DEPARTMENT OF ZOOLOGY

COURSE STRUCTURE & SYLLABI
(For the students admitted from year 2023-2024 onwards)

Programme : M.Sc. Zoology

Since 1951

JAMAL MOHAMED COLLEGE (AUTONOMOUS)
Accredited with A++ Grade by NAAC (4th Cycle) with CGPA 3.69 out of 4.0
(Affiliated to Bharathidasan University)
TIRUCHIRAPPALLI – 620 020

M.SC. ZOOLOGY

Sem	Course Code	Course Category	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
						CIA	ESE	
I	23PZO1CC1	Core - I	Functional Morphology and Comparative Anatomy of Invertebrates and Chordates	6	5	25	75	100
	23PZO1CC2	Core - II	Developmental Biology	6	5	25	75	100
	23PZO1CC3	Core - III	Applied Ecology, Evolution and Paleontology	6	5	25	75	100
	23PZO1CC4P	Core - IV	Functional Morphology and Comparative Anatomy of Invertebrates and Chordates Developmental Biology, Applied Ecology, Evolution and Palaeontology - Practical - I	6	4	20	80	100
	23PZO1DE1A/B	Discipline Specific Electives - I		6	4	25	75	100
			Total	**30**	**23**			**500**
II	23PZO2CC5	Core - V	Molecular and Human Genetics	6	5	25	75	100
	23PZO2CC6	Core - VI	Cell & Molecular Biology and Histology	6	5	25	75	100
	23PZO2CC7	Core - VII	Comparative Animal Physiology	6	5	25	75	100
	23PZO2CC8P	Core - VIII	Molecular and Human Genetics, Cell & Molecular Biology, Histology and Comparative Animal Physiology - Practical -II	6	4	20	80	100
	23PZO2DE2A/B	Discipline Specific Electives - II		6	4	25	75	100
	23PCN2CO	Community Outreach	JAMCROP	-	@	-	-	@
	@Only grades will be given		**Total**	**30**	**23**			**500**
III	23PZO3CC9	Core - IX	Biochemistry	6	6	25	75	100
	23PZO3CC10	Core - X	Immunology	6	5	25	75	100
	23PZO3CC11	Core - XI	Biostatistics and Bioinformatics	6	5	25	75	100
	23PZO3CC12P	Core - XII	Biochemistry, Immunology, Biostatistics and Bioinformatics - Practical - III	6	4	20	80	100
	23PZO3DE3A/B	Discipline Specific Electives - III		6	4	25	75	100
	23PZO3EC1	Extra Credit Course - I*	Online Course	-	*	-	-	-
			Total	**30**	**24**			**500**
IV	23PZO4CC13	Core - XIII	General and Applied Entomology	6	6	25	75	100
	23PZO4CC14	Core - XIV	Microbiology and Vaccinology	6	6	25	75	100
	23PZO4CC15P	Core - XV	General and Applied Entomology and Microbiology &Vaccinology - Practical - IV	6	5	20	80	100
	23PZO4DE4A/B	Discipline Specific Electives - IV		6	4	25	75	100
	23PZO4PW	Project Work	Project Work	6	4	-	100	100
	23PCNOC	Mandatory online course**	Online Course	-	1	-	100	100
	23PZO4EC2	Extra Credit Course - II*	Online Course	-	*	-	-	-
	23PCN4EC3	Extra Credit Course – III+	Innovation and Intellectual Property Rights	-	+	-	-	-
	*** Programme Specific Online Course for Advanced Learners** **** Any Online Course for Enhancing Additional Skills** **+ Course for Enhancing IPR Skills**		**Total**	**30**	**26**			**600**
					Grand Total	**96**		**2100**

DISCIPLINE SPECIFIC ELECTIVES

Semester	Course Code	Course Title
I	23PZO1DE1A	Biophysics, Radiation Biology and Nanotechnology
	23PZO1DE1B	Occupational Health and Safety
II	23PZO2DE2A	Biotechnology
	23PZO2DE2B	Endocrinology
III	23PZO3DE3A	Animal Behaviour and Biodiversity Conservation
	23PZO3DE3B	Aquaculture and Farm Management
IV	23PZO4DE4A	Research Methodology, Ethics & Bioinstrumentation
	23PZO4DE4B	Clinical Lab Technology

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PZO1CC1	Core – I	6	5	25	75	100

Course Title	FUNCTIONAL MORPHOLOGY AND COMPARATIVE ANATOMY OF INVERTEBRATES AND CHORDATES

SYLLABUS		
Unit	**Contents**	**Hours**
	INVERTEBRATES	
I	Animal organization: Symmetry, Coelom and Metamerism ; Origin and significance - Body wall and exoskeleton in Invertebrates - Locomotion in Invertebrates - Nutrition in Invertebrates * Molluscs and Echinoderms *	**18**
II	Respiration in Annelids, Arthropods and Molluscs – Excretory organs in Invertebrates – Nervous system in Invertebrates * Echinoderms * – Reproductive system and Reproduction in Invertebrates.	**18**
III	Larval life in Invertebrates: Larval forms, their existence, adaptation and transformation – Minor Phyla: Classification –Detailed study of Mesozoa, Rotifera, Ectoprocta, * Phoronida * and Chaetognatha**.**	**18**
	CHORDATES	
IV	Integumentary system in Vertebrates – Dermal and Epidermal derivatives of Vertebrates - Appendicular Skeleton in Vertebrates: Pectoral and Pelvic girdles of Vertebrates – Limbs of Vertebrates: Fishes, * Birds* and mammals.- Digestive system in Vertebrates – * Stomach in Mammals *	**18**
V	Respiration in Fishes – Pulmonary Respiration in Tetrapod – Circulatory system in vertebrates – Heart in Vertebrates**. –** Urinogenital system in Vertebrates – *Endocrine system in Vertebrates*.	**18**
VI	**Current Trends (For CIA only)** Molecular taxonomy, Phylogenetic Analysis, DNA barcoding	

……. Self Study

Text Book(s):

1. 1. Barnes, R.D. Invertebrate Zoology, IVEdition, Holt Saunders, 1982.
2. Barrington, E.J.W. Invertebrate Structure and Function, II Ed., ELBS and Nelson.1979.
3. Hyman, G.H., The Invertebrates, Vols. I to VII, McGraw Hill Book Co. Inc. New York.
4. Kent. G.C. Comparative Anatomy of the Vertebrates, McGraw Hill Book Co., Inc., New York.1976.
5. Malcolm Jollie, Chordate Morphology, Reinhold Publishing Corporation, New York.1962.

Reference Book(s):

1. Kotpal, R.L., Minor Phyla.,Rastogi Publication, Meerut. 2nd Edition, 2002.
2. VasantikaKashyap., Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.1997.
3. Waterman, A.J., Chordate Structure and Function, The Macmillan Company,1971.2.

Web Resource(s):

1. http://www.itis.usda.gov/itis/status.html
2. http://www.bishop.hawaii.org/bishop/HBS/hbs1.html
3. http://www.itis.usda.gov/itis/status.html
4. http://www.bishop.hawaii.org/bishop/HBS/hbs1.html

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Describe animal organization, locomotion and the process of nutrition in Invertebrates	**K2**
CO2	Acquire Knowledge and compare respiration, excretion and reproductive ability in Invertebrates.	**K3**
CO3	Analyse the larval life of Invertebrates and biology of organisms of minor phyla	**K4**
CO4	Differentiate and relate the integumentary systems, structure of appendicular skeleton in Vertebrate and digestive systems among Vertebrates	**K5**
CO5	Appreciate the organization of respiratory systems, circulatory excretory systems, reproductive systems and endocrine system in Vertebrates.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
Mean Overall Score											**2.7**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Mr. S.N. Sheik Umar Sahith

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PZO1CC2	Core - II	6	5	25	75	100

Course Title	DEVELOPMENTAL BIOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Phases of Development** Developmental patterns among Metazoans – Sperm formation - Gametogenesis: Structure of Mammalian gametes. Fertilization: Biochemical events. Cleavage (patterns & types) Gastrulation: Germ layer formation. Organogenesis - Development of Eye in Chick. Growth and differentiation. Genetic regulations of early embryonic development - *Gradient theory* - Morphogenetic gradients - Cell fate and Cell lineage.	18
II	**Embryonic Induction and Organiser** Theories of Organizer or Inductor - Embryonic induction. Organizers - Spemann and Mangold experiments. Molecular biology of the Nieuwkoop center - Functions of organizer - Induction Regional specification types - Nuclear transplantation in Amphibia - Growth and Post embryonic development - Sex determination - Genomic equivalence and cytoplasmic determinants - *Imprinting*- Cell aggregation and differentiation in *Dictyostelium.* Axes and pattern formation in Drosophila.	18
III	**Metamorphosis and Regeneration** Influence of hormones on Growth and metamorphosis in Insects and Amphibians – Formation of limb bud in Amphibia - Specification of limb fields - Induction of early limb bud - Eye lens induction - Cell death and the formation of digits and joints. Regenerative ability of various Invertebrates and Vertebrates - Mechanism of regeneration - Blastema formation - Wolffian regeneration - *Factors affecting regeneration*.	18
IV	**Differentiation and Sex determination** Differentiation - Characteristics and types of Differentiation. Selective action of genes in differentiation. Teratogenesis: Teratogenic agents. Sex determination: timing and gene expression in mammalian sex determination - Brain sex determination in Flies – temperature dependent sex determination in Turtles. *Aging and Senescence* – Apoptosis.	18
V	**Advanced Techniques in Developmental Biology** Cell differentiation and Stem cells - Applications of Stem cells in organ culture - Control of transcription involving tissue specific transcription regulators - Assisted Reproductive Technology (ART) - Super ovulation, ICSI, GIFT- Artificial insemination - *In vitro* fertilization - Cloning - Human development – Placentation. *Birth control and its need*.	18
VI	**Current Trends (For CIA only) –** • Carnegie stages based on embryo morphological features • Next Generation Sequencing (NGS) & Preimplantation genetic screening (PGS) in Embryology	

……. Self Study

Text Book(s):

1. Balinsky, B.L., An Introduction to Embryology, Publisher – Thomas Asia Pvt. Ltd, 2004 (5th Edn)
2. Gilbert, S.F., Developmental Biology, Publisher-Sinauer Associates Inc, Massachusetts, USA. 2006(8th Edn)

Reference Book(s):

1. Strickberger, M.W., Evolution. Jones and Barlett Pub. Inc., London. 1996
2. Berrill, N.J., Developmental Biology, Tata McGraw Hill, New Delhi. 1986.
3. Browder, L.N., Developmental Biology, Saunders Co., Philadelphia. 1980.
4. Saunders, A.W., Developmental Biology, Patterns, Principles and Problems. Macmillan Publishing Co., New York. 1982.
5. Stevan, B. and Oppenheimer.,Introduction to Embryonic Development, Alley and Bern. 1980.
6. Sharma, B.K. and Kaur, H. Environmental Chemistry,Goel Pub. House, Meerut. 1997.
7. Tacconi,L., Biodiversity and Ecological Economics - Participation, Values and Resource Management. Earthscan Pub. Ltd., London. 2000.
8. Castri, F.D. and Younes, T., Biodiversity: Science and Development, CABInt, Wallingford, U.K. 1996.

Web Resource(s):

1. www.corning.com › worldwide › cls › documents › CLS-DL-CC-015
2. dev.biologists.org › content
3. www.reproductivefacts.org › documents › fact-sheets-and-info-booklets
4. https://elifesciences.org/articles/15657
5. https://www.medicalnewstoday.com/articles/165748#causes_in_men

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understand the key concepts, including mechanisms by which differential gene activity controls development, mechanisms that determine cell fate, and mechanisms that ensure consistency and reliability of development	K2 & K3
CO2	Summarize the basic concepts of development and the role of genes in sex determination	K4
CO3	Analyse and apply the concept of organizer and induction in the development of limb and metamorphosis	K4
CO4	Relate and apply the concept of differentiation in gene knock out and abnormal differentiation	K5
CO5	Evaluate the modern concepts in Stem Cells and recent Technologies	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	2	1	2	3	2	1	2	2	1.8
CO2	2	2	3	2	2	1	2	3	3	3	2.3
CO3	3	2	2	2	3	3	3	2	2	3	2.5
CO4	2	3	3	2	2	2	3	2	3	2	2.4
CO5	3	1	3	2	1	2	3	3	1	2	2.1
										Mean Overall Score	2.22
										Correlation	Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. Salahudeen

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PZO1CC3	CORE - III	6	5	25	75	100

Course Title	APPLIED ECOLOGY, EVOLUTION AND PALEONTOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Concepts in Ecology:** Ecosystem: Structure and functions of ecosystem, Energy flow, Dynamics of ecosystem, primary production. Population Ecology: Characteristics of a population; Carrying capacity, population growth; population regulation - concept of metapopulation. Community Ecology: Biological communities, structure and attributes of community. Coexistence, Inter-specific and intra specific competitions - regulation – *Ecological Succession*.	18
II	**Applied Ecology:** Pollution - Types of pollution: Air, Water, Land and Light pollution, Air pollution, Ecology of air pollution, Control of Air pollution. Water pollution –Types of water pollution, Ecology of water pollution. Land pollution- Pesticide and Herbicide contamination. Bio remediation - In-situ and Ex-situ bioremediation, microorganism used in bioremediation. Remote Sensing - Principles and Concepts - Thermal and Microwave remote sensing. Geographical Information System (GIS) - Basic principles - Global Positioning System (GPS) - Applications of Remote Sensing and GIS (Forest and Water). Indian satilites: Sindhu, Netra, *EOS-03*.	18
III	**Environment & Social Issues:** Urban problems: - waste products and Management – rain water harvesting. Environmental ethics, issues – possible solutions - Green skills. Global issues: Climate change- Ozone depletion - Global Warming - Global summits – Acid rain – Harvesting population – Optimum yield problem – Pest control and biological control–Environmental protection Act - *Forest conservation Act (India 1972) * - Natural disasters – Floods, Droughts, Earthquakes, Cyclones and Landslides. Space Ecology - Environmental problems of space travel - Physiological changes of space travel - Mechanism of regeneration system	18
IV	**Evolution:** Direct and Indirect evidences of evolution - Lamarckism - Darwinism - Germ Plasm theory – Mutation theory - Isolation and Isolating mechanisms – Speciation. Origin of basic biological molecules; Urey and Miller experiment of primitive earth condition, Abiotic synthesis of organic monomers and polymers; Concepts of Oparin – Evolutionary significance of animals – Peripatus, Ostracoderms, Archaeopteryx - Evolutionary ecology – Evolutionary consequences – predator escape tactis, Adaptive coloration, *Adaptive Variation*, Mimicry, Warning calls, Co-evolution. Molecular evolution and Phylogenetic analysis.	18
V	**Palaeontology:** Scope and development – Applications of Palaeontology - Geological time scale - Eras, Periods and Epochs - Palaeontological techniques - Fossils and fossilization; Collection of fossils – Dating of Rocks – Micropalaeontology; Collection, sampling and storing – Invertebrate, Vertebrate and Analytical Palaeontology - Mammalian Palaeontology; Development of Viviparity and Parental care – *Evolution of Horse*, Evolution of Man.	18
VI	**Current Trends (For CIA only) –** Molecular Eco modelling	

……. Self Study

Text Book(s):
1. Odum, Eugene P., Fundamentals of Ecology, W. B. Saunder's Co. Philadelphia. 5th Edition. 2010. 2. P. S. Verma & V. K. Agarwal., Principles of Ecology, S. Chand & Company Ltd. New Delhi. 1983.
Reference Book(s):
1. Sharma, P.D., Ecology and Environment, VII Edition, Rastogi Publications.2005. 2. Asthana, D. K., Environment: Problems and Solutions, S. Chand & Company, 2007 3. Rockwood LL (2015) Introduction to Population Ecology. Blackwell publishing (2nd Ed.) ISBN: 978-1-4051-3263-3. 4. Miller.G.T., Jr. 2014. Environmental Science. 14th Edition, Thomson, California. 5. Sudarshan KN, Trivedi KR (2011) Population and Community Ecology. Neha Publishers & Distributors. ISBN: 978-8171692804 6. Rastogi,V.B. and M.S. Jayaraj Animal Ecology and distribution of animals, Kedarnath Ramnath. 1989, 7. Clarke, G.L. Elements of Ecology. John Wiley & Sons, New York. 1954.
Web Resource(s):
1. https://peda.net/kenya/css/subjects/biology/form-three/ecology2/concepts-of-ecology 2. http://www.yourarticlelibrary.com/environment/5-major-environmental-problems-discussed/31434 3. https://www.yourgenome.org/facts/what-is-evolution

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the different components of ecosystem and analysis in their habitats	K2
CO2	Analyse the characteristics of different kinds of ecosystems and anthropogenic activities responsible for degradation of natural resources	K3
CO3	Adopt measures to protect environment and maintain sustainability of natural resources	K4
CO4	Compare the various theories related to evolution of animal populations, evolutionary consequences in animal populations	K5
CO5	Discuss Geological time scale of animal evolution and relate the major events leading to fossilization	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	2	2	2	3	2	3	**2.5**
CO2	2	3	3	2	3	2	3	3	3	2	**2.6**
CO3	3	2	2	3	2	3	3	2	2	2	**2.4**
CO4	3	2	2	2	3	2	3	3	3	2	**2.5**
CO5	2	2	3	3	2	3	3	3	2	3	**2.6**
Mean Overall Score											**2.5**
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. P. Rajasekar

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PZO1CC4P	CORE - IV	6	4	20	80	100

Course Title	Functional Morphology and Comparative Anatomy of Invertebrates and Chordates Developmental Biology, Applied Ecology, Evolution and Palaeontology - Practical - I

SYLLABUS	
Contents	**Hours**
BIOLOGY OF INVERTEBRATES: TAXONOMY 30 Invertebrates – Identifying features up to Class level Minor Phyla - Rotifera, Phoronida, Chaetognatha. **MOUNTING :** Soil Nematodes	**90**
BIOLOGY OF CHORDATES: 20 Vertebrates – Identifying features upto Order level **MOUNTING :** Scales of Teleost Fish (Ctenoid and Cycloid types), Feathers (structure) .	
DEVELOPMENTAL BIOLOGY: Preparation of sperm suspension of bull and observation of spermatozoa. Observation of live spermatozoa & study of motility rate of bull spermatozoa.Chick blastoderm Vaginal smear preparation of at/mouse to study the stages of estrous cycle.Induced ovulation in fish. Group Project: Study of life cycle of silkworm (Egg, Larva, Pupa) Spotters: Different developmental stages in chick development.	
APPLIED ECOLOGY: Brakish /Freshwater / Marine -Collection, identification and isolation of plankton. Analysis of water samples for Chlorides, Silicates, Calcium, Total hardness, Phosphates, Nitrates, and Water Quality Index. Qualitative and Quantitative estimation of Plankton (Marine sample). A study on Pond ecosystem and Forest ecosystem – Report submission mandatory. Spotters :Secchi disk, Electrical conductivity Meter, Turbidity Meter, GIS.	
EVOLUTION AND PALAENTOLOGY: Fossil study - Nautiloid, Ammonoid Belemnites and Trilobite, Aposematism, Mimicry & Crypsis. Evolutionary significance - Limulus, Peripatus Connecting Link – Archaeopteryx.	

Text Book(s):

1. P.S.Verma , A Manual of Practical Zoology - Invertebrates, Fifteenth EditionS.Chand& Company Ltd, 2003
2.Manual of Zoology - Chordata. M. Ekambaranatha Ayyar, T.N. Ananthakrishnan, S. Viswanathan (Printers &Publishers) Pvt. Ltd. 2008.
3. P.S. Verma , V.K.Agarwal, Chordate Embryology - Developmental Biology,S.Chand& Company Ltd, 2003.

Reference Book(s):

1. Kotpal, R.L., Minor Phyla.,2nd Edition, Rastogi Publications, Meerut., 2002.
2. VasantikaKashyap., Life of Invertebrates, Vikas Publishing House Pvt., Ltd., NewDelhi.1997.
3. EkambaranathaIyer and S. Viswanathan,Manual of Zoology - CHORDATA Vol. II(Printers & Publishers) Chennai. 1993.
4.Gilbert, F.S. Developmental Biology, 8th edition, Sinauer Associates, Inc. Publishers, Massachusetts2006.
5. R.K.Trivedy&P.K.Goel, Environmental Publications, Karad, India 1984.

Web Resource(s):
1. http://www.itis.usda.gov/itis/status.html 2. http://www.bishop.hawaii.org/bishop/HBS/hbs1.html 3. http://www.itis.usda.gov/itis/status.htm

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand evolution concepts and its significance	**K2**
CO2	Acquire knowledge on Taxonomy	**K3**
CO3	Estimate water quality knowledge on pollution	**K4**
CO4	Explore various experiment in development biology	**K5**
CO5	Asses the role of GIS	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	2	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2.3**
CO2	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2.5**
CO3	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2.4**
CO5	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2.7**
Mean Overall Score											**2.5**
Correlation											Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr.A.Sadiq Bukhari

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PZO1DE1A	DSE - I	6	4	25	75	100

Course Title	BIOPHYSICS, RADIATION BIOLOGY AND NANOTECHNOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Biophysics:** Thermodynamic principles in biology – Concept of free energy – Energy rich bonds – Biological energy transducers; Biophysical aspects of vision, hearing, muscle contraction and Photosynthesis. – Oxidation, Reduction and Redox potential. Microscopy - Principles and applications of microscopy –Phase contrast. Structure determination using X-ray diffraction. Principles and Application of Electrophoresis. *Laser- Principle and applications*. *Safety standards – safety measures* *Safety standards – safety measures*	**18**
II	**Radiation Biology:** Natural Radiation - Man made radiations; Ionizing and non-ionizing radiation - Properties of Radiation – Radioactive Isotopes – Radioisotopes as biological tracers - Radiation Units (Becquerel, RAD, Gray & Curie, Sievert). Measurement of Radiation – Geiger-Muller counter- Skeletal Scintigraphy - Auto radiography *Safety standards – safety measures*.	**18**
III	Biological effects of Radiation - Cellular level – Organ and system level – Genetic effects (aberrations) – Dosimetric study – Radiation Oncology, PET, Applications of Radio Isotopes in Agriculture, Industry and Food Preservation - Radioactive wastes - Sources and Management - *Nuclear Energy Programme in India*.	**18**
IV	**Nanotechnology** Definitions and scaling. Properties at nanoscale (optical, electronic and magnetic). Metal and Semiconductor Nanomaterials, Quantum Dots, Wells and Wires, Bucky balls and Carbon Nanotubes. Introduction-Biocompatibility – anti bacterial activity – principles involved – Biomaterial nanocircuitry; Neurons for network formation. DNA nanostructures for *mechanics and computing*.	**18**
V	Nanoparticles in Drug delivery - Nanotechnology in Diagnostics applications: Biochips analytical devices, Biosensors- Natural nanocomposite systems as spider silk, bones, shells; nanomaterials in cancer treatment. Application of nanotechnology in Green energy, sustaining Natural resources, Global climate changes. Nanotechnology and *energy production*: Fuel Cells — applications in power and transportation	**18**
VI	**Current Trends (For CIA only) -** Green nanotechnology	

……. Self Study

Text Book(s):

1. Narayanan,P. Essential of Biophysics. New Age International (P)Ltd., Publishers, NewDelhi.2000
2. Sha, V.C., Elements of Radiation Biology, Todays & Tomorrows Printers & Publishers, New Delhi. 1985.
3. Siddhartha Shrivastava, Introductory Nanobiotechnology. New Central Book Agency (P) Ltd. Delhi. 2013

Reference Book(s):

1. Casey, E. J. Biophysics - Concepts and Mechanisms. East West Press Pvt. Ltd. New Delhi. 1962
2. N. Gurumani, Research Methodology for biological Sciences. MJP Publishers, 2007.
3. Daniel, M. Basic Biophysics for Biologist. Agro Botanical Publishers, Bikaner, India. 2005.
4. Narayanan, P. Essentials of Biophysics.New Age International (P) Ltd., Publishers. 2007.
5. Plummer, T.D.An introduction to Practical Biochemistry. Tata McGraw Hill Publishing Company Limited, New Delhi. 1978.
6. Rodney, C. Biophysics An Introduction. John Wiley & Sons Ltd. 2004
7. Skoog, A. D. and James, J. L. Principles of Instrumental Analysis. Saunders Golden Sunberst Series. 1992.
8. Vasanthan, P. and Gautham, N. Biophysics. Narosa Publishing House, New Delhi. 2002.
9. Sharma, B.K., Environmental Chemistry, Goel Publishing House, Meerut. 1990
10. Sood, D.D., Reddy, A.V.R. and Ramamoorthy, N. Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, Radiochemistry Division, Mumbai. 2000.
11. Arun, B. Arun, S., Bhongirwar, D.R., Food Preservation by Irradiation. Indian Association for Radiation Protection, BARC, Trombay, Mumbai. 2001.
12. M. Eisenbud and T. Gesell, Environmental Radio activity from Natural, Industrial, and Military Sources. Academic Press. 1997.
13. Shanmugam,S. Nanotechnology. MJP Pub. Chennai. 2010.
14. Breck,M.M., Nanotechnology, Vol.1 & 2. CBS Pub. & Distributors Pvt. Ltd., New Delhi. 2016.

Web Resource(s):

1. https://nptel.ac.in/courses/103108100/
2. www-pub.iaea.org › MTCD › Publications › PDF › TCS-42_webPDF
3. https://en.wikipedia.org/wiki/Radiobiology
4. https://en.wikipedia.org/wiki/Nanotechnology

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understand and apply Thermodynamic principles in biology; Acquire knowledge on the Principles and applications of microscopy	**K2 & K3**
CO2	Analyse the uses of various biological instruments by understanding their Biophysical principles	**K4**
CO3	Examine the impact of Natural Radiations	**K4**
CO4	Evaluate Radio isotopes in Energy Production and Industry	**K5**
CO5	Adapt the diagnostic principles of Radiation and Nanotechnology in Biomedical Science	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	2	3	3	2	2.6
CO2	3	2	3	3	2	3	2	2	3	3	2.8
CO3	3	3	2	3	2	3	3	3	3	3	2.6
CO4	3	3	2	3	3	2	3	2	3	2	2.6
CO5	3	3	2	3	3	3	3	2	1	3	2.8
Mean Overall Score											2.68
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. H.E. Syed Mohamed

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PZO1DE1B	**DSE – I**	6	4	25	75	100

Course Title	**OCCUPATIONAL HEALTH AND SAFETY**

SYLLABUS		
Unit	**Contents**	**Hours**
I	**INTRODUCTION TO SAFETY PHILOSOPHY** Concept and occupational health- Sequence of Accident Occurrence, Occupational Injuries-Effects of Industrial Accidents, Analysis of Accidents, *Injury Data*, Accident Investigations & Reporting, Accident Costing.	**18**
II	**HEALTH MANAGEMENT** Management of work environment in oil exploration and refinery sectors- health management in oil sector- hazards (Psychological hazards physical hazards and heat) -Employer & Employee Responsibilities, Record-keeping & Reporting Requirements, Safety Organization, *Responsibilities of Safety Officer*, Supervisors, Safety committees.	**18**
III	**RISK ASSESSMENT** Risks of infection medical personal: infection disease hepatitis B – Pulmonary tuberculosis– other diseases – Risk of infection in the laboratory -Evolution of Methodical Analysis, System safety Analysis techniques, Performance measurement, *Operational Reviews* – Internal & External.	**18**
IV	**HEALTH PROBLEM IN HOSPITAL INDUSTRY** Chemical hazard anaesthetic agent – Antibiotics – Ethylene oxide – Formaldehyde - Hazards in Chemical Operations, other chemical hazards (Chlorohexidine, Acrylic cement vapour, Rubber gloves, psyllium) Physical hazards: Accident needle stick injury – back pain, back injuries, Assaults – Radiation- Laser- *Psychological Hazards (Stress, Shift work, Suicide) *.	**18**
V	**FIRE SAFETY** Basic Elements, Causes, *Industrial Fires, * Explosions, Effect on Environment, Property & Human Loss, Prevention Techniques, Building Design, Fire Protection Systems, Contingency Plan, Emergency Preparedness, Evacuation	**18**

……. Self Study

Text Book(s):

1. Industrial safety and health, David L.Geotsch, Macmillan Publishing Company, 1993
2. Handbook of environmental health and safety.

Reference Book(s):

1. Occupation health and safety in the care and use of non-human primates. Published 13 June
2.The OHS Tide is the official illustrated magazine of the OHS national model Tiruchirappalli, India 2003. Publisher : National Academic Press
3.Fundamental principles of occupational and safety book by Benjamin O. Alli Published 2001

Web Resource(s):

1. www.webmd.com%2Fa-to-z-guides%2Foccupational-hazards&usg=AOvVaw1qOpzxXaer2qzgLnIcuKBG
2. www.osha.gov%2Fsafety-management%2Fhazard-prevention&usg=AOvVaw1WgG2_aWwteVAFTyKF59I5
3. www.who.int%2Fhealth-topics%2Foccupational-health&usg=AOvVaw08myr-cdUUl0jC6UW5IsWt
4. http://www.osha.gov

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
Co 1	Understand the basic knowledge about occupational health and safety.	**K3**
CO2	Analyse and apply the safety measures.	**K3**
CO3	Understand the definition of hazards and risks, evolution of methodical analysis	**K4**
CO4	To analyse the practices in industries.	**K5**
CO5	To understand and apply knowledge of the fire safety.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2.5	2.5	2.5	2.5	2.5	1.5	1.5	3	3	3	2.45
CO2	3	3	3	3	3	1.5	1.5	3	3	3	2.7
CO3	3	3	3	3	3	1.5	1.5	3	3	3	2.7
CO4	3	3	3	3	3	1.5	1.5	3	3	3	2.7
CO5	3	3	3	3	3	1.5	1.5	3	3	3	2.7
Mean Overall Score											**2.55**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr M.I. Hussain Syed Bava

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PZO2CC5	**CORE - V**	6	5	25	75	100

Course Title	**MOLECULAR AND HUMAN GENETICS**

SYLLABUS		
Unit	**Contents**	**Hours**
	MOLECULAR GENETICS	
I	**Genome:** Structural organization of Prokaryotic and Eukaryote Genome -Mitochondrial genome, gross base composition of nuclear genome, gene density. Gene Families- Origin - Multigene families, Classical gene families, families with large conserved domains, families with small conserved domains, *Gene super families*, Gene families in clusters.	18
II	**Gene regulation:** Gene regulation in prokaryotes: Lac operon, Catabolite repression, Attenuation and tryptophan operon - Gene regulation in eukaryotes: Short term regulation and Long term regulation. Effect of temperature and light on gene expression. CRISPR – Cas9 – Application in genome editing – *Ethical issues*.	18
	HUMAN GENETICS	
III	**Human genetics:** Human chromosome, karyotype analysis, Chromosome banding techniques. Chromosome mapping, genetic linkage maps, Physical map, LOD score for linkage testing. Human Genome Project – Objectives, Methods and Outcome – *Interaction of gene with the environment*.	18
IV	**Genetic diseases in Man:** Inborn errors of metabolism: Phenylketonuria, Alkaptonuria, Albinism. - Lesch-Nyhan syndrome, ADA deficiency, Galactosemia, G6PD deficiency, TaySach's disease, and Gaucher's disease, Muscular dystrophy, Achondroplasia, Huntington disease, Haemophilia A and B,Sickle cell anaemia, β thalassemia and cystic fibrosis disease. Chromosomal syndromes in man - Down syndrome (Trisomy 21), Klinefelter syndrome, Turner syndrome and Trisomy 18. Genes and cancer - Oncogenes– Retinoblastoma, breast cancer, *cancer of digestive system* - Metabolic changes in Cancer cells.	18
V	**Genetic diseases: Detection and treatment:** Detection of genetic diseases – Genetic counselling -prenatal diagnosis, pedigree analysis – Single nucleotide polymorphic (SNP), DNA fingerprinting – method and application, RFLP, single locus DNA profiling, multiplex STR-PCR, Y – STR and mtDNA typing, DNA microarrays in genetic testing- Treating genetic diseases – gene therapy against ADA and cystic fibrosis, Ethical issues. Prenatal diagnosis – Amniocentesis, CVS, Triple test, AFP test and FISH – *Animal model disease*.	18
VI	**Current Trends (For CIA only)** Pharmacogenomics and personalized medicine.	

……. Self Study

Text Book(s):

1. Michel R.Cummings,Human Genetics, Cengage Learning edition,2009.
2. P.S. Verma and V.K. Agarwal, Genetics, Ninth Revised edition, S.Chand& Company Ltd. Publishers, 2009.
3. Alice Marcus,Genetics,MJP Publication,1nd Edition2009

Reference Book(s):
1.Gardner,M.J.,Simmons,D.P.and Snustad,Priciples of genetics 12th edition (2006) 2. Benjamin Levin. Genes VIII, Oxford University Press, New York. 2005 2. Jenkins, J. B. Human Genetics, The Benjamin Cummings Publishing Co. 1983. 3. Robert H. Tamarin. Principles of Genetics, WCB Publishers. 1996.
Web Resource(s):
1. https://peda.net/kenya/css/subjects/biology/form-three/ecology2/concepts-of-ecology 2. http://www.yourarticlelibrary.com/environment/5-major-environmental-problems-discussed/31434 3. s://www.yourgenome.org/facts/what-is-evolution

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Acquire knowledge and analyse the Concept of genome and gene families in organisms	**K2**
CO2	Understand Gene regulation mechanism, Microbial genetics and apply the concept in molecular genetics	**K3**
CO3	Acquire knowledge and analyse and evaluate the concept and techniques relevant to **Chromosome and genes of human.**	**K4**
CO4	Explore various kinds of genetic diseases & disorders related to Genes and Metabolism in man	**K5**
CO5	Create the different treatment of apply the uses of Genetics in human welfare	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	2	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2.3**
CO2	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2.5**
CO3	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2.4**
CO5	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2.7**
										Mean Overall Score	**2.5**
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. P. Rajasekar

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PZO2CC6	Core - VI	6	5	25	75	100

Course Title	CELL & MOLECULAR BIOLOGY AND HISTOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**CELL ORGANELLES AND PROTEIN FOLDING** Structure and functions of Plasma membrane, Mitochondria, Golgi bodies, Lysosomes, Ribosome, Endoplasmic Reticulum- * Membrane models * (Fluid mosaic and Unit membrane) - Mechanism of protein sorting and molecular mechanism of resicular traffic. cell adhesion and roles of different adhesion molecules, gap junctions and extracellular matrix.	**18**
II	**NUCLEAR MATERIAL** Ultra structure and functions of Nucleus, Nuclear pore complex, Chemistry and structure of DNA, A, B & Z DNA synthesis, DNA replications: Semi conservative - Bidirectional and Circle replication - enzymes involved in replication - replication origin and replication fork- fidelity of replication - *DNA damage and repair mechanisms*, homologous and site-specific recombination - structure of chromatin and chromosomes.	**18**
III	**TRANSCRIPTION, RNA SYNTHESIS AND CELL SIGNALING** Regulation of transcription in Prokaryotes and Eukaryotes. Transcription factors and machinery- transcription activator and repressor. Regulation of Protein Synthesis: initiation, elongation and termination, RNA polymerases, tRNA splicing, capping, polyadenylation, introns, exons, and *RNA transport*. Cell signaling molecules and functions of cell surface receptors - G-protein coupled receptors. Signal transduction pathways: Cyclic AMP- MAP kinase pathway.	**18**
IV	**CELL CYCLE AND CANCER BIOLOGY** Cell cycle: Mitosis and Meiosis – Regulation of cell cycle - Types – Characteristics of cancer cells – Control & prevention - Tumor suppressor genes - Oncogenes - Tumor viruses - Role of Apoptosis in cancer - Molecular diagnosis, prevention, early detection and treatment of cancer, Therapeutic interventions of uncontrolled cell growth, *Metabolic changes in cancer cells*.	**18**
V	**HISTOLOGY** Micro techniques: Principles of Microtome- Types of Microtome- Preparation of organism of tissue Samples - Permanent Mounting - Fixing-Washing - Tissue Processing- Staining- Mounting- Labelling- Histo-chemistry: Carbohydrates, Protein, Lipid and Nucleic acids. *Histological preparation of tissues for SEM & TEM* Immunohistochemistry.	**18**
VI	**Current Trends (For CIA only) –** Cancer Cell lines and Cell migration, Immuno-florescent cell, In Situ Hybridization, Facial Transcription	

……. Self Study

Text Book(s):

1. De Robertis, E.D.P., and De Robertis, E.M.F., Cell and Molecular Biology, VIII Ed., Lippincott Williams & Wilkins, A Wolters Kluwer India Pvt., Ltd. 2020,
2. Verma, P.S. and Agarwal, V.K., Cytology, 3rd Edition, Chand & Co., Ltd. Delhi. 2020.
3. Ajoy Paul. Text Book of Cell and Molecular Biology. IV Edition, Books and Allied (P)Ltd.2015
4. Gupta, P.K. Cell and molecular Biology. Rastogi Publications, Meerut, 2004

Reference Book(s):
1. Geoffrey, M. Cooper and Robert E. Hausman., The Cell – A Molecular Approach. 5th Edition. Asm Press, Sinauer, Washington D.C. USA. 2007. 2. Alberts et al., Molecular Biology of the Cell. 4th Edition, Garland Science, A Member of the Taylor and Francis group, New York, USA. 2002. 3. Cooper, G. M. "The Cell – A Molecular Biological Approaches". ASM Press, Washington, 2013. 4. David Freifelder. "Molecular Biology" Narosa Publishing House, 2000.
Web Resource(s):
1. https://en.wikipedia.org/wiki/Cell_(biology) 2. https://www.ncbi.nlm.nih.gov/books/NBK9940/ 3. http://marjoriebrandlab.com/sitebuildercontent/sitebuilderfiles/hfspworkshop.pdf 4. http://genome.tugraz.at/MolecularBiology/WS11_Chapter_12.pdf 5. https://en.wikipedia.org/wiki/Cell_cycle

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Analyse the mechanism of protein sorting and regulation of intracellular transport and the most important methods by which cells communicate and how cells send signals with interpret the signals they receive and Cellular communication.	**K2**
CO2	Apply the knowledge, skill, and awareness to topics like DNA replication, damage, mutation and repair mechanisms.	**K3**
CO3	Integrate the knowledge of Transcription in Prokaryotes and Eukaryotes and Regulation of Protein Synthesis and RNA processing.	**K4**
CO4	Define the Cell cycle and Analyse the role of mammalian cells, Advanced knowledge of the underlying Oncogenes and Understanding of the cancer cells.	**K5**
CO5	Compare the different tissue samples and processing and chemistry of tissues	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	3	2	2	2	3	3	**2.3**
CO2	1	2	2	2	3	1	2	2	2	3	**2.0**
CO3	2	2	2	2	3	3	3	3	3	3	**2.6**
CO4	2	2	3	3	3	2	2	3	3	3	**2.6**
CO5	1	2	2	2	3	2	2	2	3	3	**2.2**
										Mean Overall Score	**Medium**
										Correlation	**2.34**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Subject in-charge: Dr. K. Prabakar

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PZO2CC7	Core – VII	6	5	25	75	100

Course Title	COMPARATIVE ANIMAL PHYSIOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Nutrition, Digestion, Respiration:** Nutritive types in animal kingdom, Role of vitamins and minerals in nutrition – Deficiency diseases Caloric value of foods – BMR. Digestion and absorption of proteins, carbohydrates and lipids – Role of enzymes in digestion. Comparison of respiration in different vertebrate; Mechanism of breathing transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration, Marine mammals respiratory adaptation. * Digestive glands *	18
II	**Blood, Cardiovascular system:** Blood corpuscles, haemopoiesis and formed elements, plasma function,blood volume, blood volume regulation, haemostasis. Ciirculation in animal: Mammals, BIrds, Fish **Cardiovascular System:** Comparative anatomy of heart , myogenic heart, ECG – its principle and significance, cardiaccycle, heart as a pump, blood pressure, neural and chemical regulation of all above. Marine mammals circulation adaptations. * Respiratory organs and pigments *.	18
III	**Nervous, Muscle, Receptor:** Nervous system - Neurons, Nerve Impulse genesis conduction and transmission across synaptic junction, neurotransmitters action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system. Types of muscles – Ultra structure of skeletal muscle – Mechanism of muscle contraction. Receptor: Chemoreception - Chemical senses, taste and smell Mechanoreception - Pressure receptor, Gravity receptor Phonoreception, Physiology of hearing Photoreception – Photochemistry of vision. *Neural control of muscle tone and posture*	18
IV	**Homeostatic, Osmoregulation, Excretion**: Homeostatic mechanisms: Thermoregulation in Poikilotherms & Homeotherms - Tolerance to high temperature, cold and freezing - Acclimatization and acclimation –Physiology of hibernation and aestivation - Osmotic and ionic regulation in crustaceans, fishes, birds and mammals. Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance. Endothermal and homethermy in Insects. *Adaptation to Pressure, High altitude – Buoyancy*.	18
V	**Endocrinology and Reproduction:** Endocrine glands: Structure, Secretion and functions of endocrine glands – Pituitary – Thyroid – Pancreas – Adrenal. Hormones: Chemical nature – functions –deficiency diseases – Mechanism of hormone action. *Reproductive processes*, gametogenesis, ovulation, endocrine glands in relation to human reproduction.	18
VI	**Current Trends (For CIA only) –** Animal models to study human diseases – Parkinson diseases	

……. Self Study

Text Book(s):
1. Singh, H. R. Animal Physiology and Related Biochemistry. SHOBAN Lal Nagin Chand and co.,Educational Publishers, New Delhi. 2.P.S.Verma , B.S.Tyagi and V.K. Agrawal, Animal Physiology,S.Chand&Company Pvt.Ltd. 2013

Reference Book(s):
1. . Rastogi, S. C. Essentials of Animal Physiology. Wiley Eastern Limited. New Delhi.1979. 2. Berry A. K., A Text book of Animal Physiology. Emkay Publications.1st Edition, 1998. 3. Hoar, S. Williams. General and Comparative Physiology. Prentice Hall.1987. 4. Parameswaran, R., Anantha Krishnan, T. N. Anantha Subramanian. Outlines of Animal Physiology, K. S. ViswanathanPvt. Ltd. Chennai .
Web Resource(s):
1. ttps://books.google.co.in/books?id=8ARZjwEACAAJ&dq=hill+wyse+anderson+animal+physiology&hl=en&sa=X&ved=0ahUKEwir0Mz1zIXoAhWUA3IKHWkDAsQQ6wEIKzAA 2.https://books.google.co.in/books?id=Ba_wAAAAMAAJ&q=animal+physiology&dq=animal+physiology&hl=en&sa=X&ved=0ahUKEwiJmePIzoXoAhVkzTgGHeilAJQQ6AEIKDAA

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the functioning of internal system	K2
CO2	Analyse role of receptors , nereve cordination	K3
CO3	Complete knowledge on circulation and respiration	K4
CO4	Asses the importance of endocrine system	K5
CO5	Develop awareness on ionic reguatlion and excreation	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
										Mean Overall Score	**2.7**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr.A.Sadiq Bukhari

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PZO2CC8P	**Core – VIII**	**6**	**4**	**20**	**80**	**100**

Course Title	**Molecular and Human Genetics, Cell & Molecular Biology, Histology and Comparative Animal Physiology - Practical - II**

SYLLABUS	
Contents	**Hours**
MOLECULAR AND HUMAN GENETICS ABO Blood groups & Rh - Genetic significance Staining of chromosomes and G- banding. Human Karyotyping Human Pedigree analysis Calculation of gene frequency for Dominant, recessive, and multiple alleles	
CELL AND MOLECULAR BIOLOGY Human Buccal Smear Cockroach Haemolymph smear Mounting of Sarcomere, Columnar epithelial cells, ciliated epithelial cell Isolation of nuclei from Animal cells. Isolation of subcellular organelles from cells (Lysosomes) Staining of mitochondria. Isolation of DNA from animal tissue Isolation of plasmid from bacteria (demo) Agarose gel electrophoresis of DNA samples (demo)	
ANIMAL PHYSIOLOGY Quantitative estimation of Amylase activity Quantitative estimation of Ammonia and Urea Rate of Salt loss and Salt gain in Fish using different experimental media Estimation of Blood Chlorides Rate of oxygen consumption in experimental fish	
SPOTTERS: Drosophila Male and Female Drosophila Mutants – White eye and Vestigial wings Human Karyotype Human Pedigree Chart. F1 Plasmid (E.coli) Haemoglobinometer. Kymograph DPX Mountant Microtome Wax block Prepared stained slides of tissue sections (For 1 Protein, 2 Carbohydrate, and 3 Lipid)	**90**
MICROTECHNIQUE (HISTOLOGY) Preparation of permanent serial sections of tissues Liver, spleen, lungs of Sheep / Goat (10 slides). Tissue sections and histochemical staining for identification of cell structure, protein, carbohydrate and lipids. **EDUCATIONAL TOUR** Visit to R & D labs and different natural habitats related to the above subjects and submission of report is compulsory. **RECORD WORK** A record of laboratory work shall be submitted at the time of Practical examination. Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:	

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Acquire skill on Drosophila genetics, Chromosome and staining techniques and Calculation of gene Frequency.	**K2**
CO2	Identify tissue types; Isolate cells and sub cellular organelles & acquire knowledge on DNA and Plasmids	**K3**
CO3	Estimate amylase activity, ammonia, urea and blood chlorides	**K4**
CO4	Understand and design microtechnique; apply histochemical staining of tissues.	**K5**
CO5	Visit to Research Institutes and acquire knowledge on natural environment and ecosystems.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2.7**
Mean Overall Score											**2.7**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. I. Hussian Syed Bava

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PZO2DE2A	DISCIPLINE SPECIFIC ELECTIVES - II	6	4	25	75	100

Course Title	BIOTECHNOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**RECOMBINANT DNA TECHNOLOGY** Vectors: properties of ideal vector, types of vectors - Plasmids- Bacteriophages, Cosmids, * Shuttle vectors *. Artificial chromosomes (YACs, BACs, PACs, MACs and HACs). Methods of Gene Transfer. Construction of genomic libraries: Shotgun cloning and cDNA libraries. Molecular Tools of Genetic Engineering: Restriction endonucleases - DNA ligases- Alkaline Phosphatase – Nucleases – Polymerases- Reverse transcriptase.	**18**
II	**MOLECULAR TECHNIQUES** & MARKERS *DNA Sequencing* – Maxam & Gilbert method and Sangar Coulson method. *Gene Amplification*: PCR Technique, Types and Applications – Automated DNA sequencing, Cycle sequencing and Next generation sequencing, Nanopores, ion torrent sequencing and *fluorescent dyes*. Blotting techniques: Southern and Northern blotting. DNA Fingerprinting **and** ***DNA Markers*:** RFLP, RAPD, Satellite, cell finishing, VNTR, STR, SNP.	**18**
III	**ANIMAL AND MEDICAL BIOTECHNOLOGY** **Animal cell culture technology**: Primary culture- secondary culture - cell lines- Organ culture - whole embryo culture. Methods involved and applications– Stem cell culture and preservation. *DNA in Disease Diagnosis*: DNA Probes, chip & Microarray. *Gene Therapy–Ex vivo* and *in vivo* therapy- *Vectors used for gene therapy* Vector delivery system.	**18**
IV	**INDUSTRIAL BIOTECHNOLOGY** Methods of Fermentation: Types- batch – continuous and fed-batch systems – Fermenter designs – Scale up microbial process - Upstream and Downstream processing– Production of hormones, vaccines, Vitamins and Enzymes. Immobilization of enzymes and its applications. Production and application of monoclonal and polyclonal antibody * Single Cell Proteins*.	**18**
V	**Environmental Biotechnology** Bioremediation: Bioreduction, Biofilteration, Biosensor, eDNA, Biosorption, Bioleaching of Heavy Metals and Ores: Copper and Gold. Wastewater Treatment: Biological Treatment System – Aerobic and Anaerobic Treatment. Sewage Treatment Plant- Distilleries, Tannery effluent. *Risks in Biotechnology* Biosafety, Bioethics. GMOs.	**18**
VI	**Current Trends (For CIA only) –** Plasmid databases, Human stem cell cloning, Biorepository, NCBI.	

……. Self Study

Text Book(s):
1. Satyanarayana, U, Biotechnology, Books and Allied (P) Ltd., Kolkata. 2009.

Reference Book(s):
1. Gupta, P. K., Biotechnology and Genetics. Rastogi Publications, Meerut. 2004. 2. Brown, C.M., Campbell, I. and Priest, F.G. Introduction to Biotechnology. Blackwell Scientific Publications, U.K(1988). 3. Old, R. W and Primrose, S B., Principles of Gene Manipulation, An Introduction to Genetic Engineering, Oxford Blackwell Scientific Publications. 1989. 4. Primrose, S. B. Modern Biotechnology. Blackwell Scientific Publications, Oxford, London. 1989. 5. Prentis, S. Biotechnology New Industrial Revolution, Orbis, London. 1985. 6. Smith John, E. Biotechnology. Edward Arnold, London. 1988.
Web Resource(s):
1. ebookpdf.com/recombinant-dna-technology 2. www.khanacademy.org › tag › pcr 3. www.khanacademy.org › science › biology › biotech-dna-technology 4. www.vanderbilt.edu › viibre › Cell CultureBasicsEU

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Explain and relate the basic principles in rDNA technology, methods of fermentation and bioremediation	**K1 & K2**
CO2	Apply the basic concepts of molecular techniques, markers animal cell culture	**K3**
CO3	Analyze the principle of gene sequencing methods, Upstream and Downstream processing	**K4**
CO4	Evaluate the methods and applications involved in stem cell preservation, gene therapy, production of hormones and vaccines	**K5**
CO5	Adapt cleaner technology through bioremediation and bioagumentation.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2.8**
CO2	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2.6**
CO3	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO4	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2.6**
CO5	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**3**	**2.6**
										Mean Overall Score	**2.68**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. MOHAMED HUSSAIN

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PZO2DE2B	DISCIPLINE SPECIFIC ELECTIVES – II	6	4	25	75	100
Course Title	ENDOCRINOLOGY						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Scope of Endocrinology** Scope of Endocrinology – Hormones – Properties – Chemical structure – Synthesis – classification – Characteristic features of hormones –General and principles of hormone action, Feedback control, Cell signalling and hormonal action – *Cyclic AMP*.	**18**
II	**Endocrine glands** Hormone functions – pituitary (hypophysis): Adenohypophysial and Neurohypophysial hormones – Thyroid – Pancreas – Adrenal – Pineal gland (Epiphysis) – *Tissue hormones*.	**18**
III	**Endocrine Hormones** Reproductive hormones: Ovary and Testis – Hormonal control of mammary glands, ovarian cycles, pregnancy and Lactation – *Placenta and its endocrine function*, Prostaglandins.	**18**
IV	**Endocrine metabolism** Gastrointestinal hormones and its function – regulation of hormone metabolism and mineral metabolism – carbohydrate– nitrogen – lipid. Metabolism. Influence of hormones on growth and development – Hormones and calcium – *phosphate homeostasis*.	**18**
V	**Hormonal regulation** Hormonal regulation of osmoregulation – Thermoregulation – Hormones and behaviour – Hormones regulation on migration – Regeneration – *Amphibian and insect Metamorphosis*, Endocrine disruptors.	**18**
VI	**Current Trends (For CIA only)** Covid 19 & Related hormonal changes.	

***……..* Self Study**

Text Book(s):

1. Chandra, S. Negi, Introduction to Endocrinology, PHI Learning Pvt. Ltd., New Delhi. 2009.

Reference Book(s):

1. Wiliam, R. H., Textbook of Endocrinology, W. B. Saunders.2011.
2. Gorbman et al., Comparative Endocrinology, John Wiley & Sons,2013.
3. Yadav, B. N., Mammalian Endocrinology, Vishal Publishing Co., Jalandhar,2000.

Web Resource(s):

1. www.endocrinology.org 2. www.hormone.org

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Determine the general principles and scope of Endocrinology	**K2**
CO2	Explain the integrated function of endocrine glands in regulation of body functions	**K3**
CO3	Relate the role of hormones in reproduction.	**K4**
CO4	Propose the intrinsic relationship existing between hormones and metabolism	**K5**
CO5	Evaluate the impact of hormones in response to internal and external environmental changes.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	3	**1**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO2	**3**	**3**	**1**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO3	**3**	**3**	**1**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO4	**3**	**3**	**1**	**1**	**2**	**3**	**1**	**3**	**3**	**1**	**2.1**
CO5	**3**	**3**	**1**	**1**	**1**	**3**	**1**	**3**	**3**	**1**	**2.1**
Mean Overall Score											**2.04**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: P.A. ASHIQUE

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PZO3CC9	Core – IX	6	6	25	75	100

Course Title	BIOCHEMISTRY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**BIOMOLECULES: CARBOHYDRATES, LIPDS AND NUCLEIC ACIDS** Structure and Properties of: Carbohydrates (mono, di and polysaccharides) – Lipids (fatty acids, triglycerides, phospholipids and steroids) – Proteins (amino acid classification) Nucleic acid: Molecular structure, Chemistry, Types and Properties of DNA and RNA. *Biomolecule interaction - van der Waals, electrostatic, hydrogen bonding*	18
II	**STRUCTURE OF PROTEINS AND ENZYME KINETICS** Conformation of proteins (Primary, Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) -. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis *isoenzymes*	18
III	**VITAMINS AND HORMONES:** Structure, Properties, Functions of fat soluble (A, D, E, and K) and water soluble vitamins (B and C). Structure, Properties, Functions of animal hormones; hormones of pituitary thyroid, adrenal, pancreas, and gonadotrophins.	18
IV	**CARBOHYDRATE METABOLISM AND PROTEIN METABOLISM:** Types of metabolism. Carbohydrate metabolism - glycolysis, TCA cycle, oxidative phosphorylation, Gluconeogenesis, glycogen metabolism - Glycogenesis and Glycogenosis, HMP shunt, uronicacid pathway, Protein Metabolism: Metabolism of Amino acid – Ammonia and Urea cycle	18
V	**LIPID METABOLISM AND PURINE AND PYRIMIDINE METABOLISM:** Metabolism of Triglycerides, Fatty acid oxidation – Ketone bodies – Metabolism of Phospholipids – Glycolipids – synthesis of fatty acids - biosynthesis of Cholesterol - HDL and LDL – Biosynthesis and breakdown of Purines and Pyrimidines. *Metabolism: DNA – RNA*	18
VI	**Current Trends (For CIA only**) Syntheis of Nanoparticles (Zinc, copper, Lead oxide -s)	

*…….*Self Study

Text Book(s):

1. Michael M. Cox, David L. Nelson., Lehninger Principles of Biochemistry, W.H. Freeman & Company, New York. 2010

Reference Book(s):

1. 1Jeremy M. Berg ,Lubert Stryer, John L. Tymoczko , Gregory J. Gatto , W.H. Freeman & Company, New York. 2019.
2. Narayanan,L.M., Nallasingam, K, Arumugam, N, Fathima, D., Pillai,R.P.M.,Kumar,S.P. Biochemistry- Saras publication. Nagercoil. 2003.
3. Frankton J.S. & S. Simmonds, G.General and R.H.Dol. Outlines of Biochemistry John Wiley & Sons. 1987.
4. Baldwin, E. An introduction to comparative Biochemistry, CUP, London. 1964.

Web Resource(s):
1. https://www.pdfdrive.com/textbook-of-biochemistry-e14983388.html 2. https://www.pdfdrive.com/textbook-of-biochemistry-for-medical-students-6th- edition-e56002358.html 3. https://www.google.com/url?sa=t&source=web&rct=j&url=https://labalbaha.files.wordpress.com/2014/04/fundamentals-of-biochemistry.pdf&ved=2ahUKEwjas-K-jsAhUGzTgGHTTPBdwQFjAIegQICRAB&usg=AOvVaw2NKyE0rUKlfhobMe8JTixa

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand and Differentiate biomolecules and macromolecules;	**K3**
CO2	Understand the structure and enzyme kinetics	**K3**
CO3	Analyse Metabolism and functions of vitamins and hormones	**K4**
CO4	Cellular respiration, carbohydrate and nitrogenous bases metabolism	**K5**
CO5	Evaluate the Protein and lipid metabolism at optimal health.	**K4**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	2	2	3	2	3	2	2	2.2
CO2	2	2	3	2	2	1	2	3	3	3	2.3
CO3	3	2	2	2	3	3	3	2	2	2	2.4
CO4	2	3	3	2	2	2	3	2	3	2	2.4
CO5	3	2	3	2	1	2	3	3	3	2	2.4
									Mean Overall Score		**2.3**
									Correlation		**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. Meeramaideen

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PZO3CC10	Core - X	6	5	25	75	100

Course Title	IMMUNOLOGY

SYLLABUS		
Unit	**CONTENTS**	**Hours**
I	**Concept of Immune System** External and internal defence system – First line (innate) and second line (acquired) of defence – Primary and Secondary lymphoid organs and lymphoid tissues. Anatomical location, structure and functions- Immunoreactive cells - macrophages, granulocytes, NK cells, T and B lymphocytes - *Role of cells in immune response*.	18
II	**Antigen and Antibody** Antigen: Definition, Types Characteristic features and classification – Basis of antigen specificity - Adjuvants – Definition types and applications Immunoglobulins: structure, types, distribution, biological and chemical properties - *Theories of antibody production- its regulation and diversity*. Monoclonal and polyclonal antibodies. – Vaccines- types, preparations and efficacies.	18
III	**Effector Mechanism and Complement system** Immune response: Hormonal immune response - Cell mediated immune response. Cytokines: Properties – General structure and functions – interferon – origin – types and functions. *Interleukins – type and functions* - Complement – definition – salient features – mode of activation- Classical, Alternate and Lectin pathways - biological functions	18
IV	**Immune Response and diseases** Hypersensitivity – types, mechanisms and Immune manifestations – Auto Immune Diseases – types, onset and spectrum of diseases - Immuno deficiency diseases – types – congenital and acquired - Tumor immunology – Immune response to tumor – Transplantation immunology – *Allograft rejection – types and mechanism* - MHC – types and importance- distribution and function	18
V	**Immunological Tests** Precipitin curve, Immuno diffusion, one and two dimensional, single radial immuno diffusion, Ouchterlony immunodiffusion - Immuno-electrophoresis: Rocket immuno-electrophoresis; - Agglutination: Direct and Indirect, – ELISA – Principle, Methodology and applications - Immuno-fluorescence: Direct and indirect method *Western Blotting technique*	18
VI	**Current Trends (For CIA only) –** • Immuno suppression - General mechanisms of Immune suppression, Immune suppression, drugs (azothioprine, methotrexate, cyclophosphamide, cycosporin-A, Steroids). • Immunization - schedules and importance in public health.	

……. Self Study

Text Book(s):

Text Book: Roitt, Immunology, (3rd Edition), Crover Medical Publishing Company, London.2011.

Reference Book(s):

1.Barret, J. T. Text Book of Immunology, (5th Edition).The C.V. Mosly, Company, 1983.

2. Chakravarthy, A.K., Immunology, Tata McGraw Hill Publishing Company, New Delhi. 1993.

3.Richard, H.M., Immunology (2nd Edition), Williams and Wilkins, Baltimore Maryland. 1992.

4.Hidemann, W.H. Essentials of Immunology, Elsevier Science Publishing, Co. Inc. 1980.

5.Weinn. D.M. and Steward, L. Immunology, Singapore Publishers Private Limited.1993

Web Resource(s):
1. https://www.ncbi.nlm.nih.gov/books/NBK279395/ 2. https://www.sciencedirect.com/topics/medicine-and-dentistry/organs-of-the-immune-system 3. https://www.immunology.org/public-information/bitesized-immunology/systems-and-processes/complement-system 4. https://www.immunopaedia.org.za/immunology/archive/type-i-iv-hypersensitivity-reactions/immune-complex-formation/hypersensitivity-reactions/ 5. https://courses.lumenlearning.com/boundless-microbiology/chapter/the-major-histocompatibility-complex-mhc/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the concepts of immunity, external and internal defence system and contributions of the organs and cells in immune responses.	K2 & K3
CO2	Analyse the role of antigens and antibodies in immune response	K4
CO3	Differentiate the humoral and cell mediated immune response and analyse the mechanisms involved in initiation of specific immune response	K4
CO4	Summarize the immune manifestations and point out the immune response to tumour	K5
CO5	Compare the sensitivity and specificity of different diagnostic immunological techniques	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	2	1	2	3	2	3	2	2	2.1
CO2	2	2	3	2	2	1	2	3	3	3	2.3
CO3	3	2	2	2	3	3	3	2	2	3	2.5
CO4	2	3	3	2	2	2	3	2	3	2	2.4
CO5	3	2	3	2	1	2	3	3	2	2	2.3
										Mean Overall Score	2.32
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. ANEEZ MOHAMED

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PZO3CC11	Core – XI	6	5	25	75	100

Course Title	BIOSTATISTICS AND BIOINFORMATICS

SYLLABUS		
Unit	**Contents**	**Hours**
I	**CORRELATION AND REGRESSION:** Correlation: - simple correlation, Carl Pearson coefficient - correlation for grouped data - multiple correlation and * rank correlation *. Regression equation – Line of Regression, Regression X on Y and Y on X– Ratio of variation - Linear regression - Multiple regression	**18**
II	**HYPOTHESIS TESTING & ANOVA:** Hypothesis testing; Student 't' test, * Chi-square test *, F – test and Z test. Confidence limits. ANOVA: One way for samples within samples, F values and Critical values.	**18**
III	**TIME SERIES AND INDEX NUMBER** Analysis of time series: Average method, least square method - Association of attributes and coefficient of association – * Sampling of attributes* – Index numbers and construction methods – Interpolation and extrapolation - Statistical packages in Biostatistics – SPSS	**18**
IV	**BIOLOGICAL DATABASES** Biological Databases: Nucleotide sequence Databases; GenBank and DDBJ - Protein Sequence Databases; Prosite and PIR - Protein structure Database; PDB SCOP, – Gene Expression Database; ArrayExpress, Ensembl – Metabolic pathway Database MetaCyc, ExPAsy, WIT, – * Specialized Database; dbEST * - Genome data bases; GDB, Entrez Genome	**18**
V	**TOOLS OF BIOINFORMATICS** Sequence Alignments: Global and Local Sequence Alignments – Multiple Sequence Alignments and structural alignment - Bioinformatics tools –* FASTA, BLAST *, SRS, LocusLink Clustal W, RasMol and Swiss-Pdb viewer, MMTK - Molecular phylogenetic analysis and construction of phylogenetic tree	**18**
VI	**Current Trends * (For CIA only) –** Contemporary developments related to the course during the semester concerned. Drug repositioning, Drug discovering, Ptotein remote homology detection and application of computational methods to protein sequence analysis.	

..... Self Study

Text Book(s):

1. Arora, P.N. Biostatistics. Himalaya Publishing House. 2018.
2. Subramanian, C. A Text book of Bioinformatics, Dominant Publishers and Distributors. New Delhi, India. 2015.

Reference Book(s):
1. Sokal, R.J. and Rohlf, S.J. Introduction to Biostatistics, W.H. Freeman, London. 1981. 2. Ramakrishnan, P. Biostatistics, Saras Publications, Nagercoil. 1996. 3. Irfan Ali Khan and AtiyaKhanum.Fundamentals of Bioinformatics.Ukaaz Publications Hyderabad, AP, India. 2003. 4. Arthur M Lesk Introduction to bioinformatics. Oxford University Press. Oxford, United Kingdom 2014. 5. Murthy, C.S.V. Bioinformatics. Himalaya Publishing House. Mumbai, Delhi, Nagpur, Bangalore, Hyderabad, India. 2003. 6. Mittal, C. Fundamentals of Information Technology, Praghati Prakasam, Meerut.2003 7. Xiong J. Essential Bioinformatics. Texas A & M University. Cambridge University Press 2006 8. ZAR, J. H. Biostatistical Analysis. Pearson Education Pvt. Ltd. Singapore.2007. 9. Kapur, S. Elements of practical statistics. Oxford&IBH Publishing Company 2008
Web Resource(s):
1. https://web2.ph.utexas.edu/~mwguthrie/t.theory_of_distributions.pdf 2. https://sites.calvin.edu/scofield/courses/m143/materials/handouts/anova1And2.pdf 3. https://www.sjsu.edu/faculty/gerstman/StatPrimer/regression.pdf 4. https://www.ncbi.nlm.nih.gov/ 5. https://pubmed.ncbi.nlm.nih.gov/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand and apply practical knowledge of correlation and regression	**K3**
CO2	Acquire knowledge of doing Hypothesis testing and ANOVA.	**K3**
CO3	Apply statistical knowledge such as making graphs, index numbers and interpolation.	**K3**
CO4	Analyse and Explore the biological databases	**K3**
CO5	Generate sequence alignment and prepare Molecular phylogenetic analysis and construction of phylogenetic tree	**K3**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2.7**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2.7**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2.7**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2.7**
										Mean Overall Score	**2.7**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Mr. S.N. Sheik Umar Sahith

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PZO3CC12P	Core – XII	6	4	20	80	100

Course Title	BIOCHEMISTRY, IMMUNOLOGY, BIOSTATISTICS AND BIOINFORMATICS - PRACTICAL - III

SYLLABUS		
Unit	**Contents**	**Hours**
I	BIOCHEMISTRY Preparation of solutions: Percentage, Molarity, Normality. Buffer preparation: Phosphate buffer, Acetate buffer– Determination of pH using pH meter. Quantitative estimation of: Proteins, Amino acids, Carbohydrates and Lipids in tissue samples. Separation of amino acids by paper chromatography.	**18**
II	IMMUNOLOGY Lymphoid organs- Primary and Secondary. Separation of lymphocytes, Immunodiffusion - Immunoelectrophoresis (Demo) – ELISA. Immunoblotting techniques. Blood group matching (Compatibility test for ABO Blood Grouping)	**18**
III	Biostatistics: Statistics using MS EXCEL: Production of bar diagrams and pie charts from statistical data. Correlation, Regression, Moving average, t-Test , z-Test, ANOVA - One way and Two way analysis.	**18**
IV	Bioinformatics: Similarity search for Nucleotide Sequences and protein sequences using BLAST, FASTA and clustalW. Protein structure determination (prediction) using SWISS-MODEL, PyMOL	**18**
V	Educational Tour: Visit to R & D labs and submission of tour report	**18**
VI	**Current Trends (For CIA only) –** Contemporary developments related to the course during the semester concerned. Observation Record. A record of lab work shall be maintained and submitted at the time of Practical Examination for valuation	

Text Book(s):
Reference Book(s):
1. David T Plummer An introduction to Practical biochemistry 3rd edition 1978 2. Shaney and Randir singh Practical biochemistry 3. Lisa M Sullivan Essentials of biostatistics workbook, stistical computing Using Excel 2007 2012 Jones & Bartlrtt learning , LLC
Web Resource(s):
1. https://www.ncbi.nlm.nih.gov/ 2. https://pubmed.ncbi.nlm.nih.gov/ 3. https://blast.ncbi.nlm.nih.gov/Blast.cgi 4. https://www.embl.org/ 5 https://prosite.expasy.org/ 6. http://www.wwpdb.org

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Acquire knowledge on the preparation of solutions, buffers; estimate the quantum of protein, amino acids and lipids.	**K5**
CO2	Learn and relate the techniques of immunodiffusion, immunoelectrophoresis and blotting..	**K5**
CO3	Analyze biological data using biostatistical tools.	**K5**
CO4	Understand and apply basic knowledge on bioinformatics	**K5**
CO5	Exposure to R&D labs and planning career.	**K5**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
Mean Overall Score											**2.7**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M.I. Hussain Syed Bava

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PZO3DE3A	Discipline Specific Electives - III	6	4	25	75	100

Course Title	Animal Behaviour and Biodiversity Conservation

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Ethology** Animal behavior: Classification, instinct, imprinting, learning, foraging and feeding behaviour. Adaptive value of behavior - Habituation and conditioning - Instinct versus learning - Circadian and circannual rhythms. Social behavior in insects. *Kin selection concept, Altruism*.	18
II	**Communication Behaviour** Visual communication – Dance language of honey bee; mating dance of birds. Chemical communication – Pheromones of insects and mammals. *Migration of fishes* and birds. Human behaviour – Neuronal control; Mania; Excitement and Depression; Schizophrenia; Alzheimer's disease.	18
III	**Biodiversity and Species concepts** Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - *Inventory Survey methods in Animal diversity* - Biodiversity Hotspots (Western Ghats, Indo - Burma region). *Commemorative days on ecological importance*.	18
IV	**Threats to animal diversity and conservation tools** Extinctions: Past rates of Extinction - Threats to animal diversity in India - IUCN Red list - Status of species: Rare, endemic, threatened and endangered species - Status of Indian animals. In situ and Ex situ conservation of Indian animals - *Project Tiger and Elephant*.	18
V	**Animal Laws and Policies in India** Wildlife (Protection) Act of India (1972) - Protected Area Network - Zoo policy - Laws and their applications in Zoological parks, Wildlife sanctuaries and Biosphere reserves. Global Conservation Organizations - Role of NGO's and Government organizations in Wildlife Conservation - *Wildlife trade* - Wildlife documentation.	18
VI	**Current Trends (For CIA only)** • Impact of invasive species on different Ecosystems Ethological and ecological approaches on studying behaviour	

* ……* Self Study

Text Book(s):

1. P.D.Sharma., Ecology and Environment, Rastogi Publication, Meerut. 2012.

Reference Book(s):

1. Lee Alan Dugatkin., Principles of Animal Behavior, 4th Edition, University of Chicago Press, 2020.
2. Mohan P. Arora., Animal Behavior, Himalaya Publishing House, 1995.
3. Reena mathur., Animal Behaviour, Rastogi Publication, Meerut. 2010.
4. Michael Begon, John L. Harper Colin R. Townsend., Ecology (Individuals, population and Communities), Wiley, 2005.
5. Hoshang S. Gunderia and Hare Govind Singh., The Text Book of Animal behaviour, S. Chand & Co, 2005.

Web Resource(s):
1. https://www.khanacademy.org/science/biology/behavioral-biology/animal-behavior/a/intro-toanimal-behavior 2. https://www.nature.com/scitable/knowledge/library/an-introduction-to-animal-communication23648715/ 3. https://www.greenfacts.org/en/biodiversity/l-3/1-define-biodiversity.htm 4. https://www.bioexplorer.net/threats-to-biodiversity.html/ 5. https://peepalfarm.org/animalrights

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the concepts of behavioural patterns of various organisms and their lifestyle.	K2 & K3
CO2	Describe visual and chemical mode of communication among insects and birds.	K3
CO3	Investigate the role of biodiversity on maintenance of ecosystem.	K3, K4
CO4	Visualise threats and values of biodiversity and conservations.	K3
CO5	Educate and apply the Laws on protection of wildlife and biodiversity.	K5

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	2	1	2	3	2	1	2	2	1.8
CO2	2	2	3	2	2	1	2	3	3	3	2.3
CO3	3	2	2	2	3	3	3	2	2	3	2.5
CO4	2	3	3	2	2	2	3	2	3	2	2.4
CO5	3	1	3	2	1	2	3	3	1	2	2.1
										Mean Overall Score	2.22
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. Salahudeen

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PZO3DE3B	DSE – III	6	4	25	75	100
Course Title	AQUACULTURE AND FARM MANAGEMENT						

SYLLABUS		
Unit	Contents	Hours
I	**Aquaculture: Introduction and Farm management:** Defnition – Scope - Aquaculture in India – Aquaculture production -Types of aquaculture – Site selection Construction of pond - Management of farm – weed control- Predator control – Stocking of young fishes – Supplementary feeding – Disease control and caring of fishes – Fish pond implement – Fish pond record.	18
II	**Water quality management in Aquaculture:** Determination of water quality- Visibility -Temperature – Oxygen content – Carbon dioxide - Salinity- pH – BOD- Plankton population – Nitrogen – Potassium – Phosphorus – Assessment of water quality – water quality management methods.	18
III	**Culture system:** Definition – Fresh water aquaculture – Brackish water aquaculture – Mariculture – Intensive culture – Semi intensive culture – Pokkli culture –Raceway culture – Pen culture – Monoculture – Monosex culture- Polyculture – Integrated fish farming – Paddy cum fish culture –animal husbandry cum fish culture – Fish cum dairy farming – Pearl culture – Ornamental fish culture.	18
IV	**Seed production and collection techniques:** Natural methods; seed collection from natural habitat – Bund breeding – Artificial methods: Hypophysation method, synthetic hormones – Transport of fish seeds.	18
V	**Fish feed, Preservation of fishes and fish marketing and Government participation**: Live feed – Artificial feed – Nutritional requirement of fish – Composition of a ideal fish feed – Quality of good artificial feed – Feeding methods –Fish harvesting - Principles of fish preservation – Methods of fish preservation – Types of fish marketing – Cooperative society in aquaculture – CMFRI,CIFRI, CIBA, CIFT, MPEDA, EIA, IIP and FSI.	18
VI	**Current Trends (For CIA only) –** Contemporary developments related to the course during the semester concerned.	

Text Book(s):

1. Agarwal, S.C. A Hand Book of Fish Farming. Narendra Publishing House, New Delhi. 3rd
a. Edition, 1994.
2. Chakrabarthi, M.N., Biology, Culture and Production of Indian major carps, Narendra Publishing House, New Delhi. 2nd Edition, 1998

Reference Book(s):

1. Hall, C.B. Ponds and fish culture. Agrobotanical Publishers India. 1999.
2. Jhingran,V.G. Fish and fisheries of India, Hindustan Publishing Co., New Delhi. 1997.
3. Santhanam,R., Fisheries Science, Daya Publication House. New Delhi. 1990.
4. S.K. Gupta., P.K. Gupta., General and Applied Ichthyology (Fish and Fisheries). S. Chand & Company LTD, Ram Nagar, New Delhi, 2006.
5. Aquaculture, N. Arumugam., Saras Publication, 114/35 G, A.R.P Camp road, Periyakavilai, Kottar P.O. Nagercoil, Kanyakumari Dist. Second edition- 2010.
6. Fish and Fisheries. Santosh Kumar and Manju Tembhare., New Central book Agency (P) LTD, London, 2010.

Web Resource(s):
1. www.fishfarming.com › services › aquaculture-farm-m... 2. www.fao.org › FAO_Training › FAO_Training › Genera 3. www.en.wikipedia.org › wiki › Aquaculture 4. www.mpeda.gov.in

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the concepts of fish farming and their associated conditioning factors and how they can be manipulated.	**K5**
CO2	Acquire the knowledge about the water quality management for aquaculture.	**K5**
CO3	Describe basic culture methodologies, problems and solutions in aquaculture practice and farm management.	**K5**
CO4	Design and apply improved seed production techniques.	**K5**
CO5	Formulate fish feed and apply the knowledge of fish harvesting and marketing methods.	**K5**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
										Mean Overall Score	**2.7**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M.I. Hussain Syed Bava

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PZO4CC13	Core - XIII	6	6	25	75	100

Course Title	GENERAL AND APPLIED ENTOMOLOGY

SYLLABUS		
Unit	**CONTENTS**	**Hours**
I	**Insect Taxonomy and Morphology** Taxonomy: Basics of Insect classification. Salient features of the insect orders with common south Indian examples. Morphology: General structure of the insect head, thorax and abdomen. Types of antennae - *Wings – Venation*; Legs – types and modifications	18
II	**Insect Physiology** Integument – structure and chemistry – physiology of moulting. Digestive system: Structure of alimentary canal and physiology of digestion. Respiratory System: Aerial respiration – aquatic respiration Circulatory system: Structure of heart – Haemolymph –Haemocytes and their functions. Excretory system: Malpighian tubules – functions Nervous system: Structure and function of Compound eyes. Reproductive system: Male and female reproductive systems. *Accessory reproductive glands, their secretions and functions*. Neuroendocrine system of insects.	18
III	**Agricultural and Medical Entomology** Biology, damage caused and control methods of any THREE insect pests of Paddy, Sugarcane, Cotton, Coconut, and Ground nut. Stored product pests and their control Arthropods as vectors of human diseases - Biology, diseases transmitted and control methods of House fly, Mosquito, Flea *Role of government organizations in vector control*	18
IV	**Economic Importance of Insects** Sericulture: Biology and culture methods – types of silkworm – silkworm diseases Apiculture: Biology and types of honey bees – culture and rearing –bee keeping accessories and their by-products – *Natural enemies and diseases of honey bees* - Uses of Honey - Lac culture: Biology and rearing methods of Lac insect - Uses of Lac.	18
V	**Insect pest management** Insect Pest-Management strategies and tools- Natural and Artificial control of insect pests – Cultural, Mechanical, Physical and Legal methods. Biological control – Parasites, Predators and Microbial agents- Chemical methods – Pesticides – classification – types of formulations – mode of action –*Non-conventional methods - Insect Growth Regulators (IGR), Repellents, Antifeedants, Pheromones and Chemosterilants* - Integrated Pest Management (IPM) – principles, advantages and limitations	18
VI	Current Trends (For CIA only) – • Tackling Insect Invasions, Promoting Advancements in Technology, and Using Effective Science Communication for pest control • The New Integrated Pest Management Paradigm for the Modern Age	

*……. * Self Study

Text Book(s):

1. Chapman, R.F. The Insects: Structure and Function, Hodder and Bhoughton Ltd., Kent, U.S.A., 2015.

Reference Book(s):

1 Mani, M.S., General Entomology, Oxford and IBH publishing Co., New Delhi. 1982.

2. Snodgrass, R.E., Principles of Insect Morphology, McGraw Hill and Co., New York. 1985.

3. Nayar, K.K.., Ananthakrishnan,T.N., and David., M., General and Applied Entomology, Tata McGraw Hill Pub. Co., Ltd., New York. 1995.

4. Vasantharaj David, B., Elements of Economic Entomology, Popular Book Depot., Chennai – 15. 2001.

5. Nayar, K.K. et al., Economic Entomology and Applied Entomology, Oxford and IBH Publishing Co., New Delhi. 1983.

6. Rathinaswamy,T.K., Medical Entomology, S. Viswanathan and Co., Madras,1986.

7. Nalina Sundari, M.S., and R. Santhi, Entomology, MJP Publishers, Chennai. 2006.

Web Resource(s):

1. www.mheducation.co.in › ... › entomology
2. www.pdfdrive.com › general-and-applied-entomology
3. www.pdfdrive.com › general-and-applied-entomology-.

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Classify insects using morphological information.	K2 & K3
CO2	Relate the structure and physiology of insect systems, including their functional mechanisms	K4
CO3	Discuss the damages caused by insect pests on agriculture and report disease causing vectors and their control measures.	K4
CO4	Analyse the economic importance of various insects	K5
CO5	Validate the different control methods employed in the successful management of insect pests.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	3	2	3	2	2	2.2
CO2	2	2	3	2	2	1	2	3	3	3	2.3
CO3	3	2	2	2	3	3	3	2	2	2	2.4
CO4	2	3	3	2	2	2	3	2	3	2	2.4
CO5	3	2	3	2	1	2	3	3	3	2	2.4
										Mean Overall Score	2.33
										Correlation	Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. ANEEZ MOHAMED

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PZO4CC14	Core - XIV	6	6	25	75	100

Course Title	Microbiology and Vaccinology

SYLLABUS		
Unit	Contents	Hours
I	**UNIT I: Introduction to Microbes**: Classification of Microorganisms - Morphological shapes of bacteria and Virus. Bacterial growth: Growth curve, Factors affecting bacterial growth, Measurement ofbacterial growth- Microbial culture – Types of Culture media – Method of Culturing Bacteria- Isolation and Purification Techniques – sterilization techniques– Safe Disposal of Microbial culture waste- Safety precautions of Microbiology laboratory.*Differentiation of Gram positive and Gram negative bacterial cell walls* -	18
II	**UNIT II: Food Microbiology** : Normal Microbial flora of common food– food infection - food poisoning– food preservation – Microbiology of Milk and Milk Products- Bakery Products– Detection of food borne pathogens – Food Sanitation –Food control agencies and their regulations - Enumeration of bacteria in water- ISI and BIS Regulations for packaged drinking water.*Food spoilage*	18
III	**UNIT III: Industrial and Agroenvironmental Microbiology** : Microorganisms used in Industries - Major products of Industrial Microbiology: Ethanol, Antibiotics - Vitamin-B12 – Industrial Applications of Microbial Enzymes – Bioreactors and Types – Biopolymers – Biosurfactants –Types of Biofuels - Biodiesel Production and Spirulina. *Organic acids (Citric acid and Glutamic acid)*- Soil Microbes, Biofertilizers, Biopesticides, Bioleaching of metals-Biodegradation using microbial communities — Xenobiotics and Heavy metals degradation in water and soil -Biodeterioration	18
IV	**UNIT IV: Medical Microbiology :** Microbial diseases - Causative agents, Mode of transmission, Symptoms, Prevention & Control - Protozoan diseases: Plasmodium, Entamoeba. Fungal diseases: Mycosis - Mycotoxicosis. Bacterial diseases: Tuberculosis (TB) – Leprosy – Tetanus – Typhoid - Gonorrhea and Syphilis. Viral diseases: Polio – Chicken box- Hepatitis B – AIDS, Corona, Dengue, Nipah, Ebola, Swine flu *Rabies*	18
V	**UNIT V: Vaccinology:** Vaccine and Types of vaccines – Whole organism: Killed and Live attenuated. Subunit vaccines – purified macromolecules: Toxoid – Bacterial and viral components as vaccines. Vaccines development and clinical trials –features of effective vaccinations – Advantages and limitations of vaccines. Isolation of pathogens for vaccine development. Role of cell lines in Vaccine development, Thiomersal and vaccine, Role of CD4 cells in vaccination. – Vaccine storage and transport *T cell vaccines* Immunization schedule in India.	18
VI	Current Trends * Probiotic Foods and Immuno-therapeutic	

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Text Book(s):

1. Pelczar, Chan and Krieg. Microbiology, Tata McGraw Hill Pub. Co. Ltd. 1993.

Reference Book(s):

1. Sulia, S.B & Santhanam, S. General Microbiology, Oxford and IBH. 2001.
2. Thomas, C.G.A. Medical Microbiology, ELBS Publications. 1988.
3. Sharma, P.D. Microbiology - Rastogi Publications, Meerut. 1993.
4. Ananthanarayanan, R and Jayaram Panicker, C.K. Text Book of Microbiology, Orient Longman, Chennai and Hyderabad. 2000.
5. Dubey R.C and Maheswari D.K. Text book of Microbiology, S.Chand and Company Ltd, New Delhi. 2009.

Web Resource(s):
1.https://www.moscmm.org/pdf/Ananthanarayan%20microbio.pdf 2.http://www.freebookcentre.net/medical_text_books_journals/microbiology_ebooks_online texts download.html 3.https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Kaiser) 4.https://www.pdfdrive.com/medical-microbiology-d18737002.html 5.https://www.health.govt.nz/our-work/immunisation-handbook-2020/1-general-immunisationprinciples

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	1. Understand the basic structure of microbes, Demonstrate theoretical skills in sterilization, Bacterial Culture and staining techniques.	**K3**
CO2	2. Analyse the role of microorganisms in fermented foods, know the spoilage mechanisms in foods and basis of food safety and regulations.	**K4**
CO3	3. Evaluate microbiological role in the manufacture of industrial products; solve environmental problems.	**K5**
CO4	4. Apply the basic principles, mechanism of transmission, diagnose and control of infectious diseases.	**K3**
CO5	5. Examine the basic principles of vaccinology to develop and isolation of vaccine and vaccination.	**K4 &K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	1	2	3	2	2	2	2.1
CO2	2	2	3	3	3	3	2	3	2	2	2.5
CO3	3	3	2	3	2	3	3	3	3	3	2.8
CO4	3	2	3	2	3	3	2	2	2	3	2.5
CO5	3	3	2	3	3	2	3	3	3	2	2.7
									Mean Overall Score		2.52
									Correlation		High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator : Dr. R. Krishnamoorthy

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PZO4CC15P	CORE - XV	6	5	20	80	100
Course Title	General and Applied Entomology and Microbiology & Vaccinology – Practical - IV						

SYLLABUS		
Unit	**Contents**	**Hours**
	I. Collection and Identification of Insects, their parts and stages 1. Collection and preservation of insects 2. Identification of insects belonging to important orders and super families using Dichotomous key. 3. Identification of beneficial insects, predators and parasites (relevant to biological control). 4. Identification of harmful insects (two examples for each of the plants mentioned in theory). 5. Identification of household pests and Vectors. 6. Study of types of larvae and pupae. Study of types of antennae, legs, wings, mouth parts and external genitalia.	**90**
	II. Mounting and Dissections 1. Mounting of mouth parts of bedbug, mosquito, honey bee and house fly. 2. Dissection of Digestive system, nervous system and reproductive systems of Grasshopper, Chrysocoris, Mylabris, House fly, Silk worm moth and Honey bee. 3. Dissection of Neuroendocrine system of cockroach, Dissection of silk gland of silk worm	
	III. Experiments 1. Estimation of insects respiratory rate using respirometer. 2. Experiment on the role of cuticular lipids in preventing transpiration. 3. Experiment on the functioning of Malpighian tubules (*in vitro* study) Insect haemolymph – Total and Differential counts of haemocyets.	
	MICROBIOLOGY AND VACCINOLOGY Culture Techniques Sterilization techniques Preparation of culture media Observation of Bacterial Motility – Hanging Drop Preparation Pure culture techniques Staining methods: Simple, Negative, acid fast, Gram staining, spore staining. Antibiotic Sensitivity Test - Kirby Bauer Diffusion Method Most Probable Number Test (MPN) Vaccination schedule for infants and adults.	
	Equipments in Microbiology Inoculation loop Autoclave Laminar flow hood Bacteriological Incubator Hot Air Oven Colony Counter Field Visits Visit to Sericulture units, Crop research stations, Farms and IPM Centers to have a first and knowledge on culture techniques and problems. Record work A record of laboratory work and submission of photograph of insects (including insects of economic importance) shall be made for the practical examination.	
	Current Trends (For CIA only) – Contemporary developments related to the course during the semester concerned.	

Text Book(s):
1. Dunston P. Ambrose. The Insects: Beneficial and Harmful aspects, Kalyani Publishers. New Delhi. 2007. 2. Dubey, R.C. and D.K. Maheshwari. Practical Microbiology. S. Chand & Company Ltd. New Delhi. 2010.
Reference Book(s):
1. Chapman, R.F. The insects: Structure and Function, Hodder and Bhoughton Ltd., Kent, U.S.A., 2015. 2. Nalina Sundari, M.S., and R. Santhi, Entomology, MJP Publishers, Chennai. 2006. 3. Sulaiman Alnaimat, . Saqer AbuShattal, Laboratory Manual in General Microbiology, 2012.
Web Resource(s):
1. https://wiki.bugwood.org/Collecting_insects. 2. www.biologydiscussion.com › culture-organism › obtain. 3. https;//bio.libretext.org. microbiology.

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the classification and identification of insects based on morphology.	**K2**
CO2	Analyse the behaviour, importance and physiology of insects	**K3**
CO3	Acquire knowledge on the impact of pests and the damages caused. Evaluate the importance of beneficial insects.	**K4**
CO4	Describe and demonstrate the different techniques in microbiology	**K5**
CO5	Apply the knowledge on preparation of microbial media and bacterial staining; determine the motility, antibiotic sensitivity of Bacteria.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	2	2	3	2	2	3	2	2.3
CO2	3	2	3	2	2	3	3	2	2	3	2.5
CO3	2	3	2	3	2	3	3	3	2	2	2.5
CO4	2	2	3	2	2	2	3	3	3	3	2.5
CO5	3	3	3	2	3	3	2	3	2	3	2.7
										Mean Overall Score	**2.54**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. Mohamed Hussain

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PZO4DE4A	DSE - IV	6	4	25	75	100

Course Title	RESEARCH METHODOLOGY, ETHICS & BIOINSTRUMENTATION

SYLLABUS		
UNIT	**Contents**	**Hours**
I	**Research and Designing** Good Laboratory Practice - Research – Objectives – Types, Importance and Processes – Literature search relevant articles – Use of Internet in Literature search - Identification and selection of Research Problem – Experimental design – *Planning and Execution of research* – Indoor and outdoor experiments – Interpretation of research results by statistical test.	**18**
II	**Thesis Writing , Journal Publication & Research Ethics** Components of thesis and Writing of thesis - Preparation of scientific research papers - Publication of research documents – Patents and patent publication – *Seminars, Conference and Symposia*. **Ethics** : Plagiarism - Fabrication – Data Fabrication – Falsification – Gift Authorship Research – Reduntant Publication – Salami Slicing in Research.	**18**
III	**Rearing and Culture of Model Organisms** Experiment Model organism - selection of model Animals and microorganisms – Rearing of animals in animal house, labs or outdoor units – Food and feeds - *culture and maintenance*. Exposure to experimental conditions (Physical and Chemical) - CPCSEA regulations.	**18**
IV	**Separation Techniques and Bioinstrumentation** Separation of sub cellular components, protein molecules, Enzymes, Lipid molecules, Nucleic acids, polysaccharides, Vitamins, Aminoacids and Antibiotcs. *Spectrophotometers*, Chromatographic instruments, Electrophoretic instruments, Centrifuges, Radiation counter, ELISA and Blotting Techniques.	**18**
V	Microtechnique and Microscopy Microtechnique: Preparation of organism or tissue samples - Permanent mounting – fixing – washing – Tissue processing – Staining – mounting – Labeling. Histochemistry – Carbohydrate, Protein, Lipid and Nucleic acids. Microscopy: *Light microscopes* and Electron microscopes (SEM and TEM) – Histological preparation of tissues for SEM and TEM.	**18**
VI	**Current Trends (For CIA only)** Modern Cell Culture Techniques, Culture of Organisms of Less sentience.	

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Text Book(s):

1. Palanichamy, S. and M. Shunmugavelu,. Research Methodology in Biological sciences. Palani Paramount publications, Palani. 1997.
2. Gurumani, N. Research Methodology for Biological Sciences. MJP Publishers, Chennai..2006.

Reference Book(s):

1. Anderson, D. P. Thesis and Assignment Writing, Wiley Eastern Limited 1970.
3. Pelczar, M.J. and R.D. Reid.. Microbiology. Tata Mc GrawHill, NewDelhi. 1996
4. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. 8th Edition, B.I. Waverly Pvt. Lid., New Delhi. 1995.
5. Das, H.K (Editor). Text book of Biotechnology. Wiley dreamtech India Pvt Ltd., New Delhi,2005.
6. Daniel, W.W. Biostatistics – A foundation for analysis in the Health sciences. John Wiley andSons, NewYork, 2000.
7. Gupta, P.K. Biotechnology and Genomics (I Edition) Rastogi Publications, Meerut, 2004.
8. Dubey, R.C and Maheshwari, D.K. A text book of microbiology. S.Chand & Co Ltd., New Delhi. 1999.

Web Resource(s):
1. https://gradcoach.com/what-is-research-methodology/ 2. https://www.sciencedirect.com/topics/engineering/bioinstrumentation

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand evolution concepts and its significance	**K2**
CO2	Acquire knowledge on Taxonomy	**K3**
CO3	Estimate water quality knowledge on pollution	**K4**
CO4	Explore various experiment in development biology	**K5**
CO5	Asses the role of GIS	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	2	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2.3**
CO2	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2.5**
CO3	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2.4**
CO5	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2.7**
Mean Overall Score											**2.5**
Correlation											Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. I. Joseph Antony Jerald

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PZO4DE4B	DSE - IV	6	4	25	75	100

Course Title	CLINICAL LAB TECHNOLOGY

SYLLABUS		
UNIT	**Contents**	**Hours**
I	**Essential Pre-Requisites of a Clinical Laboratory** Introduction – scope of the subject CLT – collection of specimens and preservation – records and report preparation and maintenance – cleaning, maintenance and care of glassware – sterilizations - physical and chemical methods – Disposal of specimen and infected materials – safety precautions in the laboratory – *First aid treatments* - Biomedical Waste Management.	**18**
II	**Laboratory Instruments** Light microscope: parts and working – Centrifuge – Weighing balance – Colorimeter –Spectrometer, Incubator - Haemocytometer – *Albuminometer* – Urinometer – Sahlis Haemoglobinometer	**18**
III	**Rearing and Culture of Model Organisms** Bacteria – structure and types – staining procedures – culture media and antibiotic sensitivity test. Sexually transmitted diseases: Syphilis, Gonorrhea, chancroid or soft sore, Donovanosis,Genital candidasis, Non-gonococcal urethrites, Corynebacterium vaginale and herpes genitalis, *Lymphogranuloma venereum*, Trichomonasis.	**18**
IV	**Haematological and Urine analysis** Blood: Collection of blood (Venous and Capillary) – Plasma and serum for analysis – Total RBC count – Total leucocytes count - differential count – Haemoglobin estimation (Sahlis methods) ESR (Wintrobe and Westegren methods) – Bleeding and clotting time – Estimation of packed cell volume – Blood grouping and cross matching (Slide and Tube methods) - Anti – D (Rho) test (slide, rapid tube and Du test). URINE : Collection, preservation, routine examinations – protein – glucose – acetone – bile salts – bile pigments – urobilin – urobilinogen – microscopical examination of urine FAECES: Microscopical examination – *intestinal parasites* – helminthes, nematodes, cestodes, trematodes, protozoa.	**18**
V	**Sputum & CSF analysis and Histopathology** Sputum: Collection – microscopical and naked eye inspection – clinical examination. Cerebrospinal fluid: Composition – CSF cells total and differential count - estimation of protein – sugar chloride. Sperm: collection of semen microscopic examination – smear and count. Pregnancy tests - *Male frog test – Gravindex test* Histopathology – Microtechnique – tissue preparation – fixation – dehydration – embedding , sectioning, staining and mounting	**18**
VI	**Current Trends * (For CIA only)** Maintanance of Automated Clinical Labs, Techniques involved.	

….. Self Study

Text Book(s):

1. Samuel, K.M. (1992) Notes on Clinical Lab Techniques (IV Edition). Publishers: M.K.G. Iyyer & Sons, Madras

Reference Book(s):
1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi. 2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd., 3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.
Web Resource(s):
1. www.en.wikipedia.org › wiki › Medical_laboratory 2. www.who.int › publications › manual_health_lab_tech

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand evolution concepts and its significance	**K2**
CO2	Acquire knowledge on Taxonomy	**K3**
CO3	Estimate water quality knowledge on pollution	**K4**
CO4	Explore various experiment in development biology	**K5**
CO5	Asses the role of GIS	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	2	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2.3**
CO2	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2.5**
CO3	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2.4**
CO5	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2.7**
										Mean Overall Score	**2.5**
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
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