, PSO-2, PSO-8
6.	Understand and classify coelomates with interpretation of their evolutionary relationships.	U	PSO-1, PSO-2, PSO-8
7.	Understand the general features of minor phyla and phylum hemichordata.	U	PSO-1, PSO-2, PSO-8
8.	Instigate curiosity of students in the biota around them and to generate a positive attitude towards its conservation.	Ap	PSO-1, PSO-2, PSO-8

*PSO-Program Specific Outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

MODULe	COURSE DESCRIPTION	Hrs.	CO.No.
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MODULE I

1.1	Introduction: Briefly mention the following Classification – Keys and Principles. Nomenclature (Uninominal, Binomial, & Trinomial), Law of Priority. Two kingdom and Five kingdom classification.	1	1,8
1.2	Symmetry - Asymmetry, Spherical, Radial, Biradial and Bilateral Coelom – Acoelomates, Pseudocoelomates and Eucoelomates Schizocoelom, Enterocoelom., Protostomia and Deuterostomia	1	1,8
1.3	Kingdom Protista Type: Paramecium Salient features and classification up to phyla Phylum Rhizopoda (eg: Amoeba) Phylum Actinopoda (eg: Actinophrys) Phylum Dinoflagellata (eg: Noctiluca) Phylum Parabasalia (eg: Trychonympha) Phylum Metamonada (eg: Giardia) Phylum Kinetoplasta (eg: Trypanosoma) Phylum Euglenophyta (eg: Euglena) Phylum Cryptophyta (eg: Cryptomonas) Phylum Opalinata (eg: Opalina) Phylum Bacillariophyta (eg: Diatoms) Phylum Chlorophyta (eg: Volvox) Phylum Choanoflagellata (eg: Proterospongia)	8	2,8

	<p>Phylum Ciliophora (eg: Paramecium)</p> <p>Phylum Sporozoa (eg: Plasmodium)</p> <p>Phylum Microsporidia (eg: Nosema)</p> <p>Phylum Rhodophyta (eg: Red algae)</p> <p>(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)</p>		
1.4	<p>General Topics : (1)Parasitic Protozoans (2). Life cycle of Plasmodium</p>	2	2,8
1.5	<p>Kingdom Animalia Outline classification of Kingdom Animalia. Three branches - Mesozoa, parazoa, Eumetazoa.</p>	1	3,8
MODULE II			
2.1	<p>Mesozoa - Eg. Rhopalura.</p> <p>Phylum Porifera.</p> <p>Classification upto classes.</p> <p>Class I- Calcarea. Eg. Sycon., Class II – Hexactinellida . Eg. Euplectella.</p> <p>Class III – Demospongia Eg. Cliona.</p> <p>General Topics</p> <p>1. Reproduction in sponges 2. Canal system in sponges.</p>	3	3,8
2.2	<p>Phylum Coelenterata Type: Obelia</p> <p>Classification upto classes.</p> <p>Class I - Hydrozoa Eg. Halistemma. Class II – Scyphozoa Eg. Rhizostoma. Class III- Anthozoa Eg. Fungia.</p> <p>General Topics: Coral and coral reefs with special reference to conservation of reef fauna.</p> <p>2. Polymorphism in Coelenterates</p>	6	4,8
MODULE III			

3.1	Phylum Ctenophora. Eg. Pleurobrachia.	1	4,8
3.2	<p>Phylum Platyhelminthes</p> <p>Classification upto classes.</p> <p>Class I - Turbellaria. Eg. Planaria.</p> <p>Class II – Trematoda Eg. Fasciola</p> <p>Class III- Cestoda Eg. <i>Taenia saginata</i>.</p> <p>General Topics-</p> <p>1. Life history of <i>Fasciola hepatica</i>.</p> <p>2. Platyhelminth parasites of Man and Dog (<i>Schistosoma</i>, <i>Taenia solium</i>, <i>Echinococcus</i>).</p>	3	4,8
3.3	<p>Phylum Nematoda</p> <p>Class phasmidia Eg.</p> <p>Enterobius, Ascaris</p> <p>Class Aphasmidia Eg. Trichinella</p> <p>General Topic-</p> <p>Pathogenic nematodes. (<i>Wuchereria bancrofti</i>, <i>Ancylostoma duodenale</i>, Trichinella).</p>	3	5,8
3.4	<p>Phylum Annelida</p> <p>Classification upto classes.</p> <p>Class I- Archiannelida Eg. Polygordius</p> <p>Class II – Polychaeta Eg. Chaetopterus</p> <p>ClassIII- Oligochaeta Eg. Megasclex.</p> <p>Class IV - Hirudinomorpha Eg. Ozobranthus, Hirudinaria</p>	2	6,8
MODULE IV			
4.0	<p>Phylum- Onychophora</p> <p>Eg. Peripatus (Mention its affinities).</p>	2	6,8
4.1	<p>Phylum Arthropoda</p> <p>Type: Panaeus</p>	10	6,8

	<p>Classification upto classes. Divided into 3 subphyla.</p> <p>1. Sub Phylum - Trilobitomorpha Class - Trilobita (mention salient features).</p> <p>2. Sub Phylum- Mandibulata Class I – Crustacea Eg. Sacculina Class II- Chilopoda Eg. Centipede (Scolopendra) Class III – Symphyla Eg. Scutigera Class IV – Diplopoda Eg. Millipede (Spirostreptus) Class V - Insecta Eg. Dragon fly Class VI – Pauropoda Eg. Pauropus</p> <p>3. Sub Phylum - Chelicerata Class - Merostomata Eg. Limulus Class II – Arachnida Eg. Scorpion</p> <p>General Topics 1. Vectorial Arthropods 2. Larval forms of Penaeus</p>		
MODULE V			
5.1	<p>Phylum Mollusca</p> <p>Classification upto classes Class I- Monoplacophora Eg. Neopilina Class II- Amphineura Eg. Chiton Class III- Gastropoda Eg. Aplysia Class IV- Scaphopoda Eg. Dentalium Class V- Pelecypoda Eg. Pinctada Class VI- Cephalopoda Eg. Sepia</p> <p>General Topic- Pearl formation and culture</p>	4	6,8
5.2	Phylum Echinodermata	4	6,8

	Classification upto classes Class I- Asteroidea Eg. Astropecten Class II- Ophiuroidea Eg. Ophiothrix Class III- Echinoidea Eg. Echinus Class IV- Holothuroidea Eg. Holothuria Class V – Crinoidea Eg. Antedon General Topics 1. Water vascular system. 2. Larval forms of Echinoderms		
5.3	Minor Phyla 1. Chaetognatha Eg. Sagitta 2. Sipunculida Eg. Sipunculus 3. Rotifera Eg. Brachionus	2	7,8
5.4	Phylum Hemichordata Eg. Balanoglossus	1	7,8

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COURSE	DETAILS
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TITLE	ANIMAL DIVERSITY-NON CHORDATA (P)
DEGREE/YEAR	B.SC ZOOLOGY, III rd SEMESTER
TYPE	CORE COURSE
CREDITS	36 HRS

CO.No	Expected course outcomes	Cognitive Level	PSO.No.
1	Use scientific drawing technique	Ap	PSO-1, PSO-2
2	Identify common invertebrates	U	PSO-1, PSO-2
3	Examine microscopic organisms	An	PSO-1, PSO-2
4	Carry out dissections and temporary mounting	Ap	PSO-1, PSO-2

*PSO-Program Specific Outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Ex p	Course Description	Hrs.	CO.No.
1	Scientific drawing - Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.	6	1
2	Anatomy:- Study of sections. (Any two) 1. Hydra. 2. Ascaris(male and female) 3. Earthworm 4. Fasciola	4	3
3	Dissections 1. Prawn - Nervous system 2. Cockroach - Nervous system	8	4
4	Mounting:- 1. Nereis - Parapodia 2. Cockroach - Salivary glands 3. Mouth parts –Plant bug/ House fly / Mosquito. (Any Two) 4. Prawn appendages.	5	4

5	Identification:- General identification &classification - The students are expected to identify the following Phylum –wise number of animals by their generic names and 20% of these by their specific names. Protista -2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca- 2, Echinodermata-2	8	2
6	Taxonomic identification with key:- Identification of insects up to the level of Order.	5	2

Course title	HUMAN PHYSIOLOGY AND IMMUNOLOGY
Course code	ZY3C03U
Programme	BSc. ZOOLOGY
Semester	3
Course type	COMPLEMENTARY
Credits	1

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Understand the physiology of various organ systems, including respiratory, circulatory, muscular, excretory and nervous systems with special reference to humans and their disorders.	U	PSO - 3,4,5
2	Describe nutritional requirements and malnutrition disorders.	U	PSO - 3,5
3	Discuss endocrine system, functions, diseases and hormone action	U	PSO - 3,5
4	Explain basic concepts of Immunology and antigen antibody reactions	U	PSO - 3
5	Identify various immune response systems, vaccines and immune disorders	An	PSO - 3,5

MODULE	COURSE DESCRIPTION	HOURS	CO.NO.
1.1	Nutrition: Types of nutrition – autotrophy, heterotrophy. Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, Fe, I), vitamins (sources and deficiency disorders), nutritional disorders	5	2
1.2	Respiration: Transport of respiratory gases in blood - transport of oxygen, transport of carbon dioxide, chloride shift. Respiratory disturbances – Hypoxia, Hypercapnia, Asphyxia, physiological effect of smoking, carbon monoxide poisoning.	4	1
1.3	Circulation: Composition and functions of blood. Plasma and formed elements - WBC, RBC and platelets, Mechanism of blood coagulation – clotting factors, intrinsic and extrinsic pathways, anticoagulants. ECG, Blood pressure, Arteriosclerosis, Hemophilia, cerebral and pulmonary thrombosis.	5	1
2.1	Excretion: Structure of a nephron. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Composition of urine – normal and abnormal constituents. Hormonal regulation of kidney function. Kidney stone, dialysis.	5	1

2.2	Neuro physiology: Structure of a neuron. Myelinated and non-myelinated nerve fibre, nerve impulse production (resting membrane potential, action potential), Impulse propagation, All or none law, saltatory conduction, synaptic transmission. Neurotransmitters (acetyl choline, adrenalin, dopamine), brain waves, EEG. Neural disorders - Parkinson's disease, Alzheimer's disease.	5	1
2.3	Muscle physiology: Types of muscles: striated, non striated and cardiac. Ultra structure of striated muscle, Mechanism of muscle contraction, Cori cycle and muscle relaxation. Muscle fatigue, oxygen debt, Rigor mortis.	4	1
3.1	Endocrinology: Introduction to Endocrine system. Mechanism of hormone action	2	3
3.2	Endocrine glands - hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, endocrine pancreas, adrenal gland, thymus gland, testis and ovary.	5	3
3.3	Physiological role of hormones, Hormonal disorders.	1	3
4.1	Immunology: Introduction to immunology, types of immunity - innate, acquired, passive, active, mechanism of innate immunity (barriers, inflammation, phagocytosis).	4	4
4.2	Types of antigens.	1	4
4.3	Basic structure of immunoglobulins, Classes of immunoglobulins and functions.	3	4
4.4	Antigen antibody reactions, Precipitation test, agglutination test, WIDAL, VDRL, HIV test (ELISA),	4	4
5.1	Immune response system: (Brief accounts of the followings) Primary and secondary lymphoid organs.	1	5
5.2	Cells of Immune system - T&B lymphocytes, natural killer cells, macrophages, plasma cells , memory cells.	1	5
5.3	Monoclonal antibodies, Hybridoma technology.	1	5
5.4	Immune disorders: Hypersensitivity, Auto immunity (rheumatoid arthritis) & Immunodeficiency (AIDS).	2	5

5.5	Vaccines - BCG, DPT, Polio vaccine.	1	5
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1	HUMAN PHYSIOLOGY Nutrition -Malnutrition disorders, Vitamin deficiencies, and mineral deficiencies (Iron, Calcium and Iodine)	3	2
2.1	Respiration - Transport of O ₂ and CO ₂ in blood,	2	1
2.2	respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.	3	1
3.1	Circulation Blood – Composition and function,	1	1
3.2	Brief account of mechanism of blood clotting; Disorders of blood clotting – Haemophilia, cerebral and pulmonary thrombosis, Cerebral haemorrhage,	3	1

3.3	Blood pressure and factors controlling it; electrocardiogram, Cardiovascular disorders – Arteriosclerosis, Myocardial infraction, Angiogram and Angioplasty.	3	1
4.1	Excretion- Structure of human nephron, composition of urine – normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism);	3	1
4.2	Hormonal control of renal function, Kidney disorders – myelonephritis, glomerular nephritis, nephrotic syndrome, Dialysis	3	1
5.1	Neurophysiology- Structure of typical neuron, myelinated and non myelinated nerve fibres.	1	1
5.2	Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters.	3	1
5.3	Brian waves, Electroencephalogram, Neural disorders – Parkinson’s disease, Epilepsy, Alzheimer’s syndrome, Dyslexia.	2	1
6.1	Muscle Physiology- Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre.	2	1
6.2	Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O ₂ dept, Rigor mortis.	2	1
7.1	Endocrinology- Endocrine glands and their hormones, mode of action - Hypothalamus and Pituitary gland& Hormonal disorders.	2	3
7.2	Endocrine glands and their hormones, mode of action - Thyroid, Parathyroid, Thymus , Islets of Langerhands, Adrenal, Testis and ovary & Hormonal disorders.	3	3
8.1	IMMUNOLOGY- Introduction to immunology Types of immunity- innate immunity, acquired, passive and active immunity	2	4
8.2	Mechanism of innate immunity (eg. Barriers , phagocytosis , inflammation) Complement System, biological effects of complements.	2	4

9.1	Antigens and antibodies-Types of antigens, haptens, antigenic determinants.	2	4
9.2	Basic structure of immunoglobulins, Different classes of immunoglobulins and functions.	3	4
10.1	Antigen antibody reactions - Precipitation test & agglutination test	2	4
10.2	Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.	3	4
11.1	Immune response system Primary and secondary lymphoid organs,	1	5
11.2	Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells , Memory cells, MHC,	1	5
11.3	Antibody synthesis, Monoclonal antibodies, Hybridoma technology	1	5
11.4	Immune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS,	2	5
11.5	Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation.	2	5

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Study Material Series published by Zoological Society of Kerala.

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Course title	HUMAN PHYSIOLOGY AND IMMUNOLOGY-PRACTICALS
Course code	ZY3C03U(P)
Programme	BSc. ZOOLOGY
Semester	3
Course type	COMPLEMENTARY
Credits	1

CO No.	<i>Expected Course Outcomes</i> <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Develop skills in performing and interpreting various laboratory procedures to investigate blood parameters of diagnostic significance.	An	PSO - 9
2	Analyse the action of salivary amylase on starch.	An	PSO - 9
3	Acquaint with various diagnostic instruments used in physiology.	U	PSO - 9
4	Acquire skills in qualitative analysis of nutrients and obtaining results through observation of appropriate reactions and documentation.	An	PSO - 9
<p>*PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create</p>			

MODULE	COURSE DESCRIPTION	HOURS	CO.NO.
1	Clinical analysis of blood - Preparation of Human Blood smear & identification of leucocytes , Estimation of Haemoglobin, Identification of human blood groups, A, AB, B and O, Rh factor	20	1
2	Qualitative analysis of Reducing Sugar, Protein and Lipid	10	4
3	Action of Salivary amylase on Starch	4	2
4	Study of Instruments: Sphygmomanometer , Stethoscope	2	3

COURSE	DETAILS
CODE	ZY4B04U
TITLE	ANIMAL DIVERSITY – CHORDATA (T)
DEGREE/YEAR	B.SC ZOOLOGY, IV th SEMESTER
TYPE	CORE COURSE
CREDITS	54 HRS

CO No.	Expected Course outcomes: ANIMAL DIVERSITY – CHORDATA (T)	Cognitive level	PSO No.
1.	Understand the diversity, classification and phylogeny of Chordates.	U	PSO-1
2.	Outline and parse the adaptive features exhibited by the vertebrates.	An	PSO-1
3.	Compare the anatomy and physiological peculiarities of of Chordates through type study.	U	PSO-1
4.	Understand the economic importance and evolutionary significance of selected Chordate groups.	U	PSO-3
5.	Determine the classification category of a given chordate based on the external observable features.	Ap	PSO-7

*PSO-Program Specific Outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

MODU LE	COURSE DESCRIPTION	Hrs.	Co No.
MODULE I			
1.1	Introduction Phylum Chordata - General classification (Classification up to order – Sub phylum, Super class, Class, Subclass, Order)	1	1,2,5
1.2	Sub phylum : Urochordata Class I Larvacea Eg. Oikopleura Class II Ascidiacea Eg: Ascidia (Mention Retrogressive Metamorphosis) Class III Thaliacea Eg: Doliolum	3	1,2,5,4
1.3	Sub phylum: Cephalochordata Example - Amphioxus	2	1,2,5
MODULE II			
2.1	Sub phylum: Vertebrata	2	1,2,5

	Division 1 – Agnatha Class I Ostracodermi Eg: Cephalaspis <i>Class II Cyclostomata</i> Eg: <i>Petromyzon</i>		
2.2	Division 2 – Gnathostomata Super class Pisces Class: Chondrichthyes Sub class - Elasmobranchi Eg: Narcine Sub class Holocephali Eg: Chimaera	2	1,2,5
2.3	Class: Osteichthyes Sub class – Choanichthyes Order 1 Crossopterigii Eg: Latimeria Order 2 Dipnoi Eg: Lepidosiren Sub class: - Actinopterygii Super order 1. Chondrostei Eg: Acipencer Super order 2. Holostei Eg: Amia Super order 3. Teleostei Eg: Sardine	5	1,2,5
2.4	General topics <ol style="list-style-type: none"> 1. Accessory respiratory organs in fish. 2. Parental care in fishes. 3. Scales in fishes. 4. Migration in fishes 5. Common culture fishes of Kerala 6. Lung fishes 	3	1,2,5,4
MODULE III			
3.1	Super class: Tetrapoda Class Amphibia Type Frog Order I Anura Eg: Hyla Order II Urodela Eg: Amblystoma (Mention axolotl larva and neotony) Order III Apoda Eg: Ichthyophis.	10	1,2,3,4,5
3.2	Class Reptilia Sub class I: Anapsida Order Chelonia Eg: Chelone	4	1,2,5

	<p>Sub class II: Parapsida Eg: Ichthyosaurus</p> <p>Sub class III: Diapsid</p> <p>Order I Rhynchocephalia Eg: Sphenodon</p> <p>Order II Squamata Eg: Chamaleon</p> <p>Sub class IV: Synapsida Eg: Cynognathus</p> <p>General topic</p> <p>Identification of poisonous and non poisonous snakes</p>		
3.3	<p>Class Aves</p> <p>Sub class I: Archeornithes Eg: Archaeopteryx (Affinities)</p> <p>Sub class II: Neornithes</p> <p>Super order I: Palaeognathe Eg: Struthio</p> <p>Super order II: Neognathe Eg; Brahminy kite</p> <p>General topics</p> <ol style="list-style-type: none"> 1. Migrations in birds 2. Flight adaptations in birds 	4	1,2,5,4
MODULE IV			
4.1	<p>Class Mammalia</p> <p>Type: Rabbit</p> <p>Sub class I: Prototheria Eg: Echidna</p> <p>Sub class II: Metatheria Eg: Macropus</p> <p>Sub class III: Eutheria</p> <p>Order 1. Insectivora Eg: Talpa</p> <p>Order 2 Dermoptera Eg: Galeopithecus</p> <p>Order 3. Chiroptera Eg: Pteropus</p> <p>Order 4. Primates Eg: Loris</p> <p>Order 5 Carnivora Eg: Panthera</p> <p>Order 6 Edentata Eg: Armadillo</p> <p>Order 7 Pholibota Eg: Manis</p> <p>Order 8 Proboscidea Eg: Elephas</p> <p>Order 9 Hydracoidea Eg: Procavia</p> <p>Order 10 Sirenia Eg: Dugong</p>	16	1,2,3,5

	Order 11 Perissodactyla	Eg: Zebra		
	Order 12 Artiodactyla	Eg: Cameleus		
	Order 13 Lagomorpha	Eg: Oryctolagus		
	Order 14 Rodentia	Eg: Porcupine		
	Order 15 Tubulidentata	Eg: Orycteropus		
	Order 16 Cetacea	Eg: Delphinus		
4.2	General topics 1. Dentition in Mammals 2. Aquatic Mammals		2	1,2,5

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COURSE	DETAILS
TITLE	ANIMAL DIVERSITY – CHORDATA (P)
DEGREE/YEAR	B.SC ZOOLOGY, IV th SEMESTER
TYPE	CORE COURSE
CREDITS	36 HRS

CO No.	Expected Course outcomes: ANIMAL DIVERSITY – CHORDATA (P)	Cognitive level	PSO No.
1.	Understand and classify the local chordate diversity.	U	1,6
2.	Examine the morphology, anatomy and osteology of chordates.	An	6
3.	Carry out identification of vertebrates using taxonomic keys.	Ap	6
4.	Use scientific drawing technique	Ap	6

*PSO-Program Specific Outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

MODULE	COURSE DESCRIPTION	Hrs.	Co No.
1.0	Scientific Drawing	5	4
1.1	Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes	3	4
2.0	Dissections	6	2
2.1	Frog: Photographs/diagrams/one dissected & preserved specimen each/models may be used for study. 1. Frog Viscera 2. Frog Digestive System 3. Frog Arterial System 4. Frog 9th& 1st Spinal nerve 5. Frog Sciatic Plexus 6. Frog Brain	5	2
3.0	Mounting of placoid scales; study of cycloid and ctenoid scales	5	2
4.0	Osteology	5	2
4.1	Frog vertebrae Pectoral and pelvic girdles of Frog and Rabbit Skull of Rabbit (Diastema -dentition Turtle – plastron and carapace	5	2
5.0	Study of sections.	5	2
5.1	Amphioxus T. S. through pharynx/T.S. through intestine	5	2
6.0	Identification:	10	3

6.1	Identify all the animals by their generic names and 25 % of them by their specific names. Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1, Mammalia-2.	5	3
6.2	Taxonomic identification with key:- i) Identification of fishes up to the level of order. ii) Identification of snakes up to family.	5	3

COURSE	DETAILS
CODE	ZY4C04U
TITLE	APPLIED ZOOLOGY (T)
DEGREE/YEAR	B.SC ZOOLOGY, IV th SEMESTER
TYPE	COMPLEMENTARY COURSE
CREDITS	54 HRS

CO No.	Expected Course outcomes: APPLIED ZOOLOGY (T)	Cognitive level	PSO No.
1.	Understand the common cultivable fishes, types of aquaculture, its management and fish processing and preservation.	U	PSO-6
2.	Construct aquaculture units for self employment	C	PSO-7
3.	Design and management of aquariums.	C	PSO-7
4.	Understand the various silkworm rearing techniques and mounting of silkworm.	U	PSO-6
5.	Use vermicomposting technique for better waste management.	Ap	PSO-7
6.	Carry out apiculture for self employment or as a hobby.	Ap	PSO-7
7.	Understand the various species of earthworms, silk worms, honey bees and be products.	U	PSO-6, PSO-8
8.	Identify diseases of fishes, earthworms, silkworms and honeybees.	U	PSO-6
*PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create			

MODULE	COURSE DESCRIPTION	Hrs.	Co No.
1.0	Aquaculture: Advantages and salient features of aquaculture, Traditional methods of aquaculture, Biotic and abiotic factors in water, Pond culture – construction and maintenance.	5	1
1.1	Types of aquaculture, composite fish culture, integrated fish culture, induced breeding of fishes. Importance of algae in aquaculture.	6	1,2
1.2	Aquarium management - Setting up of an aquarium, biological filter and aeration. Common species of Aquarium fishes. Common cultivable fishes of Kerala. Economic importance and morphology of	7	1,3

	culturable species <i>Catla</i> , <i>Rohu</i> , <i>Mrigal</i> , <i>Cyprinus carpio</i> , <i>Etropolis</i> , & <i>Tilapia</i> . <i>Penaeus indicus</i> , <i>P.monodon</i> , <i>Perna viridis</i> / <i>Perna indicus</i> , <i>Pinctada fucata</i> .		
1.3	Pond culture (Construction and maintenance) Brief Description of Carp culture. Fish diseases, Prawn culture, mussel culture, pearl culture, Fish processing and preservation.	6	1,8
2.0	Sericulture: Four species of silkworms, life history of silkworm, silk worm rearing techniques	4	4,7
2.1	Mounting of silkworm. Harvesting and stifling of cocoons.	4	4
2.2	Silkworm diseases and pest, preventive and control measures	4	8
3.0	Vermiculture: Species of earthworms suitable for vermiculture, life cycle and reproduction of earthworm. Physical & chemical effects of vermiculture.	3	7
3.1	Vermicomposting – site selection, cement pit, soil pit, preparation of pit, maintenance, monitoring.	3	5
4.0	Apiculture: Species of honey bees, organization of honey bee colony. Bee keeping methods and equipments.	5	7
4.1	Apiary management and maintenance. Bee pasturage, byproducts of honey bees and their uses.	4	6
4.2	Diseases, pests of honey bees and control measures.	3	8

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COURSE	DETAILS
CODE	ZY4C04U
TITLE	APPLIED ZOOLOGY (P)
DEGREE/YEAR	B.SC ZOOLOGY, IV th SEMESTER
TYPE	COMPLEMENTARY COURSE
CREDITS	36 HRS

CO No.	Expected Course outcomes: APPLIED ZOOLOGY (P)	Cognitive level	PSO No.
1	Identify the types of culturable fishes, earthworms, silk worms and honey bees.	U	PSO-9
2	Determine the castes of honey bees.	Ap	PSO-9
3	Determine various bee keeping equipments	Ap	PSO-9
4	Identify bee products, silk, chandrika, natrika and vermicompost	U	PSO-9
5	Identify various fish diseases and fish parasites	U	PSO-9

*PSO-Program Specific Outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

MODULE	COURSE DESCRIPTION	Hrs.	Co No.
1.0	General identification, economic importance, morphology, scientific names and common names of the following a. Economic importance and morphology of culturable fishes (Catla, Rohu, Mrigal, Grass carp, Common carp, Etroplus, Tilapia) <i>Penaeus indicus</i> , <i>P.monodon</i> , <i>Perna viridis</i> / <i>P.indicus</i> <i>Pinctada fucata</i> b. Two species of earthworms used in Vermiculture c. Two species of honey bees d. Silkworm. Cocoon/Adult	15	1
2.0	Castes of honey bees	4	2

3.0	Bee keeping equipments - Bee hive, Smoker, honey extractor	5	3
4.0	Identification and uses - Bees wax, Honey, Silk, Vermicompost	4	4
5.0	Chandrika / Natrika used in sericulture	4	4
6.0	Fish diseases (any 2diagrams/specimens)	2	5
7.0	Fish Parasite (any one)	2	5

Course	Details				
Code	ZY5B05U				
Title	Cell Biology and Molecular Biology				
Degree	B.Sc				
Branch(s)	ZOOLOGY				
Year/Semester	III/V				
Type	Core course				
Credits	3	Hrs/Week	3	Total hours	54

CO No.	Expected Course outcomes	Cognitive level	PSO No.
1.	Understand the basics of cell theory, structure and function of cell, different cell organelles and division of cells.	U	2
2.	Understand the concepts of molecular biology.	U	6
3.	Explain the genetic concept and nature of genetic material.	U	4
4.	Interpret gene expression and gene regulation	U	4
	PSO-Program Specific Outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create		

Module	Course Description	Hours	CO No.
	PART I - CELL BIOLOGY	26	
1	History of cell and molecular biology	2	
1.1	Cell theory, Prokaryotes, Eukaryotes	1	1
1.2	Actinomycetes, Mycoplasmas, Virus, Virion and Viroids, Prions	1	1
2	Cell membrane & Permeability	6	
2.1	Molecular models of cell membrane (Sandwich model, Unit membrane model, Fluid mosaic model)	2	1
2.2	Modifications of plasma membrane (Microvilli, tight junction, gap junction, desmosomes)	2	1
2.3	Cell permeability - Diffusion, Osmosis, Passive transport, Active transport, Cell coat and Cell recognition	2	1
3	Ultrastructure of Cytoplasm	7	
3.1	Cytoskeleton - Microtubules, microfilaments, intermediate filaments	1	1
3.2	Endoplasmic reticulum - Structure and functions, Ribosomes (Prokaryotic and Eukaryotic), Golgi complex - Structure and functions. Lysosomes - Polymorphism - GERL concept, functions.	4	1
3.3	Mitochondria - Structure and functions, Symbiont hypothesis.	2	1
4	Nucleus	6	
4.1	Structure and functions of interphase nucleus, Nuclear	3	1

	membrane, pore complex, structure and functions of nucleolus.		
4.2	Chromosomes – Structure; Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.	3	1
5	Cell Division	3	
5.1	Cell cycle - G ₁ , S, G ₂ and M phases	1	1
5.2	Mitosis and Meiosis	2	1
6	Cell Communication	3	
6.1	Cell signalling - Signalling molecules (neuro- transmitters, hormones, growth factors, cytokines, vitamin A and D derivatives)	2	1
6.2	Role of cyclic AMP	1	1
	PART II MOLECULAR BIOLOGY	27	
7	Nature of Genetic Material	7	
7.1	Discovery of DNA as genetic material – Griffith's transformation experiments. Hershey Chase Experiment of Bacteriophage infection	2	2,3
7.2	Structure and types of DNA & RNA DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes).	3	2,3
7.3	Prokaryotic genome, Eukaryotic genome, Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons	2	2,3
8	Gene Expressions	12	
8.1	Central Dogma of molecular biology, One gene-one enzyme hypothesis, One gene-one polypeptide hypothesis.	2	4
8.2	Characteristics of genetic code, Contributions of Hargobind Khorana.	2	4
8.3	Protein synthesis-Transcription (Prokaryotic and eukaryotic), Reverse transcription, post transcriptional modifications.	4	4
8.4	Translation, Post translational modifications.	4	4
9	Gene Regulations	8	
9.1	Prokaryotic (inducible, repressible systems), Operon concept -Lac operon and Tryptophan operon.	4	4
9.2	Brief account of Eukaryotic gene regulation, Definitions- Global control – Stimulon and modulon, Catabolite repression (Glucose effect).	4	4

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Course	Details
Code	ZY5B05U [P]
Title	Practical- Cell Biology & Molecular Biology
Degree	B.Sc.
Branch	Zoology
Year/Semester	III/V
Type	Core Practical
Credits	1

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1.	Identification of mitotic stages, meiotic stages, polytene chromosomes, epithelial tissue, striated muscles, smooth muscle, cartilage, bone, cell organelles, human blood cells and barr body.	R, An	6
2.	Squash preparation of onion root tip.	Ap	6
3.	Preparation of temporary whole mount and human blood smear.	Ap	6
4.	Identify DNA and RNA structure.	Ap	6

Module	Course Description	Hrs	CO. No.
1	CELL BIOLOGY	36	
1.1	Squash preparation of onion root tip for mitotic stages.	6	1,2
1.2	Mounting of polytene chromosome (Drosophila/Chironomous.) Demonstration	2	1
1.3	Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)	2	1
1.4	Identification of cell organelles	4	1
1.5	Identification of meiotic stages (slide/figure)	4	1
1.6	Preparation of temporary whole mount.	4	2
1.7	Preparation of permanent whole mount (demonstration)	4	1
1.8	Preparation of human blood smear and identification of Leucocytes	6	3
1.9	Models (DNA, DNA replication, RNA – Different types.)	4	4

Course		Details			
Code		ZY5B06U			
Title		ENVIRONMENTAL BIOLOGY, TOXICOLOGY AND DISASTER MANAGEMENT			
Degree		B.Sc			
Branch(s)		ZOOLOGY			
Year/Semester		III/V			
Type		Core course			
Credits	3	Hrs/Week	3	Total hours	54

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Develop knowledge on types of ecosystems, types of natural resources and interactions between nature and humans.	R	3
2	Develop skills to utilize environment sustainably and to enrich it.	C	3
3	Understand important theories and concepts of environmental sciences and Toxicology.	U	3
4	Explicate environmental hazards, their risk and the socio – economical ramifications.	E	3
5	Understand different changes occurring in environment	U	3
6	To determine the causes and potential solutions of major environmental problems.	U	3
7	Waste Management	Ap	3
8	To gain knowledge on environmental disasters and its mitigation measures	An	3

- PSO- Program Specific Outcome; CO- Course Outcome;
- Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate;
C- Create.

Module Description	Course	Hrs	CO.No
1.0	Module I : Environmental Biology	2	1
1.1	History, Development, Scope and Branches.	2	1
2.0	Module II: Ecosystems	20	1,2
2.1	Concept, Abiotic and biotic components, Interactions.	2	1
2.2	Classification		
2.2.1	Terrestrial ecosystem and types	2	1
2.2.1.1	Causes of land degradation with special reference to Kerala.	2	1
2.2.2	Freshwater Ecosystem, Types, Physico-chemical nature	2	1
2.2.2.1	Groundwater	1	1
2.2.2.2	Threats to freshwater resources of Kerala	2	1
2.2.2.3	Watershed management	2	1,2
2.2.3	Marine ecosystem, Physico chemical nature	2	1
2.2.3.1	Zonation in marine ecosystem, Coral reefs	2	1
2.2.4	Wetlands and Mangroves, Estuaries	2	1
2.2.4.1	Convention on wetlands, Ramsar sites in Kerala	1	1
3.0	Module III: Man and Environment	8	1
3.1	Natural resources: Energy resources	4	1
3.1.1	Energy conservation measures	4	1
4.0	Module IV: Global environmental changes	9	3,4,5
4.1	Global warming, Green house effect, Ozone depletion	3	4,5
4.1.1	Climate change	2	5
4.1.2	Kyoto protocol, IPCC/UNFCCC	2	3,5
4.1.3	Carbon credit, Carbon sequestration, Carbon trading	2	5
5.0	Module V – Municipal Solid Waste and Local Environmental issues	5	7,8
5.1	Waste management	1	7
5.1.1	Plastics: Types of plastics, pollution, Problems of plastics and its management strategies	1	7
5.1.2	Biowastes and e-waste.	1	7
5.1.3	Major types and sources, Toxic ingredients, Effects on environment and human health and its management.	1	7
5.2	Impact of tourism on ecology, Landscape changes	2	
	PART II. DISASTER MANAGEMENT AND TOXICOLOGY	10	3,6,8
6.0	Module VI – Disaster Management	5	8
6.1	Definition, Classification	1	8
6.2	Environmental Disasters	1	8
6.2.1	Earthquake, Landslide, Flood, Drought, Cyclone, Tsunami	2	8
6.2.2	Mitigation Measures	1	6,8
7.0	Module VII: Toxicology	5	3
7.1	Definition, History of toxicology, Classification	1	3
7.1.1	Role of toxicology	1	3
7.1.2	Toxicants of biological origin	1	3
7.1.3	Heavy metal toxicants	1	3
7.1.4	Food additives	1	3

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- Pandey Kamleshwar , J.P.Shukla and S.P.Trivedi.2005. *Fundamentals of Toxicology*. New Central Book Agency (P) Ltd. Kolkata, India
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Stiling Peter, 2002. *Ecology: Theories and applications*. Prentice Hall of India pvt. Ltd. New Delhi

Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology* Published by Zoological Society of Kerala.

Course		Details			
Code	ZY5B06U(P)				
Title	ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS (P)				
Degree	B.Sc				
Branch(s)	ZOOLOGY				
Year/Semester	III/V				
Type	Core practical				
Credits	1	Hrs/Week	2	Total hours	36

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Analyse the different soil and water quality parameters	An	6
2	Identify and count planktons	U	6
3	To gain knowledge on extraction of soil organism		
4	To identify minerals and rocks	Ap	6
5	To handle equipments used in ecology	R	6
6	Create love towards nature	C	6
PSO- Program Specific Outcome; CO- Course Outcome; Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.			

Module	Course Description	Hrs	CO
1	Estimation of dissolved Oxygen	4	1
2	Estimation of carbon dioxide	4	1
3	Estimation of soil organic carbon (Demonstration)	2	1
4	Counting of plankton using plankton counting chamber	4	2
5	Identification of marine/ fresh water planktons	4	2
6	Extraction of soil organisms	2	3
7	Identification of minerals and rocks	2	4
8	Study of equipments - Sechi disc, Plankton net	4	5
9	Field study and report of any one Terrestrial/ Marine/ Fresh water ecosystem.	10	1,5

COURSE	DETAILS
CODE	ZY5B 07U
TITLE	EVOLUTION,ZOOGEOGRAPHYÐOLOGY
DEGREE/YEAR	B.SC ZOOLOGY, V TH SEMESTER
TYPE	CORE COURSE
CREDITS	54 HRS
NAME OF THE TEACHER	DR.ELEZABETH BASIL

CO NO.	EXPECTED COURSE OUTCOME- Upon completion of this course the students will be able to ;	COGNITIVE LEVEL	PSO NO.
1	Understand the concept of unity of life,theories on the origin of organic evolution and its evidences.	U	PSO1
2.	Acquire basic skills in the observation and study of nature, rich diversity of organisms and their ecological and evolutionary significance and scientific investigation on biological origin of life from simple to more complex forms.	Ap	PSO3
3.	Describe the causes of diversification of life,concept of speciation its types and the current status of different species.	U	PSO3
4.	Understand the different tecniques used for fossil study with reference to geological time scale.	U	PSO2
5.	Compare animals with reference to their distribution on earth, geological parametes affecting distribution and different biogeographical realms.	U	PSO2
6.	Understands and develops skills to analyse the different behavioral patterns of animals,leaning and their sociobiology.	A	PSO7
7.	Plan and design the application of population genetics in modern	Ap	PSO7

	evolutionary biology and in phylogeny studies.		
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MODUL E	COURSE DESCRIPTION	Hrs.	CO.No.
PART I – EVOLUTION		(30 Hrs.)	
1.0	Module I - Origin of life	5	1
1.1	Module I – Origin of life	5	1
1.2	Introduction, Origin of universe ,		
1.3	Chemical evolution,Miller-Urey experiment, Haldane and Oparin theory		
2.0	Module II – Theories of organic evolution	7	1
2.1			
2.2	Lamarckism, Critical analysis of Lamarck’s		
2.3	propositions		
2.4	Weisman’s germplasm theory		
2.5	Mutation theory.		
2.6	Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;		
2.7	Darwinism,Critical analysis of Darwinism Modern Synthetic theory(Neo Darwinism) Neutral theory of molecular evolution .		
3.0	Module III – Population genetics and evolution	6	1, 4
3.1			
3.2	Genetic basis of variation. Hardy Weinberg equilibrium.		
3.3	Change in gene frequencies		
3.4			
3.5	Factors affecting gene frequencies (brief account only)irect evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.		
4.0	Module IV – Evolution above species level	8	1
4.1	Adaptive radiation	4	
4.2	Microevolution, Macroevolution		

4.3	Evolution of horse		
4.4	Mega evolution		
4.5	Punctuated equilibrium		
4.6	Speciation		
5.0	Module V –Geological time scale		13
5.1	Geological dating with radioactive elements	4	2,3
5.2	Mass extinction		
PART II – ZOOGEOGRAPHY&ETHOLOGY			24Hrs
6.0	Module VI – Zoogeography: Introduction	5	6
6.1	Origin of oceans and continents		
6.2	Platetectonics – continental drift		
6.3	Zoogeographical realms		
6.4	Insular fauna-Continental Islands eg Medagascar		
6.5	Oceanic Islands eg Galapagoes.		
6.6	Biogeography of India – with special reference to Western Ghats		
7.0	Module V II– Animal distribution	9	6
7.1	Types and means of animal distribution	5	6
7.2	Barriers in animal distribution.		
Module VIII– ETHOLOGY			(10 Hrs.)
8.0	Definition, History and scope of ethology	1	5
9.0	Module XI - Learning and imprinting	8	5
9.1	Types of learning with examples		
9.2	Experiments by K. Lorenz		
10.0	Module X- Ethology of man	4	1
10.1	Sociobiology and evolution of human behaviour		
10.2	Primates and human socio groups		
10.3	Human pheromones		
11.0	Module XI Ecology of behaviour	2	1
11.1	Natural selection and behaviour.		
11.2	Ecology of relationship,dominance,compettion		

REFERENCES :EVOLUTION

Core Readings (Modules 1-5)

- Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley & Sons, New York (Module 2 & 3)
- Bendall, D. S. (ed.) 1983. *Evolution from Molecules to Man*. Cambridge University Press, U.K. (Module 2, 3 and 5)
- Bull J.J and H.A. Wichman. 2001. Applied Evolution. *Annu. Rev. Ecol. Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnulReviews.org.)
- Chattopadhyay Sajib. 2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd. Kolkata, India.
- Goodwin, B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon & Schuster, NY, USA. (Module 4 & 5)
- Jerry A. Coyne and H. Allen Orr. 2004. *Speciation*. Sinauer Associates (Module 4)
- Rob Desalle and Ian Tattersall 2008. *Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA. (Module 3 & 4)
- Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution. (Module 3 & 4)
- Strickberger, M.W. 2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)
- Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evaluation and Ecology*, S. Chand & Company New Delhi (Module 1-5)

Core Readings

Zoogeography

- Andrews. M.I and Joy, K.P. 2003. *Environmental biology, evolution, ethology and Zoogeography*. St. Mary's press and book dept. (Module VI, VII, VIII and IX)
- Briggs, J.C. 1996. *Global Biogeography*. Elsevier Publishers. (Module VI and VII).
- Chandran, Subash M .D. 1997. On the ecological history of the Western Ghats. *Current Science*, Vol.73, No.2.146-155.
- Chundamannil, Mammen. 1993. *History of Forest management in Kerala*. Report number 89. Kerala Forest Research Institute, Peechi, India.
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Nair, C.S.1991. *The Southern Western Ghats : A Biodiversity Conservation Plan*. INTACH, New Delhi.

Ramesh,B.R and Rajan Gurukkal., 2007.*Forest Landscapes of the Southern Western Ghats, India Biodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India.

Tiwari, S. 1985. *Readings in Indian Zoogeography*, (Module VI)

Core Readings

Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press..NJ,USA. (Module 10)

David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd . Essex, England. (Module 8 and 9)

Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow:Longman. (Module 8, 9 and 10)

Dunbar,R. 1988. *Primate Social Systems*.Croom Helm,London. (Module 10 & 11)

Manning Aubrey and Marian Stamp Dawkins 1998. *An Introduction to Animal Behaviour*.Cambridge University Press,UK. (Module 8, 9 & 10)

Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA. (Module 10 & 11)

Wilson, E.O. 1975. *Sociobiology*. Harvard University Press, Cambridge, Mass. USA. (Module 9)

Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology* Published by Zoological Society of Kerala (Module 6, 7, 8 & 9)

Selected Further Readings

Evolution

Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley & Sons, New York

Bendall , D. S. (ed.)1983.*Evolution from Molecules to Man*. Cambridge University Press,U.K.

Bull J.J and H.A.Wichman.2001.Applied Evolution. *Annu.Rev.Ecol.Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnulReviews.org.)

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Jerry A. Coyne and H. Allen Orr. 2004. *Speciation*. Sinauer Associates

Rob Desalle and Ian Tattersall 2008. *Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA.

Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution.

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Ethology

Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press, NJ, USA.

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Dawkins, M.S. 1995. *Unravelling Animal Behaviour*. Harlow: Longman.

Dunbar, R. 1988. *Primate Social Systems*. Croom Helm, London.

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Paul W. Sherman and John Alcock., 2001 *Exploring Animal Behaviour- Readings from American Scientist* 3rd Edn. Sinauer Associates Inc. MA, USA.

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Wilson, E.O. 1975. *Sociobiology*. Harvard University Press, Cambridge, Mass. USA.

COURSE	DETAILS
CODE	ZY5B07U
TITLE	EVOLUTION,ETHOLOGY &ZOOGEOGRAPHY (P)
DEGREE/YEAR	B.SC ZOOLOGY, V TH SEMESTER
TYPE	COURSE COURSE
CREDITS	36 HRS,CREDIT 1
NAME OF THE TEACHER	DR.ELEZABETH BASIL

CO NO.	EXPECTED COURSE OUTCOME- Upon completion of this course the students will be able to ;	COGNITIVE LEVEL	PSO NO.
1	Identify various zoogeographical realms, endemic species and distribution of animals.	U	1
2	Understand the concept of homology, analogy and adaptive radiation.	U	3
3	Understand the route of HMS Beagle	U	1
4	Examine connecting links	An	1,3
5	Identify various stages of horse evolution	U	3
6	Identify various behavioural patterns and the use of pheromones.	U	3

MODULE	COURSE DESCRIPTION	Hrs.	CO.No
1.0	Identification of Zoogeographical realms using map	4	1
2.0	Study on endemic species of each realm.	5	1
3.0	Contributions of scientists (showing photos)	4	1
4.0	Identification of different stages of horse evolution	3	3
5.0	Identification of skull and facial features in human evolution	2	1
6.0	Study on Homology and Analogy	3	1
7.0	Study of connecting links	3	5
8.0	Pheromone traps	2	2
9.0	Skinner box	2	4
10.0	Tmaze	2	6
11.0	Identification of behaviour showing pictures	2	6
12.0	Experiment to demonstrate phototaxis and chemotaxis using Drosophila/House fly	2	6

COURSE	DETAILS
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CODE	ZY5B08U
TITLE	BIOCHEMISTRY, PHYSIOLOGY, AND ENDOCRINOLOGY
DEGREE/YEAR	B.SC ZOOLOGY, IV th SEMESTER
TYPE	Core
CREDITS	3

No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Understand and discuss the structure, functions and regulation of major physiological systems including the digestive, respiratory, circulatory, muscular, excretory and nervous systems with special reference to humans.	U	PSO – 2
2	Outline and distinguish clinical manifestations of physiological disorders and medical tools and techniques used in diagnosis and treatment and discuss current events in health-related fields, to contribute to the critical societal goal of a scientifically literate citizenry.	U	PSO – 2
3	Explain the concept of the internal environment and its regulations by homeostatic mechanisms.	U	PSO – 2
4	Understand and discuss the basic principles of biochemistry of different kinds of nutrients like carbohydrates, proteins, lipids and vitamins, their structure, function and metabolism.	U	PSO – 2
5	Define and describe Enzymes and analyse enzyme-related terms: enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes and Michaelis–Menten enzyme kinetics.	U	PSO – 2
6	Discuss endocrine physiology including hormones, functions and disorders of hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans and adrenal gland.	U	PSO - 2
7	Understand and analyse classification of hormones, mechanism of hormone action and its regulation to maintain internal homeostasis.	An	PSO - 2
*PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create			

MODULE	COURSE DESCRIPTION	HOURS	CO.NO
1.1	Carbohydrates, protein and lipids – structure of basic compounds, classifications with examples and its biological importance.	4	4

2.1	Carbohydrate metabolism- Glycolysis, glycogenolysis, gluconeogenesis, glycolysis –citric acid cycle, ATP synthesis, Hexose, monophosphate shunt	3	4
2.2	Lipid metabolism- Biosynthesis and oxidation of fatty acids- Beta oxidation, Physiologically important compounds synthesized from cholesterol.	3	4
2.3	Protein metabolism- Deamination, transamination, transmethylation, decarboxylation, ornithine cycle.	3	4
3.1	ENZYMES Chemical nature of enzymes, mechanism of enzyme action, factors influencing enzyme action (temperature, pH, enzyme concentration, substrate concentration), enzyme activation, enzyme inhibition, allosteric enzyme, isoenzymes, co-enzyme.	4	5
4.1	Nutrients, classification, RDA, Balanced diet. Antioxidants and functions, Mineral metabolism, Role of Ca, Fe, Na, K, and P. Role of vitamins	3	1,4
4.2	Food adulteration, Defects of modern food habits (importance of fibers in food), weight control, nutrition during pregnancy, breast feeding, anorexia, acidity and ulcers, flatulence, fasting and its significance, malfunctions of gastro intestinal tract.	2	1,2
5.1	RESPIRATION Gas transport, Factors affecting transport of respiratory gases through blood, oxy-hemoglobin curve, Bohr effect,	2	1

	reverse Bohr effect, Haldane effect.		
5.2	neural (voluntary and automatic) and chemical control (mention the role of carotid and aortic bodies) of respiration.	1	1
5.3	Smoking and its physiological effects, carbon monoxide poisoning, oxygen toxicity, nitrogen narcosis, dysbarism, oxygen therapy, artificial respiration, respiratory disorders –hypoxia, hypocapnia, hypercapnia, asphyxia.	2	2
6.1	CIRCULATION Cerebral circulation, blood brain barrier and cerebrospinal fluid, Hemodynamic principles, formation and fate of blood cells, Blood composition.	2	1
6.2	blood clotting mechanism – intrinsic and extrinsic pathways, clotting factors, anticoagulants, blood transfusion (safety and security problems), mention haemostasis, haemolysis, jaundice, thrombosis, ESR.	2	1,2
7.1	EXCRETION Urea cycle (in detail), renal handling of individual substances eg. glucose, sodium, urea, water, factors affecting GFR.	2	1
7.2	concept of plasma clearance, acid base balance and homeostasis.	1	3
7.3	kidney disorders – acute renal failure, chronic renal failure- glomerular nephritis, pyelonephritis, nephrotic syndrome and kidney stones.	1	2
8.1	MUSCLE PHYSIOLOGY Ultra structure of striated muscle. Mechanism of muscle contraction. Biochemistry of muscle contraction, isotonic and isometric contraction.	3	1
9.1	NEUROPHYSIOLOGY Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin.	2	1
9.2	General principles of hormone action, Concept of	1	3

	hormone receptors, hormonal control of homeostasis.		
10	SPORTS PHYSIOLOGY Muscular, Respiratory and cardiovascular changes during exercise, dope test, drug abuse.	2	1
11.1	Hormones as messengers, classification and types of hormones.	2	7
11.2	General principles of hormone action, Concept of hormone receptors, hormonal control of homeostasis.	3	7
12.1	Secretion, Regulation, Functions and Disorders of hormones of Hypothalamus, Hypophysis and Pineal gland.	6	6
12.2	Secretion, Regulation, Functions and Disorders of hormones of Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta, Gastro intestinal hormones.		6

References

1. Best and Taylor: Physiological basis of Medical practice
2. Chakrabarti, Ghosh &: Human Physiology, the New Book Stall Schana.
3. Chatterjee C.C.: Human Physiology, Vol I & II Medical Allied Agency
4. Eckert & Randall: Animal Physiology, Mechanism and Adaptations , CBS publishers, New Delhi.
5. Ganong W F: Review of Medical Physiology, Mc Graw Hill, New Delhi.
6. Guyton: Text Book of Medical Physiology, Saunders
7. Joshi: Nutrition and Dietetics, Tata Mc. Graw Hill
8. Knut Schmidt Nilesen 2007 Animal Physiology – Adaptation and environment. Cambridge University press 5 th ed.
9. Mackenna & Callander: Illustrated Physiology, Churchill Livingstone
10. Powar Human Physiology
11. Prosser & Brown: Comparative Animal Physiology
12. Sarada Subramanyam & K. Madhavankutty : Textbook of human physiology, S. Chand & Co Ltd, New Delhi.

Endocrinology

13. Barrington, E.J.W. General and Comparative Endocrinology, Oxford, Clarendon Press.
14. Bentley, P.J. Comparative Vertebrate Endocrinology, Cambridge University Press.
15. David O. Norris Vertebrate Endocrinology 3th Edition,
16. Gorbman, A *et. al.* Comparative endocrinology, John Wiley & Sons.
17. Hadley, M.E. 2000. Endocrinology, 5th ed. Prentice Hall, Upper Saddle River, NJ.
- Martin, C.R. Endocrine Physiology, Oxford University Press
18. Norris, D.O. 1997. Vertebrate Endocrinology, 3rd ed. Academic Press, Sand Diego, CA.
19. Williams, R.H. Textbook of Endocrinology, W.B. Saunders

Biochemistry

20. Ackerman E, Biophysical Science, Prentice Hall Inc.
21. Awapara J, Introduction to Biological chemistry, Prentice-Hall of India
22. Cohn E E and Stumpf P K, outlines of Biochemistry, Wiley Eastern
23. Foster, R.L. Nature of Enzymology
24. Garrett and Grisham. Biochemistry.
25. Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill
26. Lehninger, Biochemistry, Kalyani Publications
27. Lodish *et. al.* Molecular Cell Biology
28. Rangnatha Rao K, Text Book of Biochemistry, Prentice-Hall of India
29. Roy K N, A Text Book of Biophysics, New Central Book Agency
30. Stryer, Biochemistry, W.H Freeman and Co., Newyork
31. Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons

Course title	BIOCHEMISTRY, HUMAN PHYSIOLOGY, AND ENDOCRINOLOGY - PRACTICALS
Course code	ZY5B08U [P]
Programme	BSc. ZOOLOGY
Semester	5
Course type	CORE
Credits	1

CO No.	<i>Expected Course Outcome</i> <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Develop skills in performing and interpreting various laboratory procedures to investigate blood parameters of diagnostic significance.	An	PSO 5
2	Identify the instruments used in Physiological analysis.	An	PSO 5
3	Acquire skills in qualitative analysis of nutrients and obtaining results through observation of appropriate reactions and documentation.	An	PSO 5
4	Distinguish between human hormonal disorders	An	PSO 5
5	Visualise the endocrine glands in brain of cockroach.	An	PSO 5

*PSO-Program Specific outcome; CO-Course Outcome;

Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

MODULE	COURSE DESCRIPTION	HOURS	CO.NO.
1	HUMAN PHYSIOLOGY Clinical analysis of blood – Total RBC count, Total WBC count, Estimation of haemoglobin content of blood, Estimation of micro haematocrit, Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.	16	1
2	Study of instruments: Kymograph, Sphygmomanometer and Stethoscope, Measurement of blood pressure using sphygmomanometer	2	2
3	BIOCHEMISTRY Qualitative analysis of protein, glucose, starch and lipids.	10	3
4	ENDOCRINOLOGY Study of Corpora cardiaca & Corpora allata	4	5
5	Study of human hormonal disorders	4	4

COURSE	DETAILS
CODE	ZY5D02U
TITLE	HUMAN GENETICS, NUTRITION, COMMUNITY HEALTH AND SANITATION
DEGREE/YEAR	B.SC ZOOLOGY, V TH SEMESTER
TYPE	OPEN COURSE
CREDITS	72 HRS

CO NO.	EXPECTED COURSE OUTCOME- Upon completion of this course the students will be able to ;	COGNITIVE LEVEL	PSO NO.
1	Understand the role of physical activity and balanced diet in maintaining health.	U	PSO-10
2	Use Body Mass Index to determine the current state of health.	Ap	PSO-10
3	Understand the importance of yoga and meditation in daily life.	U	PSO-10
4	Describe public health, diseases and its prevention.	U	PSO-10
5	Use safety measures in daily life to promote health and well-being	Ap	PSO-10
6	Understand the concept of human genetics, mutations, blood grouping, DNA fingerprinting and human infertility.	U	PSO-10

MODULE	COURSE DESCRIPTION	Hrs.	CO.No.
PART I HUMAN GENETICS		18 Hrs.	
1.0	Human normal chromosome complement.	2	6
1.1	Genetic disorders in man. Chromosomal anomalies. Eg. Down Syndrome and Cri du chat syndrome. Sex chromosomal anomalies – Syndromes- Klinefelters Syndrome and Turners Syndrome.	3	6
1.2	Single gene mutation disorders- Eg. Sickle Cell anaemia. Polygenic – Cleft lip and palate. Sex linked inheritance – Haemophilia and Colour blindness.	2	6
1.3	Pre – natal Diagnosis (Amniocentesis, and Chorionic Villus Sampling) Ultra sound scanning and Fetoscopy Genetic	2	6

	Counselling. Eugenics and Euthenics.		
2.0	Human blood groups and their inheritance pattern.	2	6
2.1	Rh factor Blood transfusion – Universal Donor, Universal recipient – Importance of Blood donation.	2	6
2.2	DNA finger printing and applications – Probing for criminals – Method to resolve paternity and maternity disputes.	3	6
2.3	Causes of human infertility – a brief account. Human genome project – a brief account.	2	6
PART – II NUTRITION AND COMMUNITY HEALTH		18 Hrs.	
3.0	Definition and Meaning of Health	1	1
3.1	Dimensions and Determination of Health Physical Activity and Health benefits	1	1
3.2	Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular	2	1
3.3	Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications	1	1
4.0	Nutrition and Health	1	1
4.1	Concept of Food and Nutrition, Balanced diet	1	1
4.2	Vitamins, Malnutrition, Deficiency Disease	1	1
4.3	Determining Caloric intake and expenditure	1	1
4.4	Obesity, causes and preventing measures – Role of Diet and Exercise, BMI	1	1,2
5.0	Safety Education and Health Promotion	1	5
5.1	Principles of Accident prevention, Health and Safety in daily life.	1	5
5.2	Health and Safety at work. First aid and emergency care.	1	5
5.3	Common injuries and their management. Modern life style and hypokinetic diseases.	1	5
5.4	Diabetese, Cardiovascular disorders - Prevention and Management.	1	5
6.0	Physical activity, emotional adjustment and well being,. Yoga, Meditation and Relaxation, Psychoneuroimmunology	3	3
PART III COMMUNITY HEALTH AND SANITATION		36Hrs.	

7.0	Public health and water quality. Prevention of Water borne diseases.	3	4
7.1	Potable water quality monitoring and waste water management. Faecal bacteriae and pathogenic microorganisms transmitted by water.	3	4
7.2	Cholera and Typhoid. Determination of sanitary quality of drinking water, water purification techniques.	3	4
7.3	Vermi composting a method of solid waste management	3	4
8.0	Public Health and Food borne diseases and their prevention	4	4
8.1	Food poisoning caused by toxins produced by microbes eg Staphylococcal food poisoning, Botulism, Salmonellosis	4	4
8.2	Food infection caused by growth of microorganisms in the human body after the contaminated food has been eaten. Eg Food Infection hepatitis (hepatitis A)	4	4
9.0	Public health and diseases (a) Emerging pathogens and diseases – Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax Reemerging pathogens and diseases – TB, Chikungunya	2	4
9.1	(b) Vector borne diseases (mosquito) and their control measures (Chikungunya , Malaria, Filariasis and Dengu fever) Mosquito eradication	2	4
9.2	(c) Leptospirosis and preventive measures – Rodent control measures	3	4
9.3	(d) Cancer different types, causes of cancer, carcinogens, diet & cancer	3	4
9.4	(e) HIV, AIDS – causes & preventive measures	2	4

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Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.

Edlen Gordon Janes and Barttlet. Human Genetics a modern Synthesis. Published by Boston.

Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.

Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications)

Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

COURSE	DETAILS
CODE	ZY6CRT09
TITLE	DEVELOPMENTAL BIOLOGY
DEGREE/YEAR	B.SC ZOOLOGY, VI TH SEMESTER
TYPE	CORE COURSE
CREDITS	3

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Understand historical perspectives, basic concepts and theories of developmental biology.	U	PSO - 1
2	Describe fertilization, its significance, polyspermy, parthenogenesis and regeneration	U	PSO - 4
3	Compare and contrast egg types, fate maps and different developmental processes like cleavage, blastulation, gastrulation, and cell differentiation in various organisms and draw diagrams of each.	U	PSO - 4
4	Differentiate between embryological development of frog and Chick.	An	PSO - 4
5	Illustrate Experimental embryology and teratology	U	PSO - 4
6	Understand and explain human Reproductive Physiology and various processes involved in human development.	U	PSO - 4
7	Critically analyse Physiological and ethological aspects of human intervention in reproduction.	U	PSO - 4
8	Analyse Embryo transfer technology, cloning, stem cell research, Prenatal diagnostic techniques and related Ethical issues.	An	PSO - 4
9	Classify placenta in mammals and discuss its functions.	U	PSO - 4
*PSO-Program Specific outcome; CO-Course Outcome; Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create			

MODULE	COURSE DESCRIPTION	HOURS	CO.NO
1.1	Introduction: Definition, Scope of developmental biology, subdivisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.	2	1

1.2	Reproductive Organs and Gametogenesis. Human reproductive organs and gametogenesis (brief account) significance	2	6
1.3	Egg types. Classification of eggs, based on the amount, distribution and position of yolk. Mosaic, regulative and cleidoic eggs. Influence of yolk on development. Polarity, symmetry and egg content.	2	3
1.4	Sexual cycle Estrus cycle (non-primate) and menstrual cycle (primate cycle). Hormonal control of menstrual cycle.	2	6
1.5	Fertilization Approach and binding of spermatozoa, activation of the egg, amphimixis. Parthenogenesis (brief account) natural and artificial. Arrhenotoky, Thelytoky, Obligatory and Facultative Significance	2	2
2.1	Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.	2	3
2.2	Blastulation: Morula, blastula formation, types of blastula with examples.	1	3
2.3	Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.	1	3
2.4	Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation. Concept of germ layers and derivatives.	2	3
2.5	Cell differentiation and gene action: Potency of embryonic cells (Totipotency, Pleuripotency, Unipotency of embryonic cells). Determination and differentiation in embryonic development, Gene action during development with reference to Drosophila -maternal effect genes, zygotic genes.	2	3
2.6	Embryology of Frog: Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, neurulation, notogenesis. Differentaiton of Mesoderm and Endoderm, Development of eye. Metamorphosis of frog, Hormonal and environmental onrol.	10	4

3.1	Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18hour, 24 hour, 33 hour & 48 hour chick embryo. Extra embryonic membranes in chick.	7	4
3.2	Human development: Blastocyst, foetal membranes and placenta	1	6
3.3	Types of placenta (brief account). Classification of placenta based on Nature of contact, mode of implantation. Histological intimacy of foetal and maternal tissue. Functions of placenta.	2	9
3.4	Experimental embryology: Spemann's constriction experiments, Organizer and embryonic induction. In vitro fertilization (test tube baby) Amniocentesis, Embryo transfer technology, Cloning, Stem cell research.	3	8
3.5	Regeneration in animals	1	2
3.6	Human intervention in reproduction- contraception & birth control, Abortion – biological aspects, Ethical issues, Infertility, IVF, GIFT, & ZIFT (Intra fallopian transfer gamete/zygote)	3	7
4.1	Teratology / Dysmorphology. Definition, Teratogen / Teratogenic agents. Ionizing radiation, infection (herpes virus, parvo virus-B 19, rubella virus, syphilis, cytomegalovirus, toxoplasmosis).	2	5
4.2	Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR)	1	5
4.3	Congenital abnormalities (birth defects) Structural defects (malformation, deformation, disruption) functional defects. (inborn errors of metabolism, mental retardation).	2	5
4.4	Causes of malformation. (brief accounts.) Genetic disorders (single gene defects), Chromosome aberration, aneuploidy (numerical abnormalities). Structural abnormalities (deletion, insertion and re-arrangements), Chromosomal mosaicisms Environmental factors. (external factors) Chemicals, drugs, hormones and vitamins, Multifactorial and idiopathic disorders	3	5

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2. Berril, N.J and Kars G. 1986. Developmental biology, Mc Graw Hills
3. Berry A. K - An introduction to embryology.
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7. Harrison , Harrison's Book of Internal Medicine Churchill Livingstone 17th Ed.
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9. John Rigo Fundamental Genetics Cambridge University Press. 2009
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12. Melissa A – Gibbs, A practical Guide to Developmental Biology, Oxford university press (Int. student edition) 2006
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14. Sobte R.C., Sharma V.L. Essentials of Modern Biology Press Book India 2008
15. Vijayakumarn Nair K. and P. V George. A manual of developmental biology, Continental publications , Trivandrum.
16. Werner A Muller. Dev. Biology, Springer Verlag New York 2008
17. Arora M.P. Embryology. Himalaya Publishing House (Module I, Module II, Module III)
18. Suresh.C. Goel. *Principles of Animal Developmental Biology*. Himalaya Publishing House.
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20. Sastry & Shukal. *Developmental biology*. Rastogi publications (Module I, Module II, Module III)

Web Resources

www.Wikipedia.com. (Module IV)

www.medpedia.com. (Module IV)

Course title	REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY
Course code	ZY6B09U [P]
Programme	BSc. ZOOLOGY
Semester	6
Course type	CORE
Credits	1

CO No.	Expected Course Outcomes <i>Upon completion of this course, the students will be able to:</i>	Cognitive Level	PSO No.
1	Compare blastula and gastrula of chick and frog, and identify various stages of embryonic development in chick	An	PSO-5
2	Understand various prenatal diagnostic procedures and technological application in human development	U	PSO-5
3	Carry out candling and vital staining of chick embryo and identify various developmental stages.	Ap	PSO-5
4	Carry out dissection of reproductive organs of cockroach	Ap	PSO-5
5	Identify placenta found in animals	An	PSO-5
6	Examine the reproductive capacity of fish	Ap	PSO-5

*PSO-Program Specific outcome; CO-Course Outcome;
Cognitive Level: R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

Module	Course Description	Hours	CO.No
1	Embryological studies- Blastula (frog, chick) gastrula (frog, chick), Study of placenta- pig and man	6	1,5
2	Experimental embryology - Amniocentesis, Embryo transfer technology, cloning	4	2
4	Chick developmental studies - Candling method, 18hour, 24hour, 33 hour and 48hour chick embryo, Vital staining- demonstration.	16	3
5	Study of reproductive organs in cockroach	6	4
6	Study of reproduction in Fish (Calculation of gonado-somatic index)	4	6

Course	Details
Code	ZY6B10U
Title	Genetics and Biotechnology
Degree	B.Sc.
Branch	Zoology
Year/Semester	III/VI
Type	Core Course
Credits	3

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1.	Explain genetic concept, importance of genetics, Mendel's Laws and chromosome theory of inheritance.	U	4
2.	Examine the interaction of genes.	An	4
3.	Evaluate the types, causes and significance of linkage, recombination, mutation genetic basis of sex determination, sex linked inheritance and extra nuclear inheritance.	U	4
4.	Understand bacterial and human genetics	U	4
5.	Interpret the importance, tools, techniques, potential applications and hazards of biotechnology.	U	6

Module	Course Description	Hours	CO No.
	PART 1- GENETICS	34	
1	Introduction	2	
1.1	Scope and importance of genetics, Brief explanation of the following terms- gene, alleles, genotype, phenotype, genome, homozygous and heterozygous, wild type and mutant alleles, dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelism – Mendel's laws , Mendelian traits in man Chromosome theory of heredity.	2	1
2	Interaction of genes	5	
2.1	Allelic and non Allelic. Allelic- incomplete dominance Co-dominance Non allelic interactions, – complementary supplementary, epistasis – dominant (feather colour in fowl) and recessive (coat colour in mice)	2	2
2.2	Polygenes (Skin colour inheritance in man) pleiotropism, modifying genes, lethal genes .Multiple alleles(eg) Coat Colour in rabbits.	2	2
2.3	Man ABO blood group Rh factor, Blood group and its inheritance (Genetic problems related to this topic are included	1	2

	in practicals)		
3	Linkage and Recombination	3	
3.1	Linkage and recombination of genes based on Morgan's work in Drosophila (Complete and incomplete linkage) Linkage map Chromosome mapping.	3	3
4	Sex determination	3	
4.1	Chromosome theory of sex determination (sex chromosomes and autosomes) chromosomal mechanism (XX-XO, XX-XY, ZW-ZZ) Barr bodies and Lyon hypotheses : Sex determination in man- role of Y chromosome. Sex determination in honey bees. Genic balance theory. Drosophila- intersex, gynandromorphs. Hormonal Influence on sex determination Environmental influence - Hermaphroditism	3	3
5	Mutations	5	
5.1	Mutations, Types of Mutations. Germinal, Sex linked mutations.	1	3
5.2	Chromosomal mutations - structural and numerical changes.	2	3
5.3	Gene mutation (point mutation) Molecular basis of gene mutations – tautomerism- Induced mutations Physical and chemical mutagens	2	3
6	Extra nuclear inheritance	2	
6.1	Extra nuclear inheritance (Cytoplasmic inheritance Characteristics: Organella DNA (Mitochondrial and plastid DNA) Kappa particles in paramecium.	2	3
7	Bacterial genetics	5	
7.1	Bacterial genome Recombination in Bacteria –Bacterial transformation.	1	4
7.2	Transduction, conjugation F mediated sex duction. Resistance transfer factor (RTF) Mechanism of drug resistance in bacteria	2	4
7.3	Transposable genetic elements in bacteria, basic components and mechanisms of transposition in bacteria.	2	4
8	Human Genetics	9	
8.1	Karyotyping- Normal human chromosome complement. Pedigree Analysis Aneuploidy and Non disjunction. Genetic disorders in Man. Chromosomal anomalies Autosomal (eg.	3	4

	Down syndrome, Edward's syndrome and Cri-du chat syndrome)		
	Sex chromosomal anomalies (Klinefelter's syndrome, and Turners syndrome) Single gene disorders Gene mutation and disorders (Brief mention) Autosomal single gene disorders (Sickle cell anaemia, brachydactyly; inborn errors of metabolism such as phenylketonuria, alkaptonuria).		
8.2	Sex linked inheritance. Definition - characteristics criss-cross inheritance. Haemophilia and colour blindness. Pseudoautosomal genes (incompletely sex-linked genes and holandric	3	3
8.3	Multifactorial disorders - Polygenic traits - Cleft lip and cleft palate. Sex limited and sex influenced traits in man with examples. Prenatal Diagnosis (Amniocentesis) and genes. choriovillous sampling - Ultrasound scanning and Fetoscopy. Genetic counselling, Eugenics and Euthenics.	3	3
	PART II- BIOTECHNOLOGY	20	
9.1	Definition and scope of Biotechnology	1	5
10	Basic aspects of Genetic Engineering	6	5
10.1	Tools-Enzymes-Restriction enzymes and DNA ligases.Vectors-Plasmids and Phage vectors.	2	4
10.2	Isolation of gene/DNA. Techniques-Production of recombinant DNA. rDNA transfer and screening methods.	2	4
10.3	Cloning in host cells.Virus mediated gene transfer,DNA mediated gene transfer	2	4
11	General Techniques in Biotechnology.	5	
11.1	Techniques in gene cloning; PCR technique and DNA Amplification. Blotting Techniques- Southern Blotting, Northern Blotting, Western Blotting.	1	4

11.2	Identification of DNA, mRNA, and Protein. DNA hybridization, Fluorescence <i>insitu</i> Hybridization (FISH), Colony hybridization. DNA finger printing and its applications. RFLP- markers Applications. Gene libraries, Genomic and cDNA libraries Human DNA library, Construction of genomic library and cDNA library.	2	4
11.3	Stem cell cultures, Therapeutic cloning, human ES cell cultures, Human EG cell cultures and Human EC cell cultures, Potential uses of stem cells. Animal cell and tissue culture.	2	4
12	Practical Applications of Biotechnology	5	
12.1	Bioremediation. Tissue culture – Principle and uses Technology of mammalian and plant cell culture.	1	4
12.2	Single cell protein (SCP) The economic implications of SCP. Biotechnology and Medicine: Gene therapy, Stem cell therapy, Monoclonal antibodies, Pharmaceuticals and Biopharmaceuticals- Hormones(insulin, somatostatin, interferon, Lymphokines , Cytokines) Antibiotics, Vaccines .	2	4
12.3	Biotechnology in agriculture and forestry – Microbial insecticides, Resistance of plants to weedicides, insect pest and biotechnology microbial diseases. Production of transgenic plants. Animal– Genetic Engineering for transgenic animals. Fermentation technology in food and beverages	2	4
13	Problems in Biotechnology	3	
13.1	Hazards of genetic engineering Problems of biologically active biotechnology products.Problems of biotechnological inventions:Patenting and Patent protection – Trade secrets Plant breeder’s rights. Biowar and biopiracy	3	4

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Course	Details
Code	ZY6B10U[P]
Title	Practical- Genetics & Biotechnology
Degree	B.Sc.
Branch	Zoology
Year/Semester	III/VI
Type	Core Practical
Credits	1

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Carry out genetic calculations	Ap	6
2	Identify barr body, normal and abnormal human karyotypes.	An	6
3	Carry out sexing of Drosophila	An	6
4	Understand PCR and blotting techniques	U	6

Module	Course Description	Hours	CO.No.
	GENETICS AND BIOTECHNOLOGY	36	
1.1	Genetic problems- Mono and Dihybrid ratio (b) Back cross (c) Multiple alleles.	6	1
1.2	Study of barr body in human buccal epithelium.	6	2
1.3	Study through photographs of the Karyotype- Turner's Syndrome , Klinefelters and Down's Syndrome.	6	2
1.4	Study of the karyotype and idiogram from the given photograph of somatic metaphase chromosome-(Human)	6	2
1.5	Sexing of Drosophila melanogaster	6	3
1.6	Study of Polymerase Chain Reaction , Western blotting of proteins from SDS-polyacrylamide gel, Southern blotting of DNA fragments from agarosegel, Northern Blotting of RNA molecules (Demonstration)	6	4

COURSE	DETAILS
CODE	ZY6B11U
TITLE	MICROBIOLOGY AND IMMUNOLOGY
DEGREE/YEAR	B.SC ZOOLOGY, VI TH SEMESTER
TYPE	CORE COURSE
CREDITS	54 HRS

CO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive level	PSO No.
1	Understand the role of microbes in environment ,human health,infections and diseases and pathogenesis, transmission, prevention and control,epidemiology, symptomology,food and safety management,therapeutics, industrial application of microbes, role of microbes as decomposers, role in energy transfer and ecosystem functioning, different means of transport of microbes, bioremediation etc	U	PSO 1,3
2	Understands the history classification of microbes,our immune system,methods in microbiology, sterilization and disinfection,culture media, plating techniques and culture preservation techniques and vaccines and vaccination.	U	PSO 3
3	Applies their knowledge in operating instruments like Autoclave, Hot air oven, Bacteriological incubator,laminar flow,water bath etc, able to do culture of bacteria and fungus, microbes in living condition,plating techniques, Gram staining, Antibiotic sensitivity test and drug resistance in bacteria, determination of ABO blood groups and Rh factor.	Ap	PSO 6
4	Develop proficiency in the quantitative and qualitative estimation of microbes, microbiology laboratory techniques and safety procedures, aseptic and pure culture techniques, preparation of and viewing samples for microscopy, use appropriate methods to identify microorganisms.	Ap	PSO 6,7
5	Design and construct novel plans for dealing emerging microbial diseases, multiple drug resistant bacteria water purification techniques and waste management using microbes,	Ap	PSO 8
6	Analyse the transfer of STD,manifestation of allergic reactions, auto immune disorders, blood transfusion reactions etc	An	PSO 9

MODULE	COURSE DESCRIPTION	Hrs.	CO.No
PART I – MICROBIOLOGY 27Hrs			
1.0	Module I - Introduction and Scope of Microbiology	2	1,4
1.1	Outline classification of bacteria, fungi, viruses,		1
2.0	Module II – Methods in microbiology	6	1, 7

2.1	Sterilization and disinfection. Different methods, physical and chemical. Sterilization by moist and dry heat, by filtration, by irradiation, preparation of culture media (aerobic and anaerobic cultivation) Selective media, enrichment media and differential media, Plating techniques and isolation of pure colonies, culture preservation techniques – refrigeration, deep freezing, freezing under liquid nitrogen and lyophilization.		1
3.0	Module III- Structure of Bacteria		
3.1	Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, Pili, Capsule, cell wall and its composition, Cytoplasmic membrane, protoplast, spheroplast, , nuclear material , cell inclusions, Bacterial spores	5	1, 7
4.0	Module IV – Bacterial growth	13	2,3
4.1	Bacterial growth,Effect of various factors on bacterial growth,cell division,nutritional requirements.	4	2,3
4.2	Enumeration of bacteria ;Total count & viable count Bacterial growth curve		
5.0	Module V- Basic virology		
5.1	Viruses -Structure of Viruses, Human, Animal, Plant and Bacterial Viruses.	3	2,3
5.2	Replication of viruses, cultivation of animal and plant viruses. Viral assay.		
6.0	Module VI Infections	2	
6.1	Types,primary and secondary infections.Cross infection nosocomial infection.	3	2,3
6.2	Infection, endogenous and exogenous infections, different sources of infections, contagious diseases (Epidemic, endemic and pandemic) modes of transmission of diseases (by food, water, air, vectors, and carriers. Mention different types of carriers, healthy carriers, convalescent carriers, temporary and chronic carriers, contact carriers, paradoxical carriers , bacteraemia, Septicaemia.		
7.0	Module VII Diseases	7	4
7.1	Principles of laboratory diagnosis of Bacterial,viral and fungal diseases: A brief study of two examples from each category bacterial:Tuberculosis & Typhoid, Viral:Influenza & Polio,Fungal: Dermatophytoses & Candidiasis		
8.0	Module VIII- Immunology-27 Hrs	4	1
8.1	Types of immunity, innate immunity, Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation.) acquired - passive & active Vaccines types of vaccines, live, killed, toxoids,recombinant DNA		
9.0	Module IX Antigens Antibodies Complements	7	1,2
9.1	Types of Antigens, haptens, antigenic determinants. Basic		

	structure of immunoglobulins. Different classes of immunoglobulins and functions Complement system, biological effects of complements- a brief study.		
10.0	Module X Antigen-antibody reactions	7	2
10.1	Antigen-antibody reactions, Precipitation test, Agglutination Test, Clinical applications of antigen antibody reaction : Eg: Widal , VDRL , HIV test (ELISA) Complement fixation test, Coombs test.		
11.0	Module X Immune response system	5	1,2
	Primary and secondary lymphoid organs. Cells of the immune system – Leucocytes, Lymphocytes T & B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses, Monoclonal antibodies – Hybridoma technology , uses.		
12.0	Immunopathology	4	4
12.1	Different types of hypersensitivity reactions - A brief study on anaphylaxis, atopy, , serum sickness and delayed hypersensitivity		
12.2	Autoimmunity, mechanisms of autoimmunization A brief study on autoimmune diseases eg. Lymphadenoid goiter,thyrotoxicosis, rheumatoid arthritis and systemic lupus erythematosis		
12.3	Transplantation-Immunity-graftrejection,major histocompatibility, Human leukocyte antigen system - (HLA) immuno -suppression Immunohaematology, Immunology of blood transfusion, Erythroblastosis foetalis.		

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Core Readings

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Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009

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COURSE	DETAILS
CODE	ZY6CRP10 (PRACTICAL)
TITLE	MICROBIOLOGY AND IMMUNOLOGY (P)
DEGREE/YEAR	B.SC ZOOLOGY, VI TH SEMESTER
TYPE	CORE PRACTICAL
CREDITS	36

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Develop skills and knowledge on instrumentation and preparation of culture medias and culture techniques used in microbiological studies.	Ap	6
2	Staining and identification of microbes	An	6
3	Observe motility of bacteria and understand antibiotic sensitivity	U	6
4	Analyse blood group of sample provided	An	6
5	Understand the primary and secondary lymphoid organs	U	6

PSO- Program Specific Outcome; CO- Course Outcome;
Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.

Module	Course Description	Hrs	CO
1	Instruments –Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow.	2	1
2	Preparation of solid and liquid media for microbial cultures. (Ingredients, pH and method of preparation) (Demonstration) (a) Solid media (1) Nutrient agar (2) Mac Conkey's agar (b) Liquid Media(1) Nutrient broth (2) Peptone water.	4	1
3	Culture methods (Demonstration) a) Streak plate technique and isolation of pure colonies. (b) Lawn culture (c) Pour plate culture (d) Liquid culture	5	1
4	Examination of microbes in living condition Hanging drop method for demonstrating motility of bacteria.	4	3
5	Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.	4	2
6	Antibiotic sensitivity test (demonstration only)	4	1,3
7	Streak plating (individual performance)	4	1
8	Preparation of a fungal smear – Lactophenol cotton blue staining and mounting	3	2
9	Determination of ABO blood groups and Rh factor (Antigen – antibody Reaction)	2	4
10	Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man	4	5

Course	Details				
Code	ZY6B12U				
Title	General Informatics, Bioinformatics and Biostatistics				
Degree	B.Sc				
Branch(s)	ZOOLOGY				
Year/Semester	III/VI				
Type	Core course				
Credits	3	Hrs/Week	3	Total hours	54

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Interpret the importance of technology in Biology.	U	6
2	Identify the important components and operating systems used in computer.	R	6
3	Determine ideas on databases and data retrieval	Ap	6,7
4	Understand the principles and application of bioinformatics.	U	6
5	Identify the current developments and future prospects of Bioinformatics.	An	6
6	Apply various statistical methods in research studies.	Ap	7

- PSO- Program Specific Outcome; CO- Course Outcome;
- Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.

Module Description	Course	Hrs	CO.No
	Part I : General Informatics	12	1,2
1.0	Module 1. Introduction	6	1,2
1.1	Microprocessors – RAM, ROM, EPROM.	2	2
1.2	Memory systems, input, output devices.	2	2
1.3	Disk operating systems	1	2
1.4	Booting and formatting.	1	2
2.0	Module: 2 : Operating systems	6	2,3
2.1	DOS, Windows, Linux	1	2
2.2	MS Office (MS word, Excel, Access and PowerPoint)	1	2
2.3	computer programming	1	2
2.4	Networking (LAN, WAN), Internet, World Wide Web	1	2
2.5	Databases and information retrieval	1	3

2.6	New technology in Internet	1	2
	Part II Bioinformatics	24	4,5
3.0	Module: 3	8	
3.1	Definition, Nature & Scope of Bioinformatics- Contrast between Bioinformatics and Computational Biology	2	4
3.2	Key Bio-sequences in Molecular Biology - DNA, RNA and Amino-acid sequences	2	4
3.3	Popular Databases in Bioinformatics - NCBI, DDJB, PDB, OMIM	2	4
3.4	BLAST & FASTA sequence file formats	1	4
3.5	Approach of Comparative Biology based on sequence comparison - The basic idea of sequence comparison, idea of scoring matrices.	1	4
4.0	Module: 4	8	
4.1	The Blast search engine - important features	2	4
4.2	Idea of Multiple sequence alignment	1	4
4.3	Proteomics	1	4
4.3.1	Basic ideas of Protein Structure prediction- Concept of Homology Modeling	2	4,5
4.4	Idea of Molecular Phylogenetics - advantages and computational procedure	2	4,5
5.0	Module 5	6	
5.1	Basic concepts of computer Aided Drug Discovery- General description of drug discovery pipeline- concept of Personalized medicine	2	4,5
5.2	Bioinformatics tools: (i)Molecular Visualization Software - Rasmol (ii) ORF finding (iii) gene finding, (iii) BLAST (iv) Hydrophobicity Prediction (v) Single Nucleotide Polymorphism (SNP) prediction using GENSNP	4	4,5
6.0	Module 6	2	
6.1	Future Prospects:		
6.1.1	Human brain Project, Computer simulation and visualization of molecular structure, Protein structure prediction	2	5
	Part III Biostatistics	18	6
7.0	Module7. Sample & Sampling techniques	2	
7.1	Collection of data, Classification of data, Frequency distribution tables	1	6
7.2	Graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves	1	6
8.0	Module 8. Measures of Central Tendency	3	
8.1	Mean	1	6

8.2	Median	1	6
8.3	Mode	1	6
9.0	Module 9. Measures of dispersion	4	6
9.1	Range, Quartile Deviation.	1	6
9.2	Mean Deviation	1	6
9.3	Standard Deviation, Standard error	2	6
10.0	Module 10: Probability Distributions	3	
10.1	Normal	1	6
10.2	Binomial	1	6
10.3	Poisson distribution	1	6
11.0	Module 11:	4	
11.1	Correlation: Definition, Types of correlation. Module 12	4	6
12.0	Test of Hypothesis and Test of Significance	2	6
12.1	Basic concept, Levels of significance, test of significance, Procedure for testing hypothesis	1	6
12.2	Types of hypothesis- Null hypothesis and Alternate hypothesis. Chi- square test	1	6

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Course	Details
Code	ZY6B15U
Title	Economic Zoology
Degree	B.Sc
Branch	Zoology
Year/Semester	III/VI
Type	Core Course
Credits	3

CO No.	Expected Course Outcomes	Cognitive Level	PSO No.
1	Identify the pests of common crops of Kerala and their management measures	U, An	5
2	Design aquaculture practises and aquarium.	C	5
3	Carry out vermiculture and apiculture	C	5

Module	Course Description	Hours	CO.No.
	ECONOMIC ZOOLOGY	72	
	Part I APPLIED ENTOMOLOGY	18	
1	Pests of common crops of Kerala (Paddy and Coconut)		
1.1	Morphology, damages caused and control measures. Pests of coconut – <i>Oryctes rhinoceros</i> , <i>Rhyncophorus ferrugineus</i> , <i>Nephantis serinopa</i> , eriophid mite (<i>Aceria guerreronis</i>), Pest of paddy – <i>Leptocorisa acuta</i> , <i>Spodoptera mauritia</i> , Rice stem borer (<i>Scirpophaga incertulas</i> , <i>Nilaparvata lugens</i>) Pest of stored food products – <i>Trogoderma granarium</i> , <i>Tribolium castaneum</i> , <i>Sitophilus oryzae</i> .	6	1
1.2	Insect pest management: Chemical control- Classification and chemical composition of pesticides Insecticides and their mode of action, trade names, Biological control methods – give examples, insects used in biological control programme, Microbial insecticides, Autocidal control (sterile male technique)	6	1
1.3	Integrated Pest Management.	2	
2	PART II MANAGEMENT OF ORNAMENTAL FISH	18	
	BREEDING AND AQUARIUM MANAGEMENT		
	Ornamental Fish Breeding	15	
2.1	Introduction. Present status of ornamental fish culture.	1	2
2.2	Fresh water aquarium fish culture. Marine ornamental fishes.	3	2
2.3	Breeding of gold fish, koei, tetra, barb, fighter, gourami, live	4	2

	bearers and clown fish.		
2.4	Nutrition and feed of aquarium fishes. Establishment of commercial ornamental fish culture unit.	5	2
2.5	Common diseases of aquarium fishes and their management.	2	2
3	Aquarium management	3	
3.1	Aquarium, Aims of aquarium, Requirement of an aquarium	1	2
3.2	Setting an aquarium, Aquarium fishes.	2	2
	PART III – VERMICULTURE		
4	Vermiculture	8	
4.1	Introduction, ecological classification of earth worms. Life history.	2	3
4.2	Species of earth worms used for vermiculture, role of earth worm in solid waste management, in agriculture, in medicine etc.	2	3
4.3	Preparation of vermibed, preparation of vermi compost, Preparation of vermiwash,	4	3
	PART IV – APICULTURE		
5	Bee Keeping	18	
	Definition, Uses of bees. Sp.of bees cultured.	2	3
	Organization of honey bee colony, Social life and adaptation of honey bees.	2	3
	Communication among honey bees. Bee keeping methods (modern method only) and equipments, management and maintenance of an apiary-growth period, dividing the colony, uniting two colonies, replacing old queen with new queen, honey flow period, dearth periodswarming management, monsoon management.	10	3
	Enemies of bees. Bee diseases. Bee pasturage. Honey and wax composition. Testing the quality of honey. Extraction of wax.	4	3
	Uses of honey and wax. Apitherapy. Royal jelly, propolis.		
	Agencies supporting apiculture.		
	Field visit and report writing	10	

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Course	Details				
Code	ZY6B12U [P]				
Title	General informatics, Bioinformatics and Biostatistics (P)				
Degree	B.Sc				
Branch(s)	ZOOLOGY				
Year/Semester	III/VI				
Type	Core practical				
Credits	1	Hrs/Week	2	Total hours	36

CO No	Expected Course Outcomes Upon completion of this course, the students will be able to:	Cognitive Level	PSO No.
1	Use MS office	Ap	6
2	Biological data interpretation using statistical methods	U	6
3	Analysis of molecular sequences	An	6
4	Use of Internet for biological topics	Ap	6
<p>PSO- Program Specific Outcome; CO- Course Outcome; Cognitive Level: R- Remember; U- Understanding; Ap- Apply; An- Analyse; E- Evaluate; C- Create.</p>			

Module	Course Description	Hrs	CO
1	MS Word: Mail merge—Preparing mark sheet of students	2	1
2	MS Excel : To create mean and median	2	1
3	MS Access: To create grade of students	2	1
4	Internet: Access a web page on any biological topic.	2	4
5	Frequency distribution of the given samples to find out arithmetic mean, median, mode.	3	2
6	Range and standard deviation for a biological data	2	2
7	Correlation using any biological data.	2	2
8	Download a specified sequence from NCBI and search with it in BLAST and report results with comments.	3	3
9	Download molecular structure data files of DNA, Sugar, Water etc and inspect them through Rasmol.	3	3
10	Download a specified DNA sequence from NCBI and identify ORF & genes, if any, in it.	3	3
11	Download a specified AA sequence from NCBI and plot its hydrophobicity profile.	3	3
12	Download and study at least two samples of genome	3	3

	sequences.		
13	Spotters—copies of genome sequences and proteins.	3	3
14	Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.	3	2