ST. XAVIER'S COLLEGE (AUTONOMOUS)

Palayamkottai - 627 002

(Recognized as "College with Potential for Excellence" by UGC)

(Re-accredited with "A⁺⁺" Grade with a CGPA of 3.66 in IV cycle) (Affiliated to Manonmaniam Sundaranar University, Tirunelveli)



SYLLABUS

B.Sc. ZOOLOGY

(w.e.f. June 2021-2022)

Programme Name: B.Sc. ZOOLOGY Programme Code: UZO

Aim and Objectives:

B.Sc. Zoology is a three year undergraduate academic degree programme suited for the students who are interested in nature, biology and especially animals. This degree programme in Zoology is designed in such a way to develop scientific attitude and interest among students towards learning the various aspects of zoology in particular and life science in general. The course papers are designed to impart the essential knowledge in animal taxonomy, biochemistry, physiology, ecology, genetics, cell and molecular biology, aquaculture, entomology, immunology and microbiology. The various courses in the programme are aimed to develop proficiency both in the theory as well as in practical through experiments, laboratory work along with the collection and interpretation and presentation of scientific data.

In addition to this, the students will be equipped with knowledge in the modern areas of biotechnology and its application in medicine, aquaculture, agriculture, and various biobased industries like apiculture, sericulture, vermitechnology and animal husbandry etc. Students, who pursue this programme and pass out successfully, will surely have an urge to continue higher studies in Microbial Gene Technology, Genomics, Biochemical Technology, Marine Biology, Environmental Biology, Biochemistry, Microbiology, Environmental Biotechnology, Clinical Virology, Bioinformatics, Pharmaceutical and Analytical Chemistry.

Programme Specific Outcomes:

On completion of the B.Sc. programme in Zoology the students will be able to :

- Classify, identify and list out common animals (invertebrates, vertebrates)
- Explain various physiological changes in our bodies
- Analyze the impact of environment on our bodies
- Understand various genetic abnormalities
- Develop love and respect for nature
- Describe the role and impact of different environmental conservation programmes
- Manage harmful and beneficial animals
- Evaluate various potential risk factors to health of humans
- Summarize the importance of genetic engineering [cell culture, transgenic animals, antibiotics, engineered microbes, biodiesel, bio-plastics, biopesticides]
- Apply tools of information technology for all activities related to Zoology
- Develop self-employment skills such as vermitechnology, bee keeping, sericulture, aquarium fish keeping.
- Acquire knowledge on common vectors, their diseases, environmental hygiene and public health, and Ornamental Fish Farming (other major)

Career opportunities for B.Sc. Zoology students:

- Employment areas of B.Sc. Zoology includes: pharmaceutical companies, Environmental Agencies, Medical Laboratories, Museum, Agriculture and Veterinary Farms, Medical Representatives, Sales manager of bio-products.
- ✤ After completing B.Sc. Zoology one can seek admission in Master of Science where the student needs to go through the deep knowledge of science.
- B.Sc. course is globally agreeable where the students from science theme can pursue from any of the approved university.

- Eligibility of students for higher studies: after completing UG Zoology, the students are eligible for admission in M.Sc., degree course in Zoology, Life sciences, Aquaculture, Forensic Science, Genetics, Microbiology, Biotechnology, Integrated biology, Physiology, Aquaculture, Marine biotechnology, integrated Ph.D, P.G diploma courses in lab technology, Radiology. Further eligible for B.Ed., TNPSC, IAS, IPS, IFS (group 1 exams); also eligible to get admission in MCA, MBA, M.Sc. Microbial Gene Technology, Genomics, Biochemical Technology, Marine Biology, M.Sc. Environmental Biology, Biochemistry, Environmental Biotechnology, Medical Clinical Embryology, Clinical Virology, Bioinformatics, Pharmaceutical and Analytical Chemistryetc.
- After completing B.Sc. Zoology, one can specialize in various fields within zoology like Arachnology, Entomology, Arthropodology, Apiology, Cetology, Anthrozoology, Conchology, Ethology, Helminthology, Mammalogy, Neuroethology, Myrmecology, Nematology, Ornithology, Paleozoology, Malacology, Primatology, Herpetology etc.

Extra Credit Courses (ECC) for Advance Learners:

- ✓ Courses with extra credit for advanced learners are introduced to improve the knowledge base of the students in their core area
- \checkmark These are self study courses and are optional
- \checkmark There is no Continuous internal assessment tests (CIA)
- \checkmark There should be no standing arrears for opting Extra Credit Courses
- ✓ Students are not permitted to write the course as arrear, if he / she fails in the courses with extra credit.

CERTIFICATE COURSE

- Eligibility for Admission: Candidate who passed 10 + 2 examination with at least 45% marks in aggregate in Arts / Science / Commerce.
- The candidate after passing examination will be awarded a separate "Certificate" in addition to his/her regular degree/Detailed Marks Card of B.A., B.Sc. and B.Com.
- The supplementary examination shall be held in April or as fixed by the Controller of Examination Office.
- The candidate who doesn't pass in the supplementary examination will be given another chance to appear in above said course along with forthcoming annual examination.
- A candidate who passed the course in the supplementary examination or in the third chance in annual examination can appear alongside in next subsequent examination of above said course.
- The candidate who is unable to pass the course in three given chances, will not be allowed to continue the above said course
- Every candidate will be required to attend minimum of 75% lectures/periods delivered to that class.
- The candidate must obtain 40% of the total marks in theory and practical separately to pass the course.
- The candidate must have obtained in House Examination at least 25% marks in the subject.
- Candidates will be offered English as the medium of Instructions/ Examination

Objectives: To provide opportunities to learn and obtain knowledge and develop skills in various self employment opportunities in Zoology and allied aspects of Life Sciences. Students will be motivated to gain knowledge on the basics of the self employment awareness and also provide an opportunity to get training experience and exposure to the industry.

Expected outcome: Stake holder knows importance and fundamentals of job oriented certificate programme.

Course Fee:Rs. 1000/- [Tuition fee: Rs. 600, Laboratory Fee: Rs. 300, Library Fee: Rs. 100]

Sem	Part	Status	Course Code	Title of the Course	Hou rs	Credi t
			21UGT11	Tamil-I		
	Ι	Language	21UGF11	French-I	6	3
			21UGH11	Hindi-I		
	II	Language	21UGE11	English-I	6	3
	III	Core-T1	21UZO11	Invertebrata	4	4
	III	Core-P1	21UZOP11	Invertebrata- Practical	2	1
т	III	Allied-T1	21UCHA11	Chemistry - 1	4	4
1	III	Allied-P1	21UCHAP11	Chemistry - 1	2	1
	IV	NME-1	21UNM11	Human Vectors/ Public Health and Hygiene	2	2
	IV	SBE-1	21USB11	Integrated personality Development	2	2
	IV	VE	21UVE11	Religion /Ethics	2	2
				Sub-Total	30	22
			21UGT 21	Tamil-II		
	Ι	Language	21UGF 21	French-II	6	3
			21UGH 21	Hindi-II		
	II	Language	21UGE 21	English-II	6	3
	III	Core-T2	21UZO 21	Chordata	4	4
	III	Core-P2	21UZOP21	Chordata - Practical	2	1
т	III	Allied-T2	21UCHA21	Chemistry - 2	4	4
11	III	Allied-P2	21UCHAP21	Chemistry - 2	2	1
	IV	NME-2	21UNM21	Ornamental Fish Farming	2	2
	IV SBE-2 21U		Life Issues and Coping Skills	-		
		SBE-2	SBE-2 210SB21 Development	2	2	
	IV	SBE-3	21USB22	Professional English for Life Sciences	2	2
				Sub-Total	30	22
			21UGT31	Tamil-III		
	Ι	Language	21UGF31	French-III	6	3
	_	200.800.80	21UGH31	Hindi-III	Ũ	U
	П	Language	21UGE31	English-III	6	3
	Ш	Coro T2	2103231	Call and Molecular Piology	4	
		Cole -13	2102031		4	4
III		Core -P3	21UZOP31	Cell and Molecular Biology- Practical	2	1
	III	Allied-T3	21UBOT31	Plant Diversity	4	4
	III	Allied-P3	21UBOTP31	Plant Diversity - Practical	2	1
	IV	SBE-4	21USB31	Human Rights and Social Analysis	2	2
	IV	SBE-5	21USB32	Sericulture / Apiculture	2	2
	IV	EVS	21UES31	Environmental Studies	2	2
			T	Sub-Total	30	22
			21UGT41	Tamil-IV		
	Ι	I Language	21UGF41	French-IV		3
			21UGH41	Hindi-IV		
	II	Language	21UGE41	English-IV	6	3
IV	III	Core-T4	21UZO41	Biostatistics and Computer	4	4
	III	Core-P4	21UZOP41	Applications Biostatistics and Computer		1
				Applications - Practical		
		Elect-1	21UZOE41	Fishery Biology / Aquaculture	4	4

COURSE STRUCTURE FOR B.Sc. ZOOLOGY

				Total	180	140
STAND						1
		•	•	Sub-Total	30	25
	III	Elect-3	21UZOE61	Group Project	7	6
VI	III	Core-P11	21UZOP63	Basic Entomology - Practical	3	2
	III	Core-P10	21UZOP62	Immunology and Microbiology– Practical	2	1
М	III	Core-P9	21UZOP61	Animal Physiology - Practical	3	1
	III	Core-T11	21UZO63	Basic Entomology	5	5
	III	Core-T10	21UZO62	Immunology and Microbiology	5	5
	III	Core-T9	21UZO61	Animal Physiology	5	5
	Sub-Total					26
	III	Elect-2	21UZOE51	Evolution	5	5
	III	Core-P8	21UZOP54	Ecology - Practical	2	1
	III	Core-P7	21UZOP53	Genetics and Animal Biotechnology - Practical	2	1
V	III	Core-P6	21UZOP52	Developmental Biology -Practical	2	1
	III	Core-P5	21UZOP51	Biochemistry - Practical	2	1
	III	Core-T8	21UZO54	Ecology	4	4
	III	Core-T7	21UZO53	Genetics and Animal Biotechnology	5	5
	III	Core-T6	21UZO52	Developmental Biology	4	4
	III	Core-T5	21UZO51	Biochemistry	4	4
				Sub-Total	30	22
	IV	SBE-6	21USB41	Aquarium Fish Keeping/ Wild Life and Nature Watch	2	2
	III	Allied-P4	21BOTP41	Taxonomy of Angiosperms & Plant Physiology - Practical	2	1
	III	Allied-T4	21UBOT41	Taxonomy of Angiosperms & Plant Physiology	4	4

Part I: Language-4; Part II: Language-4; Part III: Core Theory-11; Core Practicals-11; Allied Theory-4; Allied Practical-4, Major Elective-3 (2 theory + 1 group project), Part IV: SBE-6 (with choice); NME-2 (with choice), EVS-1, VE-1 (with choice)

Semester	Course Code	Title of the Course	Eligibility
Ι	21UZOEC11	Poultry Farming	+ 2 passed Science students
II	21UZOEC21	Human Anatomy	+ 2 passed students
III	21UZOEC31	Animal Behavior/	+ 2 passed students
		Vermibiotechnology	
IV	21UZOEC41	Biodiversity Conservation /	+ 2 passed Science students
		Animal Husbandry	
V	21UZOEC51	Pharmacology	+ 2 passed students
VI	21UZOEC61	Ethnomedicine	+ 2 passed students

Extra Credit Courses (ECC) for Advanced Learners

Certificate Courses

Semester	Course Code	Title of the Course	Eligibility
III	21UZOCC31	Sericulture	+ 2 passed students
IV	21UZOCC41	Ornamental fish culture	+ 2 passed students
V	21UZOCC51	Seafood processing	+ 2 passed students

Online course

1. Industrial Zoology

INVERTEBRATA (Subject code: 21UZO11)

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Course Objective: To outline the basic concepts of classification and body organization of selected invertebrates.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain an overview of the classification and salient features of invertebrates
- 2. Describe the structure, function and life cycle of selected invertebrates by observing live and preserved specimens
- 3. Predict the behavior and examine the adaptive significance of invertebrates
- 4. Analyze the ecological role of representative organisms in each phyla
- 5. Compare and establish phylogenetic relationships between the phyla covered
- 6. Identify and name invertebrates with the use of literature and other resources

Unit I: Protozoa and Porifera

General characters, classification, salient features of the classes; Type study – *Paramecium caudatum*;General topic - canal system in sponges; Economic importance of Protozoa and Porifera.

Unit II: Coelenterataand Helminthes

General characters, classification, salient features of the classes; Type study – *Obeliageniculata, Taeniasolium* and *Pleurobrachia*; General topic - Coral reefs, Affinities of Ctenophora, Parasitic adaptations, Helminths in relation to man.

Unit III: Annelida

General characters, classification, salient features of the classes; Type study *–Nereis*, Earthworm and Leech; General topic: Coelom and metamerism; modes of life in polychaetes, Onychophora; Structure, affinities and distribution of *Peripatus*

UnitIV: Arthropoda

General characters, classification, salient features of the classes; Type study - Prawn, Scorpion and Cockroach - Mouthparts, vision, respiration and excretion; General topic - Larval forms and parasitism in Crustacea; Metamorphosis and social life in insects

Unit V: Mollusca and Echinodermata

General characters, classification, salient features of the classes; Type study - *Pila globosa* and *Asterias rubens;* General topic: Oyster culture and pearl formation; Water vascular system, Larval forms and affinities of echinoderms.

*Type Study: *Pila & Asterias* – Detailed account on External features, Brief account of Digestive System, Circulatory system, Respiratory system and Reproductive system

Textbooks:

- 1. Arumugam N et al., (2018). Invertebrata Volume-1, Saras Publications.
- 2. Jordan EL, Verma PS, (2012). Invertebrate Zoology, S Chand & Co Ltd.
- 3. Kotpal RL, (2000). Modern textbook of Zoology: Invertebrates. Rastogi Company.
- 4. Ekambaranatha Ayyar M, Ananthakrishnan TN, (2000). Manual of Zoology: Invertebrata. S Viswanathan Pvt Ltd.

12 Hours

12 Hours

12 Hours

12 Hours

Reference Books:

- 1. Barnes Robert D, (2004). Invertebrate zoology. Cengage Learning.
- 2. Rupert et al., (2006). Invertebrate zoology. Thomson Brooks Publishers.
- 3. Anderson DT, (2001). Invertebrate zoology. Oxford University Press.
- 4. Barrington EJW, (2000). Invertebrate structure and function. English Language Book Society.
- 5. Marshall AJ, Williams WD, (2000). Textbook of zoology invertebrates. English Language Book Society.
- 6. Jan A Pechenik, (2000). Biology of the invertebrates. Tata Mc-Graw Hill Publishing Company.
- 7. Borradaile LA, Potts FA, (2000). Invertebrata. Crystel Achagam.
- 8. Hymen LH, (2000). Invertebrates Volume I VI. Mc-Graw Hill Book Company.

E-resources:

- 1. https://www.mgccc.edu/learning_lab/science/PROTOZOANS.pdf
- 2. http://www.angelo.edu/~crussell/Lectures/Ppt/S05/web/chapt11-protozoa.pdf
- 3. http://nsdl.niscair.res.in/jspui/bitstream/123456789/817/1/Platyhelminthes%20%20-%20Formatted.pdf
- 4. http://www.bu.edu/gk12/eric/Annelida.pdf
- 5. http://www.mhhe.com/biosci/genbio/raven6b/graphics/raven06b/other/raven06_46.pd f
- 6. http://nsdl.niscair.res.in/jspui/bitstream/123456789/693/1/PHYLUM%20MOLLUSC A%20-%20Formatted.pdf
- 7. https://arxiv.org/abs/1606.01631
- 8. http://web2.uconn.edu/cyberinfra/module4/Taxonomy.pdf
- 9. https://www.britannica.com/animal/sponge-animal
- 10. http://biologyboom.com/phylum-porifera/
- 11. https://lter.limnology.wisc.edu/sites/default/files/Porifera%20Chapter%204_Frost.pdf
- 12. http://www.biologydiscussion.com/invertebrate-zoology/phylum-ctenophora/phylum-ctenophora-features-characters-and-other-details/28786

INVERTEBRATA - PRACTICALS (Subject code: 21UZOP11)

Semester: I Core Practical: 1	Credit: 1	Hours: 2
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- 1. Virtual dissection:
 - a. Grasshopper https://www.ent.iastate.edu/ref/anatomy/ihop/
 - b. Earthworm
 - http://www.mhhe.com/biosci/genbio/virtual_labs/BL_14/BL_14.html
 - c. Starfish http://www.k-state.edu/organismic/images/starfish_gonad.jpg
- 2. Mounting -Earthworm body setae and pineal setae
- 3. Cockroach-Mouthparts, digestive system, reproductive system, nervous system
- 4. Mounting of marine prawn appendages -Cephalothorax and abdominal appendages
- 5. Separation of spicules from drifted sponges
- 6. Collection, preservation and submission of invertebrates (dead specimens only).
- 7. Survey of pond water for free living protozoans
- 8. Field Visit: Terrestrial and coastal ecosystem
- 9. Mini project
- 10. An animal album with photographs, paper cuttings with appropriate write-up
- 11. Photographs, paper cuttings of endangered and threatened invertebrates
- 12. Study of preserved specimens : *Hydra, Aurelia*, Sea anemone, *Sepia*, Octopus, Star fish, Sea urchin, Sea cucumber, Sea lily, Liver fluke, Tape worm, *Ascaris, Nereis*, Earthworm, Leech, Prawn, Scorpion, Millipede, Crab, Scorpion, *Limulus, Peripatus, Pila, Lamellidens*
- 13. Study of slide mounted specimens : *Paramecium, Euglena, Leucosolenia,* Redia larva, Cercaria larva, Trochophore larva, Nauplius larva, Zoea larva, Mysis larva, Megalopa larva, Bipinnaria larva and Planaria

CHEMISTRY-I (FOR BOT AND ZOO)

(SUBJECT CODE:21UCHA11)

Semester: I Allied:	: A1 Credits : 4	4 Hours/W :4
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Objectives:

- To know the structure and properties of compounds
- To understand the concepts of redox system and types of reactions
- To identify the intermolecular forces in different molecules.
- To Study the chemistry of carbon and nitrogen compounds
- To Know the synthesis of important amino acids.

Outcome: Students Can

- Identify bonding and structure of organic and inorganic compounds
- Familiar with the acid-base concepts and their applications
- Understand the role of hydrogen bonding and other molecular forces through different applications
- Get the knowledge of different functionalities and their properties
- Assimilate the importance of proteins and amino acids in biological systems.

Unit I: Chemical Bonding

Self Study: Atomic number, mass number, isotopes, electronic configuration of atoms and ions.

Valency and valence electrons - Electronic theory of valency -Electrovalecy- conditions favouring electrovalency-illustration -Electrovalent compounds and their properties - covalency- conditions favouring covalency-illustration- Covalent compounds and their properties- oordinate covalency-conditions favouring formation of the bond-illustration-Transition from lectrovalency to covalency- polarisation and polarizability- Fajan's rules-statement and illustration- Atomic orbitals-Definition-charge cloud interpretation-shapes of s,p and d orbitals- Overlapping of atomic orbitals-conditions for overlap-types(s-s, s-p,and p-p) with illustrations-sigma and pi overlaps- hybridisation sp³ in CH₄, sp² in BF₃ and sp in BeCl₂. Geometry of H₂O and NH₃ molecules-VSEPR theory.

Unit II: Redox systems and analytical chemistry-I

Self Study: oxidation, reduction, acids and bases.

Redox systems- Redox reactions in terms of electron transfer - Oxidation number-Definition-Rules for assigning oxidation number- Calculation of oxidation number- Redox processes in terms of oxidation number- Advantages and disadvantages of the concept- Acids and bases-Arrhenius concept –illustration- Lowry-Bronsted concept-conjugate acid and conjugate base -Types of reactions relevant to qualitative analysis - Displacement reaction – Decomposition -Double decomposition- Hydrolysis- redox reaction- Complex formation- Interfering anions and their elimination- Group reagents and analytical group classification- Explanation and application of the following principles in qualitative analysis- Solubility and solubility product- Common ion effect- pH- Buffer

12 hrs

12 hrs

UNIT III: Intermolecular forces and properties of liquids

12 hrs

Self Study: pure covalent bonds with examples, electro negativity, conductors, insulators, boiling point, melting point

Polar and non-polar molecules - Dipole-dipole (Debye) forces, dipole-induced dipole (Keesom) forces, Induced dipole-Induced dipole (London) forces. Repulsive forces - Resultant intermolecular energies- Hydrogen bonding-Nature of hydrogen bonding-conditions favouring hydrogen bonding- Types of hydrogen bonding-illustrations-impact of hydrogen bonding on melting points, boiling points and solubilities. Electrolysis - What is electrolysis-strong and weal electrolytes - Mechanism of electrolysis - Electrical units-coulomb, Amphere, Ohm and Volt- Faradays laws of electrolysis and their importance - Conductance of electrolyte – Conductance- Specific conductance and molar conductance-Units - of equivalent conductance with concentrations

UNIT IV: Aldehydes, Ketones, Acids and Amides 12 hrs

Self Study: aliphatic compounds, aromatic compounds, Functional group of aldehydes, ketones and amides

Aliphatic aldehydes and ketones-Nomenclature-General reactions- Formaldehyde- a comparison with other aldehydes of the series - Aromatic aldehydes-Reactions of benzaldehyde-benzaldehyde compared with acetaldehyde - Aromatic ketones-Aceton, acetophenone and benzophenone-distiction- Aliphatic saturated monocarboxylic acids-Nomenclature, general reactions-comparison of formic acid with other acids of the series. Aromatic saturated monocarboxylic acids-distinction between benzoic acid and acetic acid - Aliphatic amides-nomenclature, general reactions - Aromatic amides-Distiction between benzaldehyde and acetamide.

UNIT V: Amines, Amino acids and Proteins

12 hrs

Self Study: Functionalities of amino acids and amines, Functionalities of proteins (nitrogen containing compounds)

Aliphatic monoamines - Nomenclature and classification - General reactions- Aniline-Reactions of aniline- Distinction between aniline and ethylamine- Amino acids-classificationzwitter ions-isoelectric point-preparation and properties of glycine and alanine- Proteinsintroduction-peptides and polypeptides-partial hydrolysis and terminal residue analysis in the determination of structure of peptides.

NOTE : Course materials will be supplied to the students.

ALLIED CHEMISTRY PRACTICAL-I (FOR BOT AND ZOO)

INORGANIC QUALITATIVE ANALYSIS

(Subject code: 21UCHAP11)

Semester	r:I Allied:AP1	Credit :1	Hours/w :2
Qualitative a	unalysis of a simple salt containing one anio	on and one cation	
Anions	:Carbonate, Borate, Fluoride, Oxalate ar	nd Phosphate	
Cations	: Lead, Bismuth, Copper, Cadmium, Co Barium, Strontium and Ammonium	balt, Nickel, Mangan	ese, Zinc,
NT / T 1			

Note: Laboratory manual will be supplied.

HUMAN VECTORS

(Subject code: 21UNM11)

Semester: I	NME:1 (Optional)	Credits: 2	Hours:2

Course Objective: To introduce the concept of various invertebrate and vertebrate as human vectors

Course Outcomes: At the end of the course the students will be able to:

- 1. Learn the biology of selected invertebrate vectors in relation to human health.
- 2. Describe mechanisms of transmission of diseases from pets to humans.
- 3. Illustrate the life cycle of mosquitoes and other insect vectors.
- 4. Apply methods to control vectors.
- 5. Assess the extent of damage caused by the vectors.
- 6. Develop preventive and mitigation measures to reduce the harmful effects of vectors.

Unit I: Salient features of human Vectors

General salient features of insects, rodents, snail, bird, dogs, bats and other carnivorous mammal vectors of human beings; Host- vector relationship, Vectorial capacity; Adaptations as vectors.

Unit II: Insect Vectors-I

General life cycle, mode of disease transmission, prevention and control of mosquitoes.

Unit III: Insect Vectors-II

General life cycle, mode of disease transmission, prevention and control of houseflies, cockroaches, head louse and triatomine bugs.

Unit IV: Other invertebrate vectors

General life cycle, mode of disease transmission, prevention and control of helminths, fleas, ticks, mites and snails.

Unit V: Vertebrate vectors

General life cycle, mode of disease transmission, prevention and control of birds, dogs and mammals.

Textbooks:

1. Mathews, G. 2011. Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases, Wiley-Blackwell

Reference books:

- 1. Imms, A.D. 1977. A General Text Book of Entomology. Chapman & Hall, UK
- 2. Chapman, R.F. 1998. The Insects: Structure and Function. IV Edition, Cambridge University Press, UK.
- 3. Pedigo L.P. 2002. Entomology and Pest Management, Prentice Hall Publication

E-resources:

- 1. https://www.rentokil.com/vector-control/disease-vectors/
- 2. http://www.who.int/mediacentre/factsheets/fs387/en/

6 Hours

6 Hours

6 Hours

6 Hours

- 3. http://apps.who.int/iris/bitstream/10665/42498/1/WHO_CDS_CPE_SMT_2001.14.pd f
- 4. http://www.who.int/water_sanitation_health/resources/vector337to356.pdf
- 5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3668993/
- 6. Online free book: Vector-Borne Diseaseshttps://www.ncbi.nlm.nih.gov/books/NBK52941/

PUBLIC HEALTH AND HYGIENE (Subject code: 21UNM11)

Semester: I	NME: 1 (Optional)	Credits: 2	Hours: 2

Course objective: To create awareness about human health, communicable and noncommunicable diseases and their management.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain comprehensive knowledge on health and hygiene
- 2. Understand the importance of balanced nutritional intake
- 3. Apply lifestyle changes
- 4. Categorize diseases based on communicability
- 5. Recognize the symptoms of the highlighted diseases
- 6. Create awareness on the value of human health for successful existence.

Unit I: Health Concepts

Determinants of health; indicators of health; personal hygiene; public and community health

Unit II: Nutrients

Macronutrients - proteins, carbohydrates and lipids; micronutrients and trace elements; vitamins; Energy requirements; balanced diet; malnutrition in children and adult.

Unit III: Nutritional requirements

Nutitional requirements of growing children, adults, pregnant women, lactating women and convalescents.

Unit IV: Diseases and Treatment

Communicable diseases - viral and bacterial diseases (Polio, Chicken box, Dengue, Malaria); Non communicable diseases - diabetics, heart diseases and kidney problems.

Unit V: Environment and Health

Causative agent, symptoms, prevention and management of waterborne (Typhoid and Cholera) and airborne diseases (Tuberculosis).

Textbooks:

- 1. Sorna Raj, R & Kumerasen V. 2010. Public health and hygiene, Saras Publications.
- 2. AmbikaShanmugam 1999. Fundamentals of Biochemistry for Medical Students, Published by the Author, Chennai.
- 3. Shubhangini A. Joshi 1992. Nutrition and dietetics Tata McGraw Hill, Publishing company Ltd, New Delhi.

Reference Books:

- 1. Srilakshmi, S. 1993. Dietetics New Age International (P) Ltd. Publishers, New Delhi.
- 2. Ananthanarayanan, R. and JayaramPaniker, C.K. 2000. Text Book of Microbiology, Orient Longman, Chennai.

6 Hours

6 Hours

6 Hours

6 Hours

CHORDATA (Subject code: 21UZO21)

Semester: IICoreTheory:2Credits: 4Hours: 4
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Course Objective: To introduce and inculcate the fundamentals of classification, and a descriptive account of the Classes under Chordata.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain knowledge on the general features and classification of living chordates
- 2. Understand the functioning of various systems
- 3. Demonstrate the distinguishing features of chordates
- 4. Categorize animals based on their similarities and differences.
- 5. Evaluate the adaptive features and mechanisms.
- 6. Identify, name and establish evolutionary relationships of chordates.

Unit I:Prochordates and Vertebrates

Hemichordates and chordates - key difference between prochordates and vertebrates, evolutionary perspective and phylogenetic relationships; Brief accounts on *Amphioxus*, *Balanoglossus*, Ascidian and Graptolithina

Unit II: Pisces

General characteristics and classification of Pisces up to orders with examples; Salient features of Cyclostomes, Holocephali and Dipnoi;Type study- *Scoliodon* (digestive, circulatory, sensory, reproductive systems),General topic - Respiration and Migration in fishes.

Unit III: Amphibia and Reptilia

General characters and classification of Amphibia and Reptilia up to subclasses with examples; Type study-*Rana & Calotes*-respiratory, digestive, reproductive system; General topic - Paedomorphosis and Parental care in Amphibia; South Indian venomous snakes, non-venomous, snake bite and first aid.

Unit IV: Aves

General characteristics and classification of Aves up to sub-classes with examples. Type study: *Columba livia* (respiratory, circulatory, and digestive systems); General topic: Origin of Birds, Flight adaptations and mechanism of flight, Flightless birds

Unit V: Mammalia

General characters and classification of mammals up to subclass with salient features with examples; Type study: *Oryctolagus cuniculus*(respiratory, circulatory, and digestive systems). Brief account on Monotremes and Marsupials; General topic: Aquatic mammals and Dentition in mammals.

Textbooks:

- 1. Thangamani TK et al., (2018). A textbook of chordates. Saras Publications.
- 2. Jordan EL, Verma PS, (2010). Chordate zoology. S Chand & Company.
- 3. Kotpal RL, (2000). Vertebrates. Rastogi Publications.
- 4. Ekambaranatha Ayyar M, Ananthakrishnan TN, (2000). Manual of zoology, Volume II, Chordata

12 Hours

12 Hours

12 Hours

12 Hours

Reference books:

- 1. Young JZ, (2011). The life of vertebrates. Oxford University Press.
- 2. DeBeer Gavin, (2000). Vertebrate zoology. Sidgwick & Jackson Ltd.
- 3. Robert T Orr, (2000). Vertebrate biology. WB Saunders Company.
- 4. Barrington EJW, (2000). Biology of hemichordata and protochordata. Oliver & Boyd.

E-Resources:

- 1. https://www.earthlife.net/inverts/hemichordata.html
- 2. http://www.askiitians.com/biology/animal-kingdom/phylum-chordata-and-hemichordata.html#difference-between-lower-and-higher-chordates
- 3. http://www.biozoomer.com/2011/11/pisces-classification-super-class.html

CHORDATA - PRACTICAL (Subject code: 21UZOP21)

Semester: II	Core Practical:2	Credit: 1	Hours: 2
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- 1. Mounting of Placoid Scales Preserved specimens (Shark skin)
- 2. Types of scales in fishes Preserved specimens
- 3. Diversity of Feathers- Preserved specimens
- 4. Digestive system of a fish (market specimens)
- 5. Air bags in fishes –(market specimens)
- 6. Reproductive systems of a fish (market specimens)
- 7. Simple phylogenetic grouping of Animals
- 8. Virtual dissection -Frog -https://www.emindweb.com/demo/frog/
- 9. Activity card preparation observation of birds and their behaviour
- 10. Key for identification of poisonous and non-poisonous snakes
- 11. Zoological names for common animals
- 12. Field Visit: Terrestrial ecosystem and a Sea shore.
- 13. Submission: Work sheets, Map of Hot spots of the world, Pictures of endangered species.
- 14. Project related to Biodiversity and submission of report.
- 15. Spotters: Prochordates: Amphioxus, Balanoglossus, Ascidian; Pisces: Cyclostomata, Petromyzon, Myxine, Scoliodon, Astrape, Anguilla, Echeneis, Hippocampus, Sardine, Channa, Catfish, Diodon, Tetrodon; Amphibia: Ichthyophis, Salamandra, Ambystoma, Axolotl larva, Rhacophorus, Bufo; Reptilia: Hemidactylus, Draco, Chameleon, Cobra, Viper, Enhydrina, Echis, Dendrophis, Typhlops, Chelonia-sea turtle, Testudo-sea tortoise, Crocodile; Aves: Blue jay, Netolopus, Indian spoonbill, great Indian hornbill, Pelicanus, White breasted kingfisher, Brahminy kite, Parakeet, Patridge, Black drango, Quail; Mammals: Hedge hog, Loris, Mongoose, Pangolin, Bat, Porcupine; Osteology of Rabbit- skull dorsal view, Lower Jaw, Lumbar vertebrae, Pectoral girdle, Pelvic girdle, Fore and Hind limb.

ALLIED CHEMISTRY-II (FOR BOT AND ZOO)

(SUBJECT CODE: 21UCHA21)

Semester: II Amed: A2 Creans : 4 Hours/ W :4	Semester: II	Allied: A2	Credits : 4	Hours/W :4
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Objectives:

- To understand and correctly use thermodynamic terminology.
- To describe the composition and properties of colloidal dispersions and surface phenomena
- To distinguish between mono saccharides, disaccharides, and polysaccharides
- To study the special arrangement of atoms in a molecule and know how role of hetero atoms in organic compounds
- To understand the basic concepts of quantitative analysis

Outcome: Students Can

• Explain fundamental thermodynamic properties

- List and explain several technological applications of colloids
- Summarize the roles carbohydrates, alkaloids and terpenoids play in biological systems.
- Figure out how many stereoisomers a compound has, and synthesis of a few heterocyclic molecules.
- Prepare and standard solutions and standardize an unknown solution.

Unit-I : Thermodynamics

12 hrs

Self study: ideal gas, ideal gas equation, homogeneous reactions and heterogeneous reactions, heat.

Introduction - Basic terminology and functional concepts- System, boundary and surrounding- Types of systems: open, closed and isolated- Properties of a system: extensive and intensive - State of a system and state variables (or state functions)

Thermodynamic equilibrium - Process and types: Isothermal, adiabatic, isochoric, isobaric, cyclic, reversible, and irreversible- comparison between isothermal and adiabatic processes, reversible and irreversible processes - Internal energy as a state function- components of internal energy- Work: Thermodynamic concept-types of work - Heat : Thermodynamic concept- Heat and work as path functions - First law of thermodynamics- Statement of the law of conservation of energy- Mathematical expression of the law- Application of the law-Heat capacity, specific heat capacity and molar heat capacity of asystem- Relation between molar hear capacities of gases- Enthalpy and enthalpy change- Enthalpy as a state function-Relation between Δ H and Δ E- Enthalpies of reaction, formation and combustion-Definition and illustration- standard state- Calculation of enthalpy change using Hess law- Bond enthalpies and bond dissociation enthalpies-Definition and illustration using CH₄ as example (Numerical problems not expected)- Spontaneous (natural) process- Entropy-it's meaning of disorder- Gibb's free energy-its meaning as available energy- Criteria for spontaneity

UNIT : II Surface chemistry and Colloidal Chemistry

Self study: Adsorbent, adsorbate, molecular interactions.

Adsorption chemistry-introduction-definition-distinction from adsorption- Adsorption and adsorbate-definition and explanation- Chromatography-introduction- Adsorption chromatography-column chromatography, TLC- Partition chromatography-ascending chromatography- R_f value and its significance- Ion exchange chromatography-gas liquid chromatography (GLC), high - Types of colloidal systems- Classification of colloids-Lyophilic and lyophobic sols-a comparison- Stability of colloids-origin of charge-electrical double layer-salvation- Electrical properties-electrophoresis and electro-osmosis- Gelsgelation-classificatio-properties of gels-hydration, swelling or inhibition, syneresis and thixotropy- Emulsions-types of emulsion-identification of emulsion-dilution test, dye test, spreading test, viscosity and electrical conductivity-de-emulsification- Application of colloid in food, medicine, industry, purification of water, artificial rain, blue colour of the sky and cleaning action of soap.

UNIT : III Carbohydrates, Alkaloids and Terpenoids Self study: Examples for food contains carbohydrates

Introduction- Monosaccharide- Reaction of glucose- Open chain structure and ring structure of glucose (elucidation not expected)- Epimers, mutarotation- Interconversion of glucose into fructose and vice versa- Disaccharides- Reactions and structure of sucrose (elucidation nor expected)- Structure of maltose and lactose (elucidation not expected)-Polysaccharide- Starch- amylase and amyl pectin-type of glycosidic linkage- Reaction of starch-action of heat-, hydrolysis and with iodine- Alkaloids- Definition, classification, (based on structure) occurrence and extraction- General methods of identification-functional nature of oxygen-functional nature of nitrogen-unsaturation-exhaustive methylation-Structure of conine- Terpenoids- Introduction, classification of terpenoids-Isoprene rule-Structure of citral (synthesis not included)

UNIT : IVStereoisomerism and Heterocyclic compounds

Self study: Isomers, cyclic compounds, practice to draw the structure of simple molecules like H_2O , NH_3 etc.

Optical isomerism- Plane polarized light - Optical activity - Asymmetric carbon-chirality -Elements of symmetry-plane of symmetry- axis of symmetry-centre of symmetrydissymmetric- Van't Hoff-le Bel theory- Optical isomerism of tartaric acid- Racemization -Resolution of racemic-mixture-biochemical method, chemical method and chromatographic method- Geometrical isomerism- Cause for geometrical isomerism- Illustration of compounds containing C-C double bond - Heterocyclic compounds- Pyrrole- Introductionaromatic character- Basic and acidic character of pyrrole- Pyridine- Electronic interpretation of electron-rich centers- Reaction of pyridine- Quinoline- Skaraup synthesis - Reactions of quinoline

UNIT : VAnalytical Chemistry-II

Self study: Solvent, solute, solution, saturated solution, unsaturated solution, equivalent weight.

Methods of expressing concentration of solution- Normality- Molarity- Molality- Mole fraction- Equivalent weight of acids, bases, oxidizing agent and reducing agent- Standard solution- Primary standard- Secondary standard-Preparation of standard solution-Principles underlying the following types of titration-Acid-base titration-theory of indicator-Permanganimetry-Dichrometry-Iodometry and Iodimetry-EDTA

Note: Course materials will be supplied to the students.

12 hrs

12 hrs

12 hrs

12 hrs

ALLIED CHEMSITRY PRACTICAL-II (FOR BOT AND ZOO)

INORGANIC VOLUMETRIC ESTIMATIONS

(Subject Code : 21UCHAP21)

Somester . II	Alliad AD2	Credit 1	Hound/W . 2
Semester : II	Ameu APZ	Crean : 1	$\mathbf{HOUTS}/\mathbf{VV}$: \mathbf{Z}

S.NO	Estimation	Link	Standard
1	Strong acid	Weak base/ Strong base	Strong acid
2	Strong acid	Strong base	Weak acid
3	Strong base	Strong acid	Weak base
4	Oxalic acid	Potassium permanganate	Oxalic acid
5	Ferrous sulphate	Potassium permanganate	Ferrous ammonium sulphate
6	Potassium dichromate	Ferrous sulphate	Potassium dichromate
7	Ferrous ammonium sulphate	Potassium dichromate	Ferrous sulphate
8	Potassium permanganate	Sodium thiosulphate	Potassium dichromate
9	Magnesium sulphate	EDTA	Zinc sulphate
10	Zinc sulphate	EDTA	Magnesium sulphate

Note: Laboratory manual is supplied.

ORNAMENTAL FISH FARMING (Subject code: 21UNM21)

Semester:IINME: 2Credits: 2Hours: 2

Course Objective: To develop knowledge and skill in ornamental fishes and fish keeping as hobby and a source of income generation.

Course Outcomes: At the end of the course the students will be able to:

1. Learn aquarium designing and biology of common ornamental fishes.

- 2. Describe the physiology of ornamental fish.
- 3. Apply appropriate breeding techniques.
- 4. Analyze feed and feeding behavior of fish.
- 5. Assess the health status of ornamental fishes.
- 6. Design, develop and manage ornamental fish farm.

Unit I: Management of Aquarium

Design and construction of glass aquarium and setting up of aquarium; under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, accessories (aerators, light, filters) and maintenance of water quality.

Unit II: Identification and biology of common ornamental fishes

Identification, distribution and biology of common ornamental fishes - fighting fish (Betta *splendens*), Gold fish(*Carassiusauratus*), Koicarp (*Cyprinuscarpio*), Gourami(*Colisalalia*,), Angel fish(*Pterophyllumscalare*) and Red tailed black shark(*Epalzeorhynchos bicolour*).

Unit III: Breeding of common ornamental fishes 6 Hours

Breeding technologies of common ornamental fishes - fighting fish, Gold fish, koicarp, Gourami, Angel fish, Red tailed black shark.

Unit IV:Food and Feeding

Culture of live feed organisms (Zooplankton, Rotifers, Copepods, Cladocerans, Brine shrimp), Artificial feeds. Methods of fish feeding, balanced diets for aquarium fishes.

Unit V: Disease management and Economics

Identification of common parasites (*Argulus*, *Lernaea*, nematodes) and bacterial, viral, fungal diseases of ornamental fishes and their control and prophylaxis. Economics of ornamental fish culture.

Textbooks:

1. Jameson, J.D. and Santhanam. R. 1996, Manual of ornamental fishes and farming, Technologies Peejay, Thoothukkudi.

Reference books:

- 1. Rath, R.K. 2000. Freshwater Aquaculture. Scientific Publishers (India). PO Box: 91, Jodhpur.
- 2. Mohan Kumar, C. 2008. Handbook on ornamental fish diseases, MPEDA, India.
- 3. Arumugam, N. 2010. Home Aquarium, Saras Publication.

6 Hours

6 Hours

Page 23

6 Hours gravel filt

PROFESSIONAL ENGLISH FOR LIFE SCIENCES (Subject code: 21USB22)

Semester: II	SBE: 3	Credits: 2	Hours: 2
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Course Objective: To develop language skills of students by offering adequate practice in professional contexts and to enhance the lexical, grammatical and socio-linguistic and communicative competence of first year life sciences students; to focus on developing student's knowledge of domain specific registers; and the required language skills; to develop strategic competence that will help in efficient communication; to sharpen students' critical thinking skills and make students culturally aware of the target situation.

Course Outcomes: At the end of the course, the student will be able to:

- 1. Recognize their own ability to improve their own competence in using the language
- 2. Use language for speaking with confidence in an intelligible and acceptable manner
- 3. Understand the importance of reading for life
- 4. Read independently unfamiliar texts with comprehension
- 5. Understand the importance of writing in academic life
- 6. Write simple sentences without committing error of spelling or grammar

Unit I: Communication

Listening: Listening to audio text and answering questions - Listening to Instructions; Speaking: Pair work and small group work; Reading: Comprehension passages –Differentiate between facts and opinion; Writing: Developing a story with pictures; Vocabulary: Register specific - Incorporated into the LSRW tasks

Unit II: Description

Listening: Listening to process description-Drawing a flow chart. Speaking: Role play formal context; Reading: Skimming/Scanning; Reading passages on products, equipment and gadgets; Writing: Process Description –Compare and Contrast; Paragraph-Sentence Definition and Extended definition- Free Writing; Vocabulary: Register specific – Incorporated into the LSRW tasks.

Unit III: Negotiation strategies

Listening: Listening to interviews of specialists / Inventors in fields;(Subject specific); Speaking: Brainstorming. (Mind mapping); Small group discussions (Subject- Specific); Reading: Longer Reading text.; writing: Essay Writing (250 words); Vocabulary: Register specific - Incorporated into the LSRW tasks

Unit IV: Presentation skills

Listening: Listening to lectures; Speaking: Short talks; Reading: Reading Comprehension passages Writing: Writing Recommendations; Interpreting Visuals inputs; Vocabulary: Register specific - Incorporated into the LSRW tasks

6 Hours

6 Hours

6 Hours

Unit V: Critical thinking skills

6 Hours

Listening: Listening comprehension- Listening for information; Speaking: Making presentations (with PPT- practice); Reading : Comprehension passages–Note making; Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills); Writing: Problem and Solution essay– Creative writing –Summary writing Vocabulary: Register specific - Incorporated into the LSRW tasks.

Textbook:

1. English for life sciences, Tamil Nadu State Council for Higher Education(TANSCHE) Pages1-273.

CELL AND MOLECULAR BIOLOGY (Subject code:21UZO31)

Semester: III Core Theory: 3	Credits: 4	Hours: 4
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Course objective: To study the structural and functional aspects of cell organelles as well as mechanism of gene regulation and expression.

Course Outcomes: At the end of the course the students will be able to:

- 1. Learn the basic physical and chemical organization of living organism, and use of microscopy.
- 2. Understand the structural organization and function of cell organelles.
- 3. Demonstrate how cells grow, divide, and die and how these important processes are regulated.
- 4. Illustrate the molecular structure, function and interaction of genes.
- 5. Compare gene regulation in prokaryotes and eukaryotes.
- 6. Prepare histological specimens.

Unit I: Microscopy

Principles and Applications of Light, Phase contrast, Fluorescent and Electron Microscopes (Scanning Electron Microscope-SEM and Transmission Electron Microscope-TEM); Histological techniques - Tissue fixation, sectioning and staining; Ultra structure of Prokaryotic and Eukaryotic cells.

Unit II: Cell organelles

Ultrastructure and functions of Plasma membrane, membranous organelles (Endoplasmic reticulam, Golgicomplex, Mitochondria, Peroxisomes, Lysosomes, Transport Vesicles), non-membranous organelles (Ribosomes, Microtubules, Actin Filaments, Intermediate Filaments, Centrioles).

Unit III: Nucleus and cell division

Structure of nucleus - Nuclear envelope, Chromatin, Nucleolus, Nuclear matrix; cell cycle, phases of mitosis and meiosis, Chromosomes, karyotyping, giant chromosome, apoptosis, cellular differentiation and proliferation.

Unit IV: Nucleic acids, DNA repair and Mutagenesis

Salient features of DNA and RNA; Watson and Crick model of DNA, DNA forms; Mechanism of DNA replication; DNA Repair Mechanisms - Pyrimidine dimerization and mismatch repair; Modern concept of prokaryotic and eukaryotic genes; Mutation – types; mutagens, molecular basis of mutation.

Unit V: Gene expression and regulation

Gene expression –transcription, Post-transcriptional modifications, RNA transport, Translation, protein folding; Gene Regulation -Transcription regulation in prokaryotes (lac operon and trpoperon); Transcription regulation in eukaryotes - Activators, repressors, enhancers, silencer elements; Gene silencing and Genetic imprinting.

Textbooks:

1. Rastogi S C (2011), Cell and Molecular Biology, New Age International Publishers.

12 Hours

12 Hours

12 Hours

12 Hours

- 2. Jahir Hussain G (2011), Elements of Cell and Molecular Biology, Anmol Publications Pvt Ltd.
- 3. Powar, C.B. 1977. Cell Biology, Himalayas Publishing House, Bombay.
- 4. Gupta, P.K. 1999. Cell and Molecular Biology, Rastogi Publications, Meerut, India.
- 5. Verma, P.S. and Agarwal, V.K. 1998. Concepts of Molecular Biology, S. Chand & Company Ltd., New Delhi.
- 6. Freifelder, D. 1984. Essentials of Molecular Biology, Narosa Publishing House, New Delhi.

Reference Books:

- 1. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- 2. Karp, Gerald 2012. Cell and molecular Biology, John Wiley and sons, New York
- 3. Prakash S. Lohar 2007. Cell and Molecular Biology, M.J.P. Publications, Chennai.
- 4. SivaramaSastri, K.G. and Padbanaban and Subramanian 1994. Textbook of Molecular Biology. Mac Millan India Ltd. New Delhi.
- 5. Ajoy Paul. 2011. Text book of cell and molecular Biology, Third Edition, Books of Allied (P) Ltd., Chintamani Das Lane, Kolkatta.
- 6. Jeyanthi, G.P. 2009. Molecular Biology, M.J.P. Publishers, Chennai.
- 7. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

E-resources:

- 1. https://www.hccfl.edu/media/572066/microscopy.pdf
- 2. http://www.science-info.net/docs/AO-Spenser/GreysHandbook.pdf
- 3. http://www.microbiologynotes.com/differences-between-prokaryotic-and-eukaryotic-cells/
- 4. https://www.kenhub.com/en/library/anatomy/cellular-organelles
- 5. http://www.iupui.edu/~anatd502/lecture.f04/cell.f04/Nucleus.pdf
- http://www.cuchd.in/elibrary/resource_library/University%20Institutes%20of%20Sciences/Fundamentals% 20of%20Biochemistry/Chap-15.pdf
- 7. http://bmg.fc.ul.pt/Disciplinas/FundBiolMolec/11aMutationRepair.pdf
- 8. https://www.news-medical.net/life-sciences/Gene-Expression-An-Overview.aspx

CELL AND MOLECULAR BIOLOGY – PRACTICAL (Subject code: 21UZOP31)

Semester: III	Core Practical: 3	Credit: 1	Hours: 2

- 1. Compound microscope Setting and handling procedures
- 2. Squash preparation of onion root tip for mitotic stages
- 3. Squash preparation of grasshopper testis for meiotic stages
- 4. Smear preparation of human blood for RBC/WBC observation
- 5. Differential count of WBC/RBC
- 6. Study of Polytene chromosomes from Chironomous / Drosophila larvae
- 7. Extraction, isolation and quantification of DNA (animal samples)
- 8. Smear preparation of squamous epithelium of human buccal cavity.
- 9. Separation and isolation of cells by sedimentation.
- 10. Separation of nucleic acids using AGE
- 11. Restriction enzyme digestion and separation of DNA fragments
- 12. Molecular weight determination of protein/peptides using D-Gel software
- 13. Preparation of liquid culture medium (LB) and culture of E. Coli
- 14. Observation of yeast cell (Eukaryotic cell)
- 15. Spotters: Plasma membrane, Mitochondria, Ribosomes, Lysosomes, Endoplasmic reticulum, nucleus, Nucleolus, Golgi complex, Centrioles, Types of chromosomes, Ultra structure of chromosomes, Cell secretion, DNA double helix, Variants of double helical DNA, Protein synthesis, DNA- Replication, Structure of Lac operon, DNA repair, Types of Mutation

PLANT DIVERSITY

(SUB. CODE: 21UBOTA31)

Semester: III	Core Supportive: 3	Credit: 4	Hours: 4
	Core Supportive. 5		Hours. 4

OUTCOME

- The student would gain an understanding of the diversity of lower groups of plants
- The student would understand the relations between plants and their evolution
- Students get the knowledge on importance of plants for human uses.

UNIT: I (Algae)

Classification of plants according to G.M. Smith. General characteristic features of Algae. Detailed study of the following types *Volvox* and *Caulerpa*(Occurrence, structure of cell and thallus, reproduction and life cycle). Economic importance of Algae.

UNIT: II (Fungi & Lichens)

General characters of Fungi. Detailed study of *Polyporous* (Occurrence, structure of cell and thallus, reproduction and life cycle). Economic importance of Fungi. Structure and reproduction in *Usnea*. Economic importance of Lichens.

UNIT: III (Bryophytes)

General characters of Bryophytes. Detailed study of *Marchantia*(Occurrence, structure of thallus, reproduction and life cycle). Economic importance of Bryophytes.

UNIT: IV (Pteridophytes)

General characters of Pteridophytes.Detailed study of *Selaginella*(Distribution, morphology, anatomy, reproduction and life cycle).Economic importance of Pteridophytes.

UNIT: V (Gymnosperms)

General characters of Gymnosperms.Detailed study of *Pinus* (Distribution, morphology, anatomy, reproduction and life cycle).Economic importance of Gymnosperms.

TEXT BOOKS:

- 1. Pandey, S.N. & P.S. P. Trivedi 1994.Text Book of Botany Vol. I, Vikas Publishing House Pvt. Ltd., Delhi.
- 2. **Pandey S.N., S.P Misra and P.S. Trivedi. 1998.** A text book of Botany Vol. II. Vikas Publishing House, Pvt. Ltd. New Delhi.

REFERENCES:

- 1. Singh, Pandey and Jain. 2000. A Text Book of Botany, Rastogi Publications
- 2. Vashishta, B. R.2002. The Algae, S. Chand & Co.
- 3. Vashishtha, B. R. 2002. The Fungi, S. Chand & Co.
- 4. Vashishtha, B. R. 2003. The Bryophytes, S. Chand & Co.
- 5. Vashista, P.C. 1997. Pteridophyta. S. Chand and Company Ltd., New Delhi
- 6. Vashista, P.C. 1991. Gymnosperms. S. Chand and Company Ltd., New Delhi.

PRACTICALS

PLANT DIVERSITY

(SUB. CODE: 21UBOPA32)

Study of the following types:

Algae	:	Volvox,	Cauler	pa,
	•		000000	p,

Fungi : Polyporus

Lichen : Usnea.

Bryophyte : Marchantia

Pteridophytes : Selaginella

Gymnosperms : Pinus

SERICULTURE (Subject code: 21USB32)

Semester: III SBE: 5(Optional) Credits: 2 Hours: 2
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Course objective: To make the students aware of the economic importance of silkworm for income generation and to create a self employment venture.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain knowledge on rearing of silk worm.
- 2. Describe the cultural practices and pest management in mulberry garden.
- 3. Apply rearing techniques and use of appliances
- 4. Recommend treatments for infestation with natural enemies and diseases
- 5. Evaluate quality parameters, economics and marketing of silk.
- 6. Expose to a cottage industry as well as generate an employment opportunity.

Unit I: Moriculture

Different varieties of mulberry, Planting materials, Mulberry cultivation; Weeds, insect pests and microbial diseases of mulberry, and their management.

Unit II: Silkworm rearing

Classification of silkworms, Life cycle of Bombyxmori, egg production technology, Silkworm rearing technology; spinning, harvesting and storage of cocoons, rearing appliances.

Unit III: Natural enemies and management

Natural enemies of silkworm (Uzi fly, Dermestid beetle); Silkworm diseases-source, symptoms and management (a brief account on viral-Grasserie, bacterial-Pebrine, fungal-Muscardine and protozoan diseases).

Unit IV: Silk production

Types of silk (Mulberry, Oak Tasar & Tropical Tasar, Muga, Eri), Physical and commercial qualities of silk – silk reeling – reeling appliances – quality testing.

Unit V: Economics and marketing

Prospects of sericulture in India; Economics of mulberry, mulberry and non-mulberry sericulture; Marketing - role of Central Silk Board, Future prospects.

Textbooks:

- 1. Ganga, S. G. and Sulochana Chetty, J. 2008. Introduction to sericulture (II Ed.), Oxford and IBH Publishing House, New Delhi.
- 2. Ullal S.R. and Narasimhanna, M.N. Handbook of Practical Sericulture: CSB, Bangalore.

6 Hours

6 Hours

B.Sc. ZOOLOGY 2021

6 Hours

6 Hours

Reference books:

- 1. David, B.V. and Ramamoorthy, V.V. 2011. Elements of economic entomology. NP Namrutha Publications, Chennai.
- 2. Sengupta, K. A. 1989. Guide for Bivoltine Sericulture; Director, CSR & TI, Mysore.

E-resources:

- 1. http://csb.gov.in/assets/Uploads/documents/note-on-sericulture-2016-17.pdf
- 2. http://csb.gov.in/publications/annual-report/

APICULTURE (Subject code: 21USB32)

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Course Objective: To enlighten the students about the importance of honey bees, apiculture practices and the economic importance.

Course Outcomes: At the end of the course the students will be able to:

- 1. Define the scope and importance of Apiculture and honeybee species.
- 2. Understand bee colony and queen bee management
- 3. Predict the suitable environment for the construction of apiary
- 4. Categorize natural enemies and diseases of honey bee
- 5. Justify the economic importance of honey, bee-wax and bee-venom.
- 6. Construct and maintain artificial bee hive.

Unit I: Honey bees

Scope of Bee keeping, Present status of Apiculture in India and Tamil Nadu; Honeybee -Systematic position, Species of Honey bees, Morphology and Life history; Stinging apparatus and bee poisoning. Bee colony - Castes, natural colonies and their yield; Bee foraging -Pollen and nectar yielding plants; Honey bee – behaviour – swarming – Pheromones

Unit II: Apiary

Apiary Management – Artificial bee hives (Newton's hive) – types – construction of space frames - Selection of sites - Handling - Maintenance - Instruments employed in Apiary. Queen and its management.

Unit III: Economic importance

Honey - Honey extraction, Composition, seasonal maintenance; Bee wax and its uses; National and International markets for Honey and bee Wax; Apiculture as Self employment venture.

Unit IV: Natural enemies and management

Natural enemies – parasites and predators and their control; Diseases: viral, bacterial, fungal and protozoan diseases (two examples each) and their management.

Unit V: Economic importance

Economic importance - honey; beewax, bee venom, pollination; Prospects of apiculture as self employment venture.

Textbooks:

- 1. Johnson, J., and Jayachandra, I. 2005. Apiculture, Olympic Graphics, Marthandam.
- 2. Shukla, G. S. and Upathyay, V.B. 2000. Economic Zoology, Rastogi Publications, Meerut.
- 3. Abrol, D. P. 1997. Bees and Beekeeping in India. Kalyani Publishers, Ludhiana
- 4. Singh, S. Bee keeping in India, Indian Council of Agricultural Research, New Delhi.
- 5. Jeya Chandra I & Johnson J, (2012) Apiculture, Olympic Offset Printers.

6 Hours

6Hours

6 Hours

6 Hours

Reference Books:

- 1. Sharma, P. and Singh L. 1987. Hand book of bee Keeping, Controller Printing and Stationery, Chandigarh.
- 2. Stephen, R. 1998. Introduction to Bee Keeping, Vikas publishing house, New Delhi.
- 3. Nagaraja, N and Rajagopal, D. 2009. Honey bee diseases, Parasites, Pest, Predators and their Management. MJP publishers, Chennai.
- 4. David, B.V. 2003. Elements of economic Entomology, Popular Depot, Chennai.
- 5. Amsath, A. and Marimuthu Govindarajan, 2013. Apiculture. Lambert Academic Publishing.

E-resources:

- 1. https://aabees.org/ebooks/Honey_bee_e_book.pdf
- 2. https://www.easternapiculture.org/addons/2013/Delaney/HoneyBeeBiologyIindividua l.pdf
- 3. http://www.sembabees.org/pdfs/biologyhoneybee.pdf
- 4. http://www.fao.org/3/a-a0849e.pdf
- 5. http://lib.icimod.org/record/7676/files/attachment_301.pdf

BIOSTATISTICS AND COMPUTER APPLICATION (Subject code: 21UZO41)

Semester: IVCore Theory:4Credits: 4Hours: 4

Course Objective: To understand the basic bio-statistical methods and use of computer application to solve the common and scientific problems in science.

Course Outcomes: At the end of the course the students will be able to:

- 1. Learn how to collect, categorize and present the data
- 2. Understand the basics of MS office word, excel and PowerPoint
- 3. Solve scientific problems applying statistical formula
- 4. Organize data in tables and diagrams
- 5. Analyze data and test the significance of hypothesis.
- 6. Create document, excel sheet and PowerPoint slides.

Unit I: Data-collection, categorization and presentation

Types of data: Primary and secondary data collection; Sampling-methods, merits and demerits, sampling error; Categorization - ungrouped and grouped data with continuous and discontinuous series; Presentation - Tabulation and Diagrammatic presentation -line, bar diagram, pie diagram, histogram, Ogive and Dot diagram.

Unit II: Measures of central tendency

Arithmetic mean, median, mode, standard deviation and standard error; Kinds and measures of skewness, measures of kurtosis. Normal distribution

Unit III: Tests of significance

Chi-square test, Student's't' test; simple correlation; linear regression and regression line; One way ANOVA.

Unit IV: MS-Word (2009)

MS-word- home, insert, page layout, references, mailing, review and view menus; Creating, editing, formatting and aligning new word document; Numbering and bullets, Spelling and grammar check; saving and printing; Creating and formatting table; Inserting pictures; Review a word file.

Unit V: MS-Excel and MS-PowerPoint (2009)

MS-Excel: Specific menu and tool bars; Creating and formatting table; Chart wizards creation and formatting charts; Functions-significance tests (t, Z, F), MS-PowerPoint: Specific Menus and tools; Animation – schemes and customs.

Textbooks:

- 1. Ramakrishnan, P. 2015. Biostatistics, Saras Publication, Nagercoil.
- 2. Veer Bala Rastogi. 2011. Fundamentals of biostatistics, 2nd edition. Ane Books Pvt. Ltd.
- 3. Gurumani, N. 2010. An introduction to Biostatistics, Tamil Nadu Book House, Chennai.
- 4. Sanjay Saxena 2006. M.S. Office 2000 for every one, Rrevised edition IV, Vikas Publication Pvt. Ltd. New Delhi.

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Reference books:

- 1. Ronald N Forthofer et al. (2007). Biostatistics a guide to design, analysis and discovery. Academic Press.
- 2. Cliffor Blari, Richard A Taylor. (2009). Biostatistics for health sciences. Pearson education.
- 3. Negi KS. (2012). Methods in biostatistics with latest MCQs. AITBS Publishers.
- 4. Zar 2003. Biostatistical analysis (IV Ed.), Pearson Education, Singapore.
- 5. Annadurai, B. 2007. A Text Book of Biostatistics, 1st Edition
- Bittu Kumar. 2013. Microsoft Office 2010. V & S Publishers; Latest Revised Edition, pp.208.

E-resources:

- 1. http://www.nios.ac.in/media/documents/316courseE/E-JHA-31-10A.pdf
- 2. http://dspace.vpmthane.org:8080/jspui/bitstream/123456789/2836/1/Measures%20of %20Central%20Tendency.pdf
- 3. http://www.indiana.edu/~ensiweb/lessons/oat.stat.signif.pdf
- 4. http://www.nysl.nysed.gov/libdev/nybbexpress/curriculum/poklib/word102.pdf
- 5. https://www.tutorialspoint.com/excel/excel_tutorial.pdf
- 6. https://www.computer-pdf.com/office/powerpoint/
BIOSTATISTICS AND COMPUTER APPLICATION - PRACTICAL (Subject code: 21UZOP41)

Semester: IV	Core Practical: 4	Credit: 1	Hours: 2

- 1. Formatting a document (number and bullets, alignment, spelling and grammar), saving, renaming and printing a document
- 2. Table creation and formatting (spilt cell, merge cell)
- 3. Arrangement of references in APA style
- 4. MS Excel Functions (student 't'test, 'Z' and 'F' tests)
- 5. Chart creation Column or Bar, Error bar, Pie diagram and Line diagram
- 6. PowerPoint slide preparation texts, tables, bullets and numbers, charts, clipart, word art and pictures with animations
- 7. Mean, median, mode and standard deviation using biological samples
- 8. Correlation between cockroach weight and length /height and weight of students
- 9. Regression analysis using escaping behaviour of different sized cockroaches
- 10. Prepare a PowerPoint presentation.
- 11. Spotters: CD, Pen drive, portable drive, primary and secondary data, binomial distribution, Poisson, normal curves, simple bar diagram, multiple bar diagram, pie diagram, line diagram, histogram, error bar chart, skewness, kurtosis, hypothesis testing, correlation, regression line, MS-Word Home tab, insert tab, MS-Excel Work sheet, data tab, MS-PowerPoint Animations tab, Slide show tab, SmartArt Graphic

TAXONOMY OF ANGIOSPERMS AND PLANT PHYSIOLOGY

(SUB. CODE: 21UBOTA41)

Semester: IV	Core Supportive:2	Credits: 4	Hours: 4
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OUTCOME

After the completion of the course, the students will have;

- To understand the principles of biosystematics, classification and nomenclature of plants
- To know the modem trends in plant Taxonomy
- To understand the functions of plants
- To realize the importance of water and minerals in the life of plants
- To understand the role of light in the plants life

UNIT: I

Objectives of Systematic botany. Morphology: Leaf types, Inflorescence, Flower structure and fruit types. Taxonomic hierarchy, Botanical Survey of India. Flora of Tirunelveli hills.

UNIT: II

Herbarium Methodology: Definition, its utility in the study of plants; Procedure: Plant collection, poisoning, pressing, drying, mounting, identification, preservation, field book and field data. Nomenclature: Definition, importance of binomial nomenclature

UNIT: III

Systems of Classification: A detailed study of Bentham and Hooker's system - merits and demerits. Study of the following families with reference to the morphology, taxonomy and economic importance: *Fabaceae, Solanaceae, Euphorbiaceae, Poaceae*

$\mathbf{UNIT} - \mathbf{IV}$

Water potential. Absorption of water and minerals, ascent of sap – cohesion and tension theory. Transpiration: types, mechanism of stomatal movement – Stewart hypothesis. Factors affecting transpiration. Guttation. Role of macro (N, P, K) and microelements (B, Mo, Zn) in plants.

$\mathbf{UNIT} - \mathbf{V}$

Photosynthesis: ultra structure of chloroplast, photosynthetic pigments, light reaction and dark reaction .Calvin cycle,C4 cycle. Factors affecting photosynthesis.

Text Book:

- 1. Vashista, P.C.1988. Taxonomy of Angiosperms, R.Chand&Co.
- 2. Singh, V& D.K. Jain 1985. Taxonomy of Angiosperms, 2nd Ed. S. Chand & Co.
- 3. Lawrence, G.H.M, 1974. Taxonomy of Vascular Plants.
- 4. Pandy, S.N. 1991. Plant Physiology, Tata McGraw Hill Publishers (P) Ltd., New Delhi.
- 5. Verma, V., 1991. A Text Book of Plant Physiology, Emkay Publications, NewDelhi.

PRACTICALS

TAXONOMY OF ANGIOSPERMS AND PLANT PHYSIOLOGY -

(SUB. CODE: 21UBOPA42)

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- 1. Determination of DPD by Gravimetric method and plasmolytic method
- 2. Effect of temperature and detergent on membrane permeability.
- 3. Estimation of photosynthetic pigments
- 4. Demonstration of Clinostat, Ganong's photometer, Khun's tube, Phototrophic chamber.
- 5. Identification of commonly available Leaf, Inflorescence and Fruit types

6. Technical descriptions of plant parts, including floral parts (L. S. of flower, floral diagram and floral formula) with reference to the families prescribed in theory.

7. Submission of record work for valuation in the semester practical examination

0FISHERY BIOLOGY (Subject code: 21UZOE41)

Semester: IV	Elective: 1 (Optional)	Credits: 4	Hours: 4

Course Objective: To introduce and to familiarize the basic aspects of Indian fisheries, Fishery techniques, classification of fishes, and help the students to pursue related research avenues and job opportunities.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain knowledge on fishery status and fishing methods.
- 2. Describe the characteristics of common edible fishes.
- 3. Examine the adaptations in fishes.
- 4. Classify and analyze fish diseases.
- 5. Select appropriate management techniques to control fish disease.
- 6. Use fish processing techniques and enhance fish marketing.

Unit I: Indian fishery

Types and status - Prospects, Capture and culture fishery; Inland, estuarine, coastal, marine fishery. Fishing methods:Types of crafts - canoes, Kattumaram, Vallam, Vanchi, Fibre boats, Trawlers and line vessels; Gears - Gill nets, cast nets, Trap nets, purse net gumcha), lift nets, Seine nets, Trawl nets and Dredges, and line fishing.

Unit II: Common edible fishes of Tamil Nadu

Freshwater fishes: Indian Major Carps - *Catla*, Rohu, Mrigal; Catfishes – *Heteropneustusfossillis*, *Clariasbatrachus*, *Mystusgulio*; Murrels – *Channastriatus*, *Channamarulius*, *Channa punctatus*; *Tilapia*; Brackish water fishes –*Chanoschanos*, Grey mullets and *Etroplussuratensis*, Marine fishes - Bony fishes- Pomfrets, Indian Mackerel, Seer fish, Carangids, Ribbon fish, Flat fishes and sardines; Shell fishes - Prawns, Oyster and Mussels.

Unit III: Adaptation in fishes

Fin types and function; Scales of fishes - Placoid, cycloid, ctenoid, ganoid; Accessory respiratory organs - Buccopharyngeal epithelium, Integument, external gills, Labyrinthiform organs,Opercular lungs,Air bladder/ swim bladder,Alimentary canal and feeding adaptation.

Unit IV: Fish disease and Management

Causes of fish diseases, Bacterial diseases (Bacterial gill disease, Vibriosis) Fungal diseases (Saprolegnia, Achlya); Viral diseases (White spot syndrome (WSS), Monodon baculovirus (MBV)); Protozoan diseases (Ich, Costiasis); Other parasitic diseases (Argulosis, Lernaeosis) and non-infectious diseases. Integrated fish disease management.

Unit V: Fish processing and marketing

Principles of fish processing; Methods of preservation - curing, drying, wet curing, smoking, Icing, freezing, deep freezing, freeze drying, canning; Economic importance of fishes, their products and by-products and marketing.

Textbooks:

1. Rath, A.K. 2011. Freshwater Aquaculture, Third Edition, Scientific Publishers, Jodhpur, India.

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- 2. Santhanam, R. 1990. Fisheries Science, Daya Publishing House, New Delhi.
- 3. Arumugam, M. 2012. Aquaculture and Fisheries, Saras Publications, Nagarkoil
- 4. Vijay Singh Thakur, 2012. Fish diseases. Sonali Publications.
- 5. Pandey BN, Sunil P Trivedi, 2012. Fish and fisheries. Sarup Book Publishers Pvt. Ltd.

- 1. Ninawe, A. S and Khadkar, G. D. 2009. Nutrition in Aquaculture (I Ed.) Narendra publishing house, New Delhi.
- 2. Jhingran, V.G. 1997. Fish and Fisheries of India. Hindustan Publishers, New Delhi.
- 3. Schaperclaus W, 2000. Fish diseases. Oxonian Press Pvt. Ltd.
- 4. Karl F. Lagler, 2000. Freshwater fishery biology. W.M.C. Brown Company.
- 5. Peter B Moyle, Joseph J Cech, (2004). Fishes an introduction to ichthyology, 5th edition, PHI Learning Pvt. Ltd.

E-resources:

- 1. http://fisheries.tamu.edu/files/2013/09/Fins-and-Scales-%E2%80%93-A-Project-for-4-H-Members.pdf
- 2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=88437
- 3. http://www.ciba.res.in/Books/ciba0076.pdf
- 4. http://nptel.ac.in/courses/120108002/module5/lecture9.pdf
- 5. http://www.ncap.res.in/upload_files/others/oth_2.pdf

AQUACULTURE (Sub code: 21UZOE41)

Semester: IVElective: 1 (Optional)Credits: 4	Hours: 4
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Course Objective: To introduce and familiarize the basic and aspects of culture practices of both fin fishes and shell fishes, feeding and breeding techniques and help the students to pursue higher studies and research and job opportunities in aquaculture.

Course Outcomes: At the end of the course the students will be able to:

- 1. Acquire knowledge on fish pond construction and its management.
- 2. Explain fish culture practices.
- 3. Illustrate shell fish and seaweed culture.
- 4. Categorize commercially important edible fishes
- 5. Select appropriate fish feed, breeding and rearing techniques.
- 6. Construct pond and grow fishes of economic and market value.

Unit I: Pond construction and management

Aquaculture-Global scenario, Present status in India and Tamil Nadu; Fish pond construction- site selection; types of ponds, water quality analyses, liming and fertilization, morphology and commercial characteristics of cultivable fishes, culture practice, predator and weed control.

Unit II: Fin fish culture

Composite fish culture (Indian Major Carps and Murrels); Sewage fed fish culture and integrated fish culture, Marine water fish culture.

Unit III: Shellfish and seaweed culture

Culture of prawns, edible and pearl oysters, adaptive management; Seaweeds- types and culture practices.

Unit IV: Feeding and breeding

Live feed organisms – *Artemia* and rotifers culture; Fish feed - types, formulation and preparation, techniques, Importanceof artificial feeding; Breeding – Bundh breeding and hypophysation; rearing of hatchlings, fry and fingerlings.

Unit V: Applied aquaculture

Identification of cultivable fish species; Morphometry of pond (Enclosed rectangular method/Shore length/ shore area and shore line development);Demonstration of breeding technologies - natural seed production, artificial fertilization and induced breeding (hypophysation).

Textbooks:

- 1. Rath, AK (2011). Freshwater Aquaculture, Third Edition, Scientific Publishers, Jodhpur, India.
- 2. Arumugam N (2008). Aquaculture. Saras publications.
- 3. Santhanam R, Sukumaran N (2000). Manual of freshwater aquaculture. Sugainna Pathipagam.
- 4. Shanmugam K (2000). Fishery biology and aquaculture. Leo Marca Ashram.

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- 5. Srivastava CBL, (2000). Textbook of fishery science and Indian fisheries. Kitab Mahal.
- 6. Ninawe AS, Khedkar GD, (2009). Nutrition in aquaculture. Narendra Publishing House.

- 1. Jhingran VG (2000). Fish and fisheries of India. Hindustan Publishers.
- 2. Peter B Moyle, Joseph J Cech, (2004). Fishes an introduction to ichthyology, 5th edition, PHI Learning Pvt. Ltd.
- 3. Baeumont Hoare K, (2000). Biotechnology and genetics in fisheries and aquaculture. Blackwell Publishing.
- 4. Landau Matthew, (2000). Introduction to aquaculture. John Wiley & Sons Inc.

E-resources:

- 1. http://agritech.tnau.ac.in/fishery/fish_freshwaterprawn.html
- 2. http://www.fao.org/3/contents/6c2f5977-bc3e-528e-b90fee63c7605e27/AC417E00.htm
- 3. http://nacogdoches.agrilife.org/files/2011/06/feeding_fish_7.pdf
- 4. https://www.slideshare.net/SameerChebbi1/freshwater-brackish-water-and-marine-fish-culture-of-india-by-dr-s-g-chebbi

AQUARIUM FISH KEEPING (Subject code: 21USB41)

Semester: IV SBE: 6 (other major students) (optional) Credits: 2 Hours: 2

Course Objective: To impart knowledge about aquarium fishes and basic skills on aquarium fish keeping and expose the students to fish keeping as an alternative source of income generation.

Course Outcomes: At the end of the course the students will be able to:

- 1. Know the component of an aquarium
- 2. Identify aquarium fishes and explain its biology.
- 3. Predict the breeding behavior of aquarium fishes
- 4. Select feed based on the feeding behavior of fish
- 5. Evaluate fish diseases and choose appropriate control strategies.
- 6. Design, construct and manage an aquarium

Unit I: Introduction and aquarium

Scope and utility value of aquarium fish industry; Different varieties of exotic and indigenous fishes; Aquarium – Design and construction, aquarium accessories.

Unit II: Biology of aquarium fishes

Common characters, sexual dimorphism and biology of aquarium fishes (Guppy-Poecilia reticulata, molly-Poecilia sphenops, fighting fish-Betta splendens, Gold fish-Carassius auratus, Angelfish-Pterophyllum, Butterfly fish-Tetragonopterus mitratus).

Unit III: Food and Feeding

Live fish feed organisms - Daphnia, Rotifers, Copepods, Cladocerans, Brine shrimp, Blood worm, Tubifex; Artificial feed - ingredients, formulation, preparation of pellets, feeding schedules; commercial fish feeds.

Unit IV: Fish Breeding and rearing of Egg layers

Fish Breeding- Gold fish, Angel fish, Zebra fish and Neon tetra; Hatchery and Nursery management system for egg layers; Live fish packing and forwarding techniques.

Unit V: Maintenance and Management Aspects

General aspects of aquarium maintenance; Ornamental Fish-diseases and their management; Aquarium plants – selection, propagation and Management; Water quality management.

Textbooks:

- 1. Jameson, J.D. and Santhanam. R. 1996. Manual of ornamental fishes and farming, Technologies Peejay, Thoothukkudi.
- 2. Arumugam, N. 2010. Home Aquarium, Saras Publication

Reference Books:

- 1. Rath, R.K. 2000. Freshwater Aquaculture. Scientific Publishers (India). PO Box: 91, Jodhpur.
- 2. Mohan Kumar. C. 2008. Handbook on ornamental fish diseases, MPEDA, India
- 3. Arumugam, N. 2010. Home Aquarium, Saras Publication

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4. Jayashree, K.V., Thara Devi, C.S., Arumugam, N. Home aquarium and ornamental fish culture, Saras Publication

E-resources:

- 1. www.mpeda.com www.cifa.in/
- 2. www.fao.org > FAO Home > Fisheries & Aquaculture
- 3. www.ofish.org www.nabard.org/english/fish_ornamental_fish.aspx

WILDLIFE AND NATURE WATCH (Subject code:21USB41)

SBE: 6 (other major students) (optional) Credits: 2 Hours: 2 Semester: IV

Course Objective: To expand the knowledge of the underlying conceptual and theoretical framework required by conservation biologist.

Course Outcomes: At the end of the course the students will be able to:

- 1. Tell wildlife organizations, projects and reserves in India.
- 2. Understand the importance of wildlife and its conservation.
- 3. Examine conservation issues along a spectrum ranging from individual animals to populations, re-introductions, habitat restoration and anthropogenic sources of conflict.
- 4. Select tools and techniques for tracking animals.
- 5. Recognize the value and limitations of applying biological principles and disciplines to real-world conservation.
- 6. Live with nature and develop a productive hobby.

Unit I: Wildlife in India

Definition, WWF India, Brief account of National Parks, Biosphere Reserve, World Network of Biosphere Reserves, Wild life sanctuaries, Tiger Reserves and project Tiger; National symbols (animals).

Unit II: Tools and Techniques

Tools - Trial and digital cameras, Track plates, GPS Units, Binoculars, Wildlife Callers; Techniques - count, tracking, capturing-marking-recapture, genetic sample collection, census, radio-telemetry, Pugmarks, traps, radio-telemetry.

Unit III: Wildlife Biology and Conservation

Biology of selected wild animals of Western Ghats; Snakes of India - identification of poisonous and non poisonous snakes, first aid for snake bite; Wildlife conservationprinciples, needs and efforts in India.

Unit IV: Bird Watching

Birds of Tirunelveli district, Morphology of birds, Bird behaviour, Silhouette: Shape, Size, Bird flight.

Unit V: Eco-Ethics

Wildlife tours - Dress code, Behaviour code, Do's and Don'ts, Zoo behaviour; Eco-living, Man-wildlife conflicts. Man-eaters.

Textbooks:

- 1. Prater, S.H. 1974. The Books of Indian Mammals, Oxford University Publication, New Delhi
- 2. Salim Ali, 1996. Birds of Indian Subcontinent, Bombay Natural History Society publication, Bombay.

Reference Books:

1. Richard Grimmet, 2007. Princeton field guide Birds of India

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- 2. Romulus Whitaker2004. Common Indian Snakes, Oxford University Publication, New Delhi
- 3. Jim Corbett, 2001. Man-eaters of Kumaon, Oxford India Publications, Chennai.
- 4. Jim Corbett, 2001. Man eating leopard of Rudraprayag. Oxford India Publications, Chennai.

E-resources:

- 1. www.wii.gov.in
- 2. www.wwfindia.org
- 3. www.bnhs.org
- 4. www.indianjungles.com
- 5. www.sanctuaryasia.com
- 6. www.cranes.org

BIOCHEMISTRY (Subject code: 21UZO51)

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Course Objective: To inculcate the basic knowledge on the biochemical aspects of animals.

Course Outcomes: At the end of the course the students will be able to:

- 1. Define biomolecules and their properties
- 2. Describe the major biochemical pathways in the biological system.
- 3. Determine the general three dimensional structures of the highlighted molecules.
- 4. Classify the molecules based on their structure and properties.
- 5. Recognize deficiency and metabolic diseases
- 6. Build models on cell metabolism.

Unit I: Small biomolecules of biological importance

Properties of water, buffers, biologically important buffers; Diffusion, Osmosis and Viscosity. Acid-base concepts, concepts of pH, factors affecting pH and Role of pH in biological systems.

Unit II: Carbohydrates

Carbohydrates: chemical nature, properties, classification; Monsosaccharides, Oligosaccharides and Polysaccharides; Metabolism – Glycolysis, Kreb's cycle, HMP pathway, glyoxylate cycle, Electron Transport System

Unit III: Lipids

Lipids: chemical nature, properties, classification and fatty acids, biosynthesis of saturated fatty acids – palmitic acid; metabolism – β oxidation.

Unit IV: Amino acids and Proteins

Aminoacids: structure, properties, classification, transamintion, deamination and biosynthesis of urea.

Protein: properties, classification, structural organization – primary (peptide bond), secondary (α and β), tertiary (myoglobin) and quaternary (haemoglobin) structure; biological importance of proteins.

Unit V: Nucleic acids, Enzymes and Vitamins

Chemistry of DNA,Nitrogen bases, nucleosides, nucleotides, variants of DNA, and types of RNA; Enzymes -Classification, mechanism of action; enzyme inhibition.Vitamins: Types, sources, structure of vitamin A, D, B1 and B₂, deficiency manifestation.

Textbooks:

- 1. Arumugam N et al., (2014). Biochemistry. Saras Publication.
- 2. Satyanarayana U et al., (2013). Essentials of biochemistry. Books and allied (P) Ltd.
- 3. Ambika Shanmugam, (2011). Fundamentals of biochemistry for medical students. Arthur's Publication
- 4. Rastogi SC, (2010). Biochemistry, 3rd edition. Tata McGraw Hill Education Pvt. Ltd.
- 5. Jain JL et al., (2010). Fundamentals of biochemistry. S Chand and Co Ltd.
- 6. Power CB, Chatwal GR, (2008). Biochemistry. Himalaya Publishing House.
- 7. Veerakumari L, (2005). Biochemistry. MJP Publishers.

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- 1. Keith Wilson, John Walker, (2017). Biochemistry and molecular biology. Cambridge University Press.
- 2. Michael M Cox, David L Nelson, (2010). Lehninger's principles of biochemistry, 5th edition. WH Freeman and Co.
- 3. Mary K Campbell, Shawn O Farrell, (2009). Introduction to biochemistry. Cengage learning.
- 4. Voet et al., (2008). Principles of biochemistry. John Wiley & Sons, Inc.
- 5. William H Elliott, Daphne C Elliott, (2007). Biochemistry and molecular biology. Oxford University Press.
- 6. Lubert Stryer, (2000). Biochemistry. CBS Publishers & Distributors.
- 7. Victor W Rodwell, (2000). Harper's review of biochemistry. Lango Medical Publication.

DEVELOPMENTAL BIOLOGY (Subject code: 21UZO52)

Course Objective: To understand the development and functioning of various organs as well as to know about the concepts, trends and patterns of animal development.

Course Outcomes: At the end of the course the students will be able to:

- 1. Define life and its processes
- 2. Understand the developmental patterns and stages.
- 3. Apply laws and concepts to describe evo-devo trends.
- 4. Analyze gene function in development.
- 5. Compare tissue differentiation between organisms.
- 6. Integrate different disciplines with developmental biology.

Unit I: Gametogenesis and Fertilization

Structure of mammalian ovary and testis; Spermatogenesis and Oogenesis- ovulation; Types of eggs; Fertilization - external and internal, physiological and chemical changes, post-fertilization changes; Parthenogenesis (General account).

Unit II: Cleavage, Fate Map and Gastrulation

Cleavage: rules, patterns and laws; Cleavage in Frog; Fate map and gastrulation; morphogenetic movements.

Unit III: Organizer and Organogenesis

Types of embryonic induction - structure, mechanism and theories of induction; organizer concept; organogenesis - brain, eye and heart in frog; development of metanephros in chick.

Unit IV: Extra-embryonic Membranes and Placenta

Egg membranes; Development and factors involved in the formation of amnion, chorion, allantois and yolksac - their function; Formation of extra-embryonic membranes in humans; Origin, types and functions of placenta.

Unit V: Metamorphosis and Regeneration

Metamorphosis in Frog – physical and chemical changes, causation of metamorphosis; abnormal development; Regeneration –types .

Textbooks:

- 1. Arumugam. (2009). Textbook of embryology. Saras Publications.
- 2. Veer Bala Rastogi (2000). Developmental Biology. Kedarnath, Ramnath & Co.
- 3. Verma, P.S. and Agarwal, V.K. 1999. Chordate Embryology, Chand & Co. New Delhi.
- 4. Jain, P.C. 2000. Elements of developmental biology, Vishal Publications, Jalandhar.

Reference Books:

- 1. Twyman RM (2003). Developmental biology, Viva books Pvt. Ltd.
- 2. Banerjee.S (2005), A Textbook of Developmental Biology, Dominant Publishers and Distributors.
- 3. Werner A Muller (2005). Developmental biology. Springer Publications.

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- 4. Balinsky, RJ. 1981. An Introduction to Embryology, CBS College Publishing, Holt, Rinehart and Winston.
- 5. Scott F. Gilbert (2000). Developmental biology. Sinauer Associates Inc.
- 6. Gurubachan S. Miglani (2006). Developmental genetics. IK International Publishing House.
- 7. Lewis Wolpert (2000). Principles of development. Oxford University Press.

GENETICS AND ANIMAL BIOTECHNOLOGY (Subject code: 21UZO53)

Course Objective: To introduce and familiarize the basic aspects of genetics and to inculcate the knowledge of biotechnological tools and their application.

Course Outcomes: At the end of the course the students will be able to:

- 1. Define genes, their arrangement and interactions
- 2. Associate chromosome with phenotypes
- 3. Apply laws of genetics to trace hereditary diseases.
- 4. Analyze the nature and alterations of chromosomes in humans
- 5. Recommend appropriate rDNA technique in agricultural, medical and environmental field
- 6. Develop techniques in genetic engineering

Unit I: Mendelism and its deviations

Mendel's law – Law of segregation and law of independent assortment, backcross and test cross. Allelic interaction- Incomplete dominance, Co-dominance, Complementary genes, Lethal genes, Reversion, Epistasis, Multiple allele inheritance - ABO blood groups, Rh factor; Polygenic inheritance – skin colour.

Unit II: Linkage, crossing over and sex linked inheritance

Linkage and crossing over, linkage map; Sex determination in man and Drosophila; Gynandromorphism (eg: Bonellia); sex linked inheritance in man and drosophila; nondisjunction, holandric genes, sex influenced and sex limited genes; Extra chromosomal inheritance- maternal inheritance.

Unit III: Human genetics and chromosomal alterations

Human chromosomes; Abnormalities of chromosomes – Edward, Down's, Klinefelter's, and Turner syndromes, sickle cell anaemia; Inborn errors of metabolism -alkaptonuria, phenylketonuria; Chromosomal alterations- deletion, duplication, inversion, translocation; Eugenics, euthenics and euphenics; Pedigree analysis

Unit IV: Genetic engineering

rDNA technology-construction of recombinant DNA, gene transfer techniques (gene gun, electroporation, liposome-mediated), Selection and multiplication of recombinant host cells, expression of cloned gene. Cloning vectors – pBR322, Ti plasmid, bacteriophage, DNA sequencing (Sanger's), cDNA libraries; Method of gene amplification- PCR.

Unit V: Applications of genetics

Monoclonal antibodies, DNA finger printing, Biotechnological products-insulin, drugs, somatotropin production, Cloning method-Dolly; transgenic animals and their applications; Gene therapy and immunotoxins.

Textbooks:

- 1. Verma, P.S. and Agarwal, V.K. 1998. Concepts of Genetics, Human Genetics and Eugenics. S.Chand & Company Ltd, Ram Nagar, New Delhi.
- 2. Sambamurthy, A.V.S.S. 2010. Genetics, Narosa Publication, New Delhi

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- 3. Ajoy Paul ,(2012) Genetics, Books And Allied (P) Ltd.
- 4. N. Arumugam, LM. Narayanan, A. Mani A.M. Selvaraj, P. Singh, 2013. Genetic engineering, Saras publications
- 5. Dubey, R.C. 2001. A text book of biotechnology, S. Chand & Company, Ramnagar, New Delhi.
- 6. Miglani G S, (2008) Fundamentals of Genetics, Narosa Publishing house.
- 7. Channarayappa,(2006), Molecular Biotechnology. University Press
- 8. Prakash S Lohar, (2012), Textbook of biotechnology. MJP Publishers
- 9. Rema L P ,(2007) Applied Biotechnology. MJP Publishers
- 10. Satyanarayana, U. (2008). Biotechnology, Book and allied Ltd.
- 11. Er.Prabhanshu kumar, Santhosh kumar Rai. (2008) Biotechnology (2000), G.K.Publishers (P) Ltd.

- 1. Gardner, Simmons and Snusted (2006). Principles of Genetics, JohnWiley& Sons, INC, New York.
- 2. Tamarin, R.H (2010). Principles of genetics, Tata McGraw Hill Publishing company, New Delhi.
- 3. Lewine Benjamin (2007). Gene XII, Pearson Education International, New Jersey.
- 4. Alice Marcus. (2009). Genetics, MJP publishers.
- 5. Eldon John Gardner Micheal J.Simmone.D.Peter snustad (2006) Principle of Genetics,, Wiley India Pvt Ltd., Eight Edition.
- 6. Monroe W.Strickberger, (2012) Genetics third edition, PHI Learning Pvt Ltd.,
- 7. Micheal Fumento.(2009),Biotechnology How It Is Changing Our Life, Jaico Publishing House.
- 8. Colin Ratledge and Bjorn Kristiansen,(2000) Basic Biotechnology --6th Edition, Cambridge.
- 9. CM Brown (2000), Introduction of Biotechnology, Panima Publishing Corporation

ECOLOGY (Subject code: 21UZO54)

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Course Objective: Provides the students with a basic and advanced scientific knowledge relevant to addressing current environmental issues. In particular, the students will acquire theoretical knowledge required for environmental and pollution monitoring, and nature conservation and management.

Course Outcomes: At the end of the course the students will be able to:

- 1. Define the principles and basics of ecology
- 2. Learn the population and animal relationship
- 3. Illustrate biogeochemical cycles and significance of habitat
- 4. Classify natural resources
- 5. Recommend wildlife conservation methods
- 6. Reduce, re-use and recycle to protect environment

Unit I: Principles of Ecology

Definition and Scope, Biosphere, Biotic and abiotic factors and their roles, Ecosystemconcept, components and types, food chain and food web, Trophic level, ecological pyramid, energy flow. Keystone species, Indicator species, Umbrella and flagship species

Unit II: Population and community

Population Ecology–Definition, Density, growth, Estimation, Natality, Mortality and Age distribution; Community characteristics, structure and stratification, ecological niche, ecotone and edge effect; Animal relationship -Symbiosis, Commensalisms, Mutualism, Antagonism, (Antibiosis, Parasitism, Predation), Competition; Ecological Succession.

Unit III: Biogeochemical cyclesand habitat ecology

Biogeochemical cycles - Carbon, Oxygen, Phosphorous; Habitat Ecology - Fresh water, Marine Water, Estuarine, Terrestrial habitat; Man-made ecosystems; Niche concepts.

Unit IV: Conservation and Natural resources

Biodiversity - Concept, types and components; value, loss and action; hotspots; IUCN species categories – rare, endangered and threatened; Causes of Animal extinction; Techniques for Conservation; Wildlife Sanctuaries in Tamil Nadu; Natural resources management - renewable and non-renewable; Biodiversity conservation – *in situ* and *ex situ*.

Unit V: Pollution and its control

Sources and causes, effects (human, environment), prevention and control of Air, water and soil pollution; Pollution control devices; Biomagnifications; Bio-indicators and their role in environmental monitoring; Pollution control acts and regulations of India.

Textbooks:

- 1. Arumugam N, (2010). Ecology and toxicology. Saras Publications.
- 2. Verma PS, Agarwal VK, (2005). Principles of ecology. S Chand & Co. Ltd.
- 3. Tyagi PN, (2013). Textbook of ecology. Astha Publishers Distributors.
- 4. Subrahmanyam NS, Sambamurty AVSS, (2011). Ecology, 2nd edition. Narosa Publishing House.

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- 5. Mohan P Arora, (2000). Ecology, 4th edition. Himalaya Publishing House.
- 6. Sharma PD, (2000). Ecology and environment. Rastogi Publications.

- 1. Michael PN, (2016). Ecology. CBS Publishers & Distributors Pvt. Ltd.
- 2. Eugene P Odum, (2014). Fundamentals of ecology. Cengage Learning.
- 3. Edward J Kormondy, (2013). Concepts of ecology, 4th edition. PHI Learning Pvt. Ltd.
- 4. Saha TK, (2010). Ecology and environmental biology. Books and allied (P) Ltd.
- 5. Peter J Russell et al., (2009). Ecology. Brooks/Cole Cengage Learning.
- 6. Charles S Elton, (2000). Animal ecology. Methuen & Co.
- 7. Robert E Rickleft, (2000). Ecology. Nelson and sons Ltd.

E-resources:

- 1. https://www.gov.mb.ca/waterstewardship/fisheries_education_sustain_dev/education/ outcomePages/grade10/pdf/cycle.pdf
- 2. https://en.wikipedia.org/wiki/Conservation_biology
- 3. http://download.nos.org/333courseE/10.pdf
- 4. http://bio1510.biology.gatech.edu/module-2-ecology/population-ecology/
- 5. https://www.cbd.int/2010/biodiversity/#tab=2
- 6. http://tamilelibrary.org/teli/wildlife1.html
- 7. http://www.biologydiscussion.com/ecology/top-4-types-of-habitat-ecology/59797
- 8. https://en.wikipedia.org/wiki/Pollution

BIOCHEMISTRY – PRACTICAL (Subject code: 21UZOP51)

Semester: V CorePractical:5 Credit: 1 Ho	urs: 2
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- 1. Qualitative analysis of carbohydrates
- 2. Determination of Glucose Concentration by Nelson's Method
- 3. Qualitative analysis of proteins
- 4. Qualitative analysis of amino acids
- 5. Qualitative analysis of fats
- 6. Preparation of buffer and molar solutions
- 7. Determination of pH in water samples
- 8. Absorption maxima of colored solution using colorimeter.
- 9. Separation of amino acids and determination of R_f value by paper chromatography
- 10. Spotters: Structure of glucose, Starch, Secondary structure of protein, Myoglobin, Haemoglobin, Oleic acid, Cyclic AMP, Urea cycle, Kreb's cycle, Structure of DNA, Structure of RNA-Types, Enzyme action- lock and key model, Induced fit model; Fat soluble and water soluble vitamins, Instruments: pH meter, colorimeter, Paper chromatography, gel electrophoresis, spectrophotometer and centrifuge.

DEVELOPMENTAL BIOLOGY - PRACTICAL (Subject code: 21UZOP52)

Semester: V	Core Practical: 6	Credit: 1	Hours: 2
	Core I factical.		IIVuis. 2

- 1. Temporary mounting of Chick blastoderm
- 2. Observation of developmental stages :
 - a. Frog Egg, cleavage, gastrulation, section through optic cup.
 - b. Chick –24hrs, 33 hrs, 48hrs, 72hrs and 96 hrs
- 3. Drosophila Life stages observation, Sex and mutant identification
- 4. Observation of Mosquito life stages
- 5. Placental types: Shark, platypus, sheep, rabbit, pig.
- 6. Teratology abnormal development in animals.
- 7. Preservation of gametes in fishes / Observation of gametes (mammals)
- 8. Demonstration of fertilization, cleavage and gastrulation using color balloons.
- 9. Regeneration frog tadpole tail (demonstration)
- 10. Effect of iodine on metamorphosis of frog (optional/demonstration).
- 11. Spotters:Slides of mammalian sperm and ovum, Different developmental stages of chick embryos(primitive streak, 24,48,72,96hrs), Blastula and gastrula of frog(morula, early gastrula, yolk plug stage, late gastrula), Placenta of fish,sheep,pig,platypus and rat.

GENETICS AND ANIMAL BIOTECHNOLOGY - PRACTICAL (Subject code: 21UZOP53)

Semester: V	Core Practical: 7	Credit: 1	Hours: 2

- 1. Demonstration of Monohybrid and Dihybrid cross using colored beads.
- 2. Verification of Hardy Weinberg's law using beads (partial)
- 3. Polygenic inheritance- Human height weight
- 4. Variation in left thumb impression
- 5. Probability Coin tossing (two coin only)
- 6. Isolation of casein from milk
- 7. Isolation of citric acid from lemon juice
- 8. Isolation of Protein –PAGE(Demonstration)
- 9. Isolation of DNA AGE (Demonstration)
- 10. Demonstration of DNA amplification (PCR)
- 11. Cell viability test
- 12. Spotters: gene interaction- test cross, Incomplete dominance, Co-dominance, Complementary genes, Lethal genes, and Epistasis, Rh factor, Free-Martin, color blindness, human abnormalities, hypertrichosis (holandric gene), chromosomal alterations, construction of recombination DNA, PCR, Monoclonal antibodies, DNA finger printing, insulin production, Cloning.

ECOLOGY-PRACTICAL (Subject code: 21UZOP54)

Semester : V Core Practical : 8 Cre	edit: 1 Hours : 2
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- 1. Determination of pH of Soil and Water
- 2. Determination of primary productivity (dark and light bottle)
- 3. Transparency of water using Secchi disc
- 4. Analysis of freshwater and marine water planktons
- 5. Estimation of salinity (chlorides) of water samples
- 6. Estimation of dissolved oxygen of pond water, sewage water and effluents.
- 7. Determination of water hardness Silicates and phosphates
- 8. Calculation of LC₅₀ /LD₅₀ using SPSS software
- 9. Mimicry : leaf insects, stick insects, monarch and Viceroy butterflies
- 10. Visit to a Wild Life Sanctuary/National Park/Zoo/Biosphere Reserve/Natural Ecosystems Report submission (compulsory)
- 11. Spotters: Ecosystem Aquatic (freshwater and Marine) and terrestrial (Grass land and forest); Pyramids (biomass, number and energy)- Animal inter relationship, (Parasitism, Commensalism, Mutualism), Food chain and food web, energy flow in an ecosystem, Biogeochemical cycle (Phosphorous, Nitrogen and Carbon); Instrumentations field thermometer, anemometer, barometer, hygrometer and anemometer.

EVOLUTION (Subject code: 21UZOE51)

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Course Objective: To make the students understand the concepts, trends and patterns of evolution as well as evolution of selected groups.

Course Outcomes: At the end of the course the students will be able to:

- 1. Tell the chemical and biological origin of life.
- 2. Understand the mechanism of natural selection.
- 3. Demonstrate patterns of evolution.
- 4. Trace the evolutionary history of animals.
- 5. Compare adaptive features based on behavioral and natural selection.
- 6. Construct phylogenetic tree using molecular data.

Unit I: Evolutionary history and Origin of cells

Evolutionary time scale: eras, period, and epoch; Major events in the evolutionary time scale, fossils;Origin of biomolecules, chemical and biological evolution of life; concepts of Oparin and Haldane-experimental evidences.

Unit II: Paleontology and Evolutionary thoughts

Lamarckism, Darwinism-, Natural selection in action, fitness and adaptive value, industrial melanism-mutation theory and modern synthetic theory. Evolution of horse; Physical and cultural evolution of Man.

Unit III: Patterns of evolution

Speciation, concepts, Sequential and divergent evolution, isolating mechanisms; micro, macro and mega evolution; Adaptive radiation of reptiles, birds and mammals; migration, navigation, domestication.

Unit IV: Behavioral Adaptation and variation

Mimicry and coloration- Batesian and Mullerian mimicry. Variation - pre-adaptation and post adaptation; normalizing, directional and diversifying selection; Group and individual selection, Altruism-Kin selection.

Unit V: Molecular Evolution

Principles of molecular evolution studies; methods of molecular evolution studies; DNA bar molecular phylogeny- history, terms, definition and limitations, coding- mtDNA, construction of phylogenetic trees using molecular data, construction of phylogenetic trees.

Textbooks:

- 1. Arumugam N, (2010). Organic evolution. Saras Publication.
- 2. Veer Bala Rastogi, (2017). Organic evolution, 13th edition. Medtech Publisher.
- 3. Sanjib Chattopadhyay. (2011). Evolution, adaptation, ethology. Books and allied (P) Ltd.
- 4. Mohan P Arora, (2000). Evolutionary biology. Himalaya Publishing House.
- 5. Tomar SB, Singh PS, (2000). Evolutionary biology. Rastogi Publications.

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- 1. Strickberger, M.W. 2005. Evolution. Jones and Bartett Publishers, London.
- 2. Jay M Savage (2000). Evolution. Amerind Publishing Company.
- 3. David J Merrell, (2000). Evolution and genetics. Holt, Rinehart and Winston Publishers.
- 4. Julian S Huxley (2000). Story of evolution. Rath bone Books.
- 5. Douglas J Futuyma (2000). Evolutionary biology, 3rd edition. Sinauer Associates Inc.
- 6. Dobzhansky T et al., (1973). Evolution. Surjeet Publication, New Delhi.
- 7. Earnest Mayer, 1978. Animal species and Evolution. Harward University Press, Massachusetesz.
- 8. Paul Moody, (2000). Introduction to Evolution, Kalyani Publishers, New Delhi.
- 9. Bryson Brown, (2009). Evolution a historical perspective. Pentagon Press.
- 10. Barton, N.H, Briggs, D.E.G., Eisen, J.A., Goldstein, D.B. and Patel, N.H. 2007. Evolution. CSHL Press.

ANIMAL PHYSIOLOGY (Subject code: 21UZO61)

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Course Objective: To enable the students to understand the general principle, physiological functions of animals as well as to understand the nature, mechanism and uses of various receptors.

Course Outcomes: At the end of the course the students will be able to:

- 1. Describe physiological processes of all major body systems in detail.
- 2. Discuss the components and structure of each body system.
- 3. Demonstrate functioning of individual organ systems.
- 4. Infer altered physiology.
- 5. Discriminate normal and abnormal functioning of the organs.
- 6. Integrate the role of each body system in maintaining homeostasis.

Unit I: Nutrition and Digestion

Nutrients –Types, calorific values and daily requirements. Digestion, absorption and assimilation in man. Gastrointestinal hormones; Standard, active and routine metabolism, balanced diet, BMR and BMI.

Unit II: Respiration & Circulation

Respiration: Types. Respiratory pigments; Structure of mammalian lungs-exchange and transport of gases ($CO_2\& O_2$); respiratory quotient (RQ).Circulation: Compositionof blood, Types of heart- neurogenic and myogenic hearts; structure of human heart and its working mechanism – Heartbeat, cardiac cycle, blood pressure,

Unit III: Excretion, osmoregulation and thermoregulation

Classification of animal on the basis of excretory products; Structure and function of Kidney and nephron - urine formation, regulation of water balance, electrolyte and acid base balance. Osmoregulation - osmoconformers and osmoregulators; water and ionic regulation by aquatic and terrestrial animals; Thermoregulation - thermoregulators and thermoconformers.

Unit IV: Effectors and Receptors

Muscle - Types of muscles, ultrastructure of skeletal muscle, physiology and theories of muscle contraction.Nerve physiology - neuron; impulse transmission; Synapse-synaptic; transmission; reflex action; neurotransmission; Photoreceptors, Phonoreceptors, mechano, Chemoreceptors - structure and physiology and functions.

Unit V: Endocrinology and Reproduction

Human male and female reproductive organs, puberty and menopause. Structure, secretion and functions of pituitary, thyroid, parathyroid, adrenal glands, testis and ovary; Hormonal control of estrus and menstrual cycles.Role of hormones in growth, metamorphosis and reproduction in Arthropods.

B.Sc. ZOOLOGY 2021

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Textbooks:

- 1. Rastogi, S.C. 2001. Essentials of Animal Physiology (III Ed.), New Age International Publication, New Delhi.
- 2. Verma, Tyagi and Agarwal, 2000. Animal Physiology. Chand and Company Ltd., New Delhi.
- 3. Goel K A; Sastri K V (2000) Text Book of Animal Physiology, Rastogi Publications.
- 4. Ashok Kumar (2004) Animal Physiology, Discovery Publishing House.
- 5. Sobti R C (2008) Animal physiology, Narosa Publishing House.
- 6. Arumugam N; Mariakuttikan A (2017) Animal Physiology, Saras Publication

Reference Books:

- 1. Schmidt Nielsen, K. 2002. Animal Physiology-Adaptation and environment, Cambridge University Press, Cambridge.
- 2. Eckert, David Randall, 1982. Animal Physiology, Surjeet Publications, Delhi.
- 3. William S. Hoar, 2004. General and Comparative Physiology, Third Edition, Prentice- Hall of India Private Limited, New Delhi.
- 4. Yapp W B, (2000) Introduction to Animal Physiology, International Development Research Centre.
- 5. Murkat, P.C.; Mathur, P.M. (2000) Text Book of Animal Physiology, NIL.

IMMUNOLOGY AND MICROBIOLOGY (Subject code: 21UZO62)

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Course Objective: To strengthen the knowledge on immune system, immune response, microbial diseases as well as to impart knowledge on microbiological applications.

Course Outcomes: At the end of the course the students will be able to:

- 1. Describe organs and cells involved in immune system, its structure and functions
- 2. Explain the immune response and mechanisms
- 3. Examine the basic structure of microbes and their growth in relation to abiotic factors
- 4. Categorize microbial diseases, their causative agents, symptoms, curative and control methods
- 5. Assess gene transfer methods to improve human life and increase birth rate
- 6. Prepare different microbial products of biological utilization.

Unit I: The Immune system

Innate and adaptive immunity, Cells - B and T cell, mast cells, dendritic cells, NK cells, Null cells, Macrophages; Organs -Primary and secondary lymphoid organs, antigen processing and presentation; Antibody - structure, types, binding sites and binding mechanisms; Structure and functions of MHC.

Unit II: Immune Response and Reactions

Antigen and Antibody interactions; Humoral immune response, cell mediated immune response. Hypersensitivity - Types and Mechanisms. Immunity to infection - Antibacterial immunity, antiviral immunity. Auto immune disorders-organ specific and Non-organ specific.

Unit III: Structure and culture of Bacteria

General structure, classification and identification of bacteria; Culture media for bacteria and fungi; Growth and growth curves of bacteria, fungi and virus; Factors affecting growth of microbes (temperature, pH and O₂).

Unit IV: Microbial diseases of Man

Pathogenecity, epidemiology, prevention and control of Bacterial (Bacillus anthracis, Salmonella typhii, Vibrio cholera, Clostridium tetanii, Mycobacterium tuberculosis), fungal (Crytococosis, Dermatomycosis, Candidiasis) and viral(Hepatitis, influenza, mumps, Measles, Zika) diseases.

Unit V: Applications of immunology and microbiology

Immunoprophylaxis – types of vaccines, production, immunization schedule, vaccine safety; Mono and polyclonal antibodies; Microbial products – antibiotics, enzymes; Agricultural uses - Bt, NPV, Baculovirus in agriculture, biopolymers, synthetic peptides.

Textbooks:

- 1. Chackrobarthy, Ashik, K. (1996). Immunology. Tata McGraw-Hill, Publishing Companty Ltd. New Delhi.
- 2. Sharma, P. D. 2001. Microbiology, Rastogi Publications, Meerut, India.

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- 3. Ananthanarayan R, Jayaram Paniker CK (2016). Text book of Microbiology, 9th edition. Universities Press.
- 4. Michael J Pelczar et al. (2000). Microbiology, 5th edition. Tata McGraw-Hill Pub. Co. Ltd

- 1. Roit and Delves (2001). Essential Immunology, Blackwell Science, London.
- 2. Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton (2011). Prescott's Microbiology. Mc-Graw Hill.
- 3. Moshrafuddin Ahmed, Basumatary SK, (2006). Applied Microbiology. MJP Publishers.
- 4. Tortora G, Funke B, Case C, Weber D. (2018). Microbiology in Introduction, 13th edition. Addison-Wesley Publications.
- 5. Meena Kumari S (2006). Microbial Physiology. MJP Publishers.
- 6. Promila Parihar (2008). Applied Microbiology. Swastik Publication.
- 7. Subhash Chandra Parija. 2012. Textbook of Microbiology & Immunology, 2nd Edition, Elsevier India.

E-resources:

- 1. http://www.helmberg.at/immunology.pdf
- 2. https://icuadelaide.com.au/files/primary/physiology/immunology.pdf
- 3. https://is.muni.cz/do/med/mimsa/12840881/12995390/43886337/Microbiology____final.pdf
- 4. https://en.wikipedia.org/wiki/List_of_infectious_diseases
- 5. http://www2.sunysuffolk.edu/czuraa/BIO244LectureMaterials/BIO244Chapter18Slid es.pdf
- 6. http://www.lamission.edu/lifesciences/Steven/Micro20%20Chapter%2018.pdf
- 7. https://www.researchgate.net/publication/272179875_Microbial_Healthcare_Products

BASIC ENTOMOLOGY (Subject code: 21UZO63)

Course Objective: To study the elements of insect diversity and structure; as well as to understand about the insect pest of cultivable crops and their management.

Course Outcomes: At the end of the course the students will be able to:

- 1. List out and identify different insect orders
- 2. Describe locally available insect belong to various orders
- 3. Illustrate the utility value of various productive insects, biological control agents, and other beneficial insects
- 4. Classify pestiferous insects on locally cultivable plants.
- 5. Summarize pests of stored products.
- 6. Develop management strategies for insect pests and vectors.

Unit I. Structure and Salient features

Insect classification and their distinctive characters; Morphological features of head, thorax and abdomen; Salient features of insect orders - Orthoptera, Isoptera, Hemiptera, Diptera, Coleoptera, Lepidoptera, Dermaptera, Odonata, Neuroptera and Hymenoptera

Unit II: Productive and Beneficial insects

Bionomics and economic importance of Silkworms, Honeybee and Lac insects; Brief account on biological control agents - Lacewings, ladybird beetles, *Trichogramma*; Pollinators, weed killers, scavengers, insect as food and feed.

Unit III: Field crop and Horticultural Crop Pests

Bionomics, damage, symptoms and management of two major pests of rice (Scirpophaga incertulas, Cnaphalocrocis mainsails)sugarcane (Chilo infuscatellus, Aleurolobus barodensis) groundnut (Amsacta albistriga, Aproaerema modicella), cotton (Helicover paarmigera, Aphis gossypii), coconut (Oryctes rhinoceros, Rhynchophorus ferrugineus), brinjal (Leucinodes orbonalis, Henosepilachna vigintioctopunctata, tomato (Bemisia tabaci, Tuta absoluta) and banana(Cosmopolites sordidus, Odoiporus longicollis)

Unit IV: Pests of stored products, Domestic pests and insect vectors

Bioecology, damage caused and management of *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*; Medical importance and management of *Pediculus humanus capitis*, *Pediculus humanuscorporis*, *Anopheles*, *Culex*, *Aedes*, *Xenopsylla cheopis*.

Unit V. Pest management concept, components and methods

Infestations – sucking, defoliators, borers; Economic Injury Level; Pest Management decision making; Brief account on physical, chemical, cultural, biological, genetic control of pests, IPM (general account only), Bt cotton -concepts and application.

Textbooks:

- 1. David, B.V. and Ananthakrishnan, T.N. 2004. General and Applied Entomology. Tata-McGraw Hill Publishing Company, New Delhi.
- 2. Kalyanasundaram, S. and Kalyanasundaram, M. 2003. Pest management in field Crops / Horticultural Crops. Keran Desk Top Publisher, Vellore.

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- 3. Ambrose, D. P. 2015. The Insects Structure, Function and Biodiversity, Kalyani Publishers, Ludhiana.
- 4. D.B. Tembhare2021. Modern Entomology, Himalaya Publishing House Pvt. Ltd, Mumbai
- 5. Mike W. Service. 2004. Medical entomology for students. Third Edition. Cambridge University Press, USA.

- 1. David, B.V. and Ramamoorthy, V.V. 2011. Elements of economic entomology. NP Namrutha Publications, Chennai.
- 2. Larry P. Pedigo 1988. Entomological pest management. Mac Mille Publishing Company, New York.
- 3. Romoser, W.S and Stoffolano, J.G. 1998. The Science of Entomology, McGraw-Hill Company, New York.
- 4. Pedigo, L.P 2002. Entomology and pest Management. Pearson Education, Singapore.
- 5. Robert F Morris, Edward P. Caswell-Chen and Marcos Kogan 2002. Concept in Integrated Pest Management. Prentice-Hall of India P. Ltd, New Delhi.

ANIMAL PHYSIOLOGY – PRACTICAL (Subject code: 21UZOP61)

Semester : VICore Practical: 9Credit: 1Hours: 3	3
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- 1. Rate of oxygen consumption of a freshwater fish
- 2. Salt loss and salt gain in a freshwater fish
- 3. Effect of temperature on human salivary amylase activity
- 4. Identification of nitrogenous excretory products ammonia, urea, uric acid
- 5. Estimation of Haemoglobin using haemoglobinometer
- 6. Measurement of blood pressure in Man Demonstration
- 7. Preparation of haemin crystals in human/chick blood
- 8. BMI analysis using height and weight
- 9. Determination of blood clotting time
- 10. Qualitative analysis of protease, amylase and lipase in cockroach digestive system.
- 11. Effect of temperature on fish opercular movement
- 12. Spotters: Human brain, heart, lungs, eye, tongue, ear, pancreas, kidney, Human circulatory system, digestive system, L.S. of testis, L.S. of Ovary, Types of muscles, Endocrine glands (Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland), ECG, Oxygen dissociation curve (Bohr effect), Menstrual cycle, and Gastro intestinal hormone.

IMMUNOLOGYANDMICROBIOLOGY - PRACTICAL (Subject code: 21UZOP62)

Semester: VI	Core Practical:10	Credit: 1	Hours: 2
1. Human blood gro	uping (ABO and Rh factor).		
2. WBC count in hu	nanblood		
3. Double diffusion	radial immuno diffusion.		
4. Separating lymph	ocytes.		
5. Haemagglutinatio	n test.		
6. Demonstration of	lymphoid organs of rat (preser	ved specimen)	
7. Demonstration of	ELISA		
8. Media preparation	for the culture of microbes		
9. Isolation of micro	bes by serial dilution technique	e	
10. Simple staining te	chnique		
11. Gram staining tec	hnique		
12. Acid fast techniqu	e		
13. Motility test			
14. Spore counting w	th Haemocytometer		

15. Spotters: Microbiology: forms of bacteria, bacterial growth curve, pour plate technique, streak plate technique, *Streptococci*, *Vibrio cholerae*, *Clostridium tetanii*,Morphology of viral particles, T4 bacteriophage, HIV, Hepatitis – B virus. Immunology: thymus, spleen, lymph node, bone marrow, Bursa of Fabricius, macrophage, natural killer cell, IgM, IgG, IgA, IgE, IgD, antigen-antibody reactions

BASIC ENTOMOLOGY - PRACTICAL (Subject code: 21UZOP63)

- 1. Insect collection devices and preservation methods
- 2. Representative insects from various insect orders
- 3. Cockroach: Mounting of antennae, mouthparts, spiracles
- 4. Housefly: Mounting of mouthparts, halter, wing
- 5. Honeybee (preserved slide) : mouthparts, legs, and sting
- 6. Mosquito (preserved slide) : life stages, mouthparts, wings
- 7. Submission of representative harmful insects from different orders
- 8. Mini-projects
 - a. Human vectors [mosquitoes, bed bugs, louse, cockroaches] –photos or paper cutting with notes.
 - b. Life cycle, nature of damage, control measures of cotton, paddy, coconut, brinjal, lady's finger pests
- 9. Spotters: Insect pests (maximum of 6); Types of head, antennae, mouth parts, legs, wings
- 10. Field trip and inclusion of report in the record note book Agro-ecosystems / Agriculture College /Research institutes (compulsory)

GROUP PROJECT (Subject code: 21UZOE61)

Semester: VI	Elective: 3	Credits: 6	Hours: 7

Group projects help students to develop skills specific to collaborative efforts, which pool knowledge of all individuals, are increasingly important in the professional world. Positive group experiences have been shown to contribute to student learning and retention and also to the institutional growth.

Each group consists of 4 - 6 under-graduate students, based on number of students in III B.Sc. class. Students will be selected by the staff members by lot system during the fifth semester. Topics are allotted depends on the interest of the group / research centres of the faculty. Tentative title of the group project is displayed in the department notice board at the beginning of the sixth semester.

Two continuous assessments will be done on 31st and 62nd day of the 6th Semester. In the first assessment, review of literature (photo copies of the reprints), objectives, materials and methods and works carried out by the candidates should be submitted for evaluation. In the second assessment, results obtained up to the submission could be submitted along with first assessment materials. Marks for these internal assessments will be allotted by the guide. In the final (External) evaluation students are required to submit hard bound detailed project report in the form of dissertation. It will be evaluated by the guide and external examiner and the marks will be allotted based on dissertation and *viva voce* thereof.

Extra Credit Courses

POULTRY FARMING (Subject Code: 21UZOEC11)

Course coordinator:Dr. T.Elizabeth ThangamaniSunitha

Course Objective: To develop entrepreneurial skills and equip youth in different facets of poultry production.

Course Outcomes: At the end of the course the students will be able to:

- 1. Highlight the common breeds of poultry, body systems, breeding systems involved in poultry farming, Culling and judging of poultry.
- 2. Explain the status advantages perspective of Indian poultry industry of rearing poultry.
- 3. Examine the principles of poultry housing, housing environment and housing management. Housing for chicks, growers, layers and broilers.
- 4. Analyze the basic principles of nutrition, kinds of feeds and their role on the growth and reproduction
- 5. Evaluate poultry diseases, preventive and control measures.
- 6. Formulate high quality balanced diet

Unit I - Introduction

Farming poultry, poultry registration, Breed selection for farming, Poultry in Namakkal, Marketing, and Economics of poultry.

Unit II – Poultry farming

Different Types of Poultry Farming Systems – Backyard, commercial, breeder, mixed farming; Choosing commercial layers and broilers; Practical aspects of chick rearing; External and Internal body parts.

Unit III – Poultry Nutrition and feeding

Poultry diets in general, Energy and nutrients for poultry, various poultry diets, Major ingredients for poultry diets, Feeding appliances and programs.

Unit III – Poultry Management

Management of eggs, chick, beak trimming, breeders, brooders, growers, layers, broilers

Unit V – Poultry Diseases

Viral (Ranikhet diseases, fowl pox), Bacterial (Salmonellosis, Mycoplasmosis, tuberculosis); fungal (Aspergillosis and Aflatocicosis), Miscellaneous diseases; Principle of immunity, immunization and control of infectious diseases.

Textbooks:

- 1. Jadav, N.V. 2010. Handbook of Poultry Production and Management, Second edition, Jaypee Brothers Medical Publishers Private Limited, PP. 410.
- 2. Sreenivasaiah, P.V. 2015. Text book of Poultry Science, Write and Print Publication, First Edition, PP. 720
3. Sushil Prasad. 2011. Handbook Of Poultry Production: A Practical Guide, Enkay Publishing House, PP. 248.

- 1. https://www.daera-ni.gov.uk/articles/introduction-poultry-and-eggs-farming
- 2. http://www.fao.org/ag/againfo/themes/en/poultry/AP_management.html
- 3. http://agritech.tnau.ac.in/animal_husbandry/ani_chik_poultry%20mgt.html
- 4. http://www.ag.auburn.edu/~chibale/an12poultryfeeding.pdf

HUMAN ANATOMY (Subject Code: 21UZOEC21)

Semester: II	ECC: 2	Credits: 2
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Course coordinator: Dr. R. Santha Kumari

Course objective: Acquire scientific knowledge about the structure of the human body to be used as the study for use in professional activities as well as help improve other people's health and wellbeing.

Course Outcomes: At the end of the course the students will be able to:

- 1. Describe the morphology and functional anatomy of the human body
- 2. Explain the normal structure and function of the human body
- 3. Demonstrate the implications of disruption of normal structure and function.
- 4. Select medical or health-related careers.
- 5. Summarize the common diseases.
- 6. Developing strategy to cope with disorders.

Unit I: Introduction to Human Anatomy

Human Anatomy Human beings-*Homo sapiens sapiens* Features- Morphological features (Definition, types of Anatomy (microscopic and Gross), levels of organizations; vital properties of living beings.), Definition and significance of Vestigial organs.

Unit II:Skeletal and Muscular systems

Integumentary, Skeletal, Muscular systems – locations, organ basic structure and functions; their related common diseases.

Unit III: Neuro and Cardiovascular systems

Nervous, Endocrine, Cardiovascular—locations, organ basic structure and functions; their related common diseases.

Unit IV: Respiratory, digestive and Lymphatic systems

Lymphatic, Respiratory, Digestive—locations, basic structure and functions; their related common diseases.

Unit V: Urinogenital organ systems

Urinary, male Reproductive-, female Reproductive- -- locations, basic structure and functions; their related common diseases.

Textbooks:

- 1. T.S. Ranganathan, 1987. A text book of Human Anatomy.
- 2. Ester.M. Greishcimer. 1955.Physiology and anatomy with Practical Considerations. J.P. LippinCott, Philadelphia.
- 3. Willam Davis. Understanding Human Anatomy and Physiology, MC Graw Hill. Willam's (Pter, L) Gray's Anatomy, 38lfl eds. Churchill Livingstone, 1995.
- 4. Fahana, Human Anatomy (Descriptive and Applied) Saunder;s& Co., Prism Publishers, Bangalore.

- 1. http://www.medicalcityiq.net/medlib/Anatomy%20of%20the%20human%20Body.pd f
- 2. https://www.alamo.edu/uploadedFiles/SPC/Academics/Departments/Natural_Science s/Natural_Sciences_Tutoring_Lab/Files/Biol2401LecNotes.pdf

ANIMAL BEHAVIOUR (Subject Code: 21UZOEC31)

Semester: IIIECC: 3 (optional)Credits: 2

Course coordinator: Dr.J. Babila Jasmine

Course Objective: To understand the basic concepts of animal social and reproductive behaviours and their function related to environment.

Course Outcomes: At the end of the course the students will be able to:

- 1. List the general and innate behavior of animals
- 2. Comprehend the ecological aspects of behavior
- 3. Predict the social behavior
- 4. Classify reproductive behavior
- 5. Summarize biological rhythms and memory
- 6. Integrate the role of environment on behavior

Unit I: General and innate behaviour

Definitions of ethology and animal psychology - ethogram; classification of behavioural patterns - neural and hormonal control of behaviour - communication - genetic and environmental components in the development of behaviour.

Unit II: Ecological aspects of behaviour

Habitat and food selection -optimal foraging theories- aggression - homing - territoriality - dispersal- host parasite relationship.

Unit III: Social behaviour

Aggregation - schooling in fishes -flocking in birds -herding in mammals - group selection - kin selection - altruism - inclusive fitness - forms of social organization (insects and primates).

Unit IV: Reproductive behaviour

Reproductive strategies - mating systems - mate choice - sex differences - courtship -sexual selection - parental care in vertebrates – allomothering.

Unit V: Biological rhythms, learning and memory

Circadian and circannual migration of fishes and birds; conditioning, habituation - insight learning - association learning - reasoning - cognitive skills.

Reference Books:

- 1. McFarland 1985. Animal behaviour, ECBS Longman, Essex.
- 2. Manning and M. S. Dawkins 1998. An Introduction to Animal Behaviour, Cambridge University Press, Foundation Books, New Delhi.
- 3. Alcock, J.2006. Animal Behaviour, Sinauer Associates, INC, Sunderland, Massachusetts.

VERMIBIOTECHNOLOGY (Subject Code: 21UZOEC31)

Semester: IIIECC: 3 (optional)Credits: 2

Course coordinator: Dr. T. Pushpanathan

Course Objective: To impart knowledge on the recent trends in vermi-technology, agricultural and economic importance of earthworms.

Course Outcomes: At the end of the course the students will be able to:

- 1. Identify earthworms and know the recent trends in vermi-technology.
- 2. Explain the biology and methods of earthworm collection.
- 3. Demonstrate different culture methods.
- 4. Analyze the pros and cons of various models and their economics.
- 5. Choose the best vermicomposting technique based on the desirability.
- 6. Develop vermiculture as self-employability skill.

Unit I: Types, Collection and Preservation of earthworms

Types and basic characteristics of species suitable for vermicomposting; Role of earthworms in soil fertility, Biology of *Lampitomaruitti*; Collection and Preservation of Earthworms; Flow sheet for vermitechnology.

Unit II: Culturing techniques of earthworms and composting materials

General method; Pot method; Wooden box method; Propagation; Factor affecting Vermicomposting; Composting materials; Preliminary treatment of composting materials.

Unit III: Small scale techniques of Vermicomposting

Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermi-compost.

Unit IV: Large scale techniques of Vermicomposting

Outdoor dual bin; Raised cage; Dual pit; Commercial model; Trickling filter vermicomposting; Keep it simple and save (KISS) plan.

Unit V: Vermiwash and Economics

Chemical composition of vermiwash; Techniques of vermiwash production - Ecoscience Research Foundation Method, Karuna's method, Kale's method - Advantages of Vermicomposting; Prospects of vermi-culture as self employment venture.

Textbooks:

- 1. Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
- 2. Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.

Reference Book:

1. Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.

BIODIVERSITY CONSERVATION (Subject Code: 21UZOEC41)

Semester: IV

ECC: 4 (optional)

Credits: 2

Course coordinator: Dr.T. Pushpananthan

Course Objectives: To educate the students about the importance of biodiversity, species concept, loss of animal diversity, direct implications for the management of species and ecosystems, captive breeding and reintroduction and habitat restoration

Course Outcomes: At the end of the course the students will be able to:

- 1. Describe the concepts of Biodiversity and animal diversity
- 2. Differentiate the causes and effects of biodiversity
- 3. Determine the loss of animal diversity
- 4. Categorizeanimal laws and policies in India
- 5. Assess economics of biodiversity conservation and measure the status of species in the wild
- 6. Create awareness through the conservation tools and conservation education.

Unit I: Biodiversity; species concepts; animal diversity

Ecosystem, Genetic and Species diversity; Assigning values to biodiversity - Species concepts; GIS and remote sensing for diversity assessment; Biodiversity Hotspots -Western Ghats, Indo-Burma region; Biogeography of India.

Unit II: Loss of animal diversity, status of species

Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction-threats to wildlife (examples). Threats to animal diversity in India; **Status of species -**Rare, endemic and threatened species; Measuring status of species in the wild - IUCN Red list.

Unit III: Conservation tools

In situ and *Ex situ* conservation; Captive breeding programme; People participation in conservation; Red listing process: categories and criteria; Wildlife conservation in India - importance of conservation - methods of wildlife conservation;

Unit IV: Animal laws and policies in India; Economics of biodiversity conservation

Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity. Economics of biodiversity conservation; The world Conservation Unit (IUCN) - World wildlife fund (WWF) - Indian Board for Wildlife (IBWL).

Unit V: Conservation education, awareness and implementations

Role of NGO's and Government organizations in wildlife conservation. Wildlife / Animal magazines, Journals - Government organizations in wildlife conservation - Wildlife celebration days in India; Wildlife conservation in Tamil Nadu; National park and sanctuaries in Tamil Nadu.

Textbooks:

- 1. M. P. Singh and Arvind Kumar. 2015. Biodiversity and Conservation, APH Publishing Corporation, New Delhi.
- 2. Janamjit Singh, 2006. Biodiversity: Planning For Sustainable Development, Deep & Deep Publications Pvt Ltd, New Delhi.

Reference Books:

- 1. Prabodh K. Maiti and PaulamiMaiti, 2011. Biodiversity: Perception, Peril and Preservation, Prentice-Hall of India Pvt.Ltd, New Delhi.
- **2.** Gabriel Melchias,2001. Biodiversity and Conservation, Oxford & IBH Publishing Company, Delhi.
- 3. B. K. Singh,2004. Biodiversity: Conservation and Management, Mangal Deep Publications, Jaipur, Rajasthan.
- 4. Krishnamurthy K.V, 2009. An Advanced Textbook on Biodiversity Principles and Practice, Oxford & IBH Publishing Co Pvt.Ltd,New Delhi, India

- 1. https://www.conserve-energy-future.com/biodiversity-conservation-types-importancemethods.php
- 2. https://www.environmentalpollution.in/essay/biodiversity-types-importance-and-conservation-methods-with-diagram/311
- 3. http://www.businessandbiodiversity.org/the_issues_conserve.html
- 4. https://vikaspedia.in/energy/environment/biodiversity-1/conservation-of-biodiversity
- 5. https://www.worldwildlife.org/pages/what-is-biodiversity
- 6. https://www.biodiversitya-z.org/

ANIMAL HUSBANDRY (Subject Code: 21UZOEC41)

Semester: IV	ECC: 4 (optional)	Credits: 2
Course coordinator Da	D Ashaan Dal	

Course coordinator: Dr. R. Azhagu Raj

Course Objectives: To make aware of the students about the importance of animal husbandry for income generation and to create self employment venture.

Course Outcomes: At the end of the course the students will be able to:

- 1. Learn livestock production and management.
- 2. Discuss the different breeds of livestock
- 3. Examine the product, nutritional and economic values of livestock
- 4. Sort out the common diseases and give appropriate treatments.
- 5. Justify the role of livestock in Indian economy and human health
- 6. Develop and manage a farm

Unit 1: Dairy farming

Breeds and types of cattle breeds; housing of dairy animals, dairy products; nutritive value of milk; Lactometer

Unit II: Poultry farming

Poultry houses; Management of chicks, growers, and layers; Management of broilers and layers; Nutritional requirement for different stages of layers and broilers; common poultry diseases, their control and prophylaxis.

Unit III: Goat and Sheep farming

Breeds of Indian goats and sheep; Exotic breeds of goats and sheep; Nutrition requirements; Housing and management of lambs and kids; Common diseases and vaccination.

Unit IV: Rabbit farming

Types and breeds of rabbits; nutritional requirement; housing, caring and farm management.

Unit V: Pig Farming

Types of breeds of pigs; housing and maintenance of pigs, nutritional requirements; care during weaning; common diseases and their management.

Texbooks:

- 1. Banerjee, G.C. 2010. Text book of animal husbandry, Oxford & IBH Publishing company Pvt. Ltd, New Delhi, India.
- Arumugam, N., Jeyasurya, Nair, N.C., Soundarapandian, N., Thangamani, A., Narayanan, L.M., Leelavathi, S., Murugan, T., Prasanna Kumar, S., Johnson Rajeshwar, J. and Ram Prabu, R. 2013. Economic Zoology, Saras publication, Nagerkoil.

Reference Book:

1. Sandeep Tomar 2011. Basic operations of Animal husbandry, Oxford Publishers, New Delhi.

- 1. http://www.agrifarming.in/rabbit-farming/
- 2. http://www.sheepfarm.in/goat-sheep-farming-business-plan

PHARMACOLOGY (Subject Code: 21UZOEC51)

Semester: V	ECC: 5	Credits: 2

Course coordinator: Dr. S. Mabel Parimala

Course Objective: To provide necessary information on the properties, dose, effects, metabolism and benefits of drugs.

Course Outcomes: At the end of the course the students will be able to:

- 1. Define therapeutic uses of the commonly available drugs for various ailments.
- 2. Discuss the impact of drugs on nervous system
- 3. Examine the impact of drugs on organs
- 4. Classify hormones and hormone antagonists
- 5. Choose appropriate chemotherapy
- 6. Design protocol for drug development.

Unit I: General Pharmacology

Definition, categories of drugs, routes of drug administration; absorption, distribution and excretion of drugs; factors modifying drug effects.

Unit II: Drugs acting on nervous system

Hypnotics and sedatives, anti-convulsants, analgesic-antipyretics, antidepressants, local anaesthetics, cholinergic and adrenergic drugs and their side effects.

Unit III: Drugs acting on organs

Gastrointestinal - appetizers, emetics, antiulcer drugs; Respiratory organ -bronchial asthma, expectorants, antitussives; Heart -anti-arrhythmic, anti-hypertensive agents; and their side effects.

Unit IV: Hormones and hormone antagonists

Adrenocortical steroids, androgen and anabolic steroids, estrogens and progestins, thyroid and antithyroid drugs, oral antidiabetic drugs and their side effects.

Unit V: Chemotherapy

Synthetic antimicrobial agents; Common Antibiotics-penicillins, cephalosporins, tetracyclins; Chemotherapy of urinary tract infections, malaria, typhoid, tuberculosis, amoebiasis; Diabetics and hypoglycaemic drugs, Disinfectants and antiseptics.

Textbooks:

- 1. Murugesh N., 2004. A Concise Textbook of Pharmacology. Sathya Publishers.
- 2. Tripathi K..., 2000. Essentials of Medical Pharmacology. Jaypee Brothers.

Reference Books:

- 1. Panda, U.N., 2005. Handbook of Pharmacology. AITBS Publishers.
- 2. Uma, Bhandari, 2012. A Textbook of Pharmacology. Biotech Pharma Publications.
- 3. Das, 2001. Pharmacology. Books and Allied Pvt. Ltd.
- 4. Chunawalla, S.A., 1998. Essentials of Pharmacology. Himalaya Publishing House.

5. Budhiraja, R.D., 1993. Elementary Pharmacology and Toxicology. Popular Prakashan.

- 1. https://www.dphu.org/uploads/attachements/books/books_734_0.pdf
- 2. https://www.intechopen.com/books/basic-pharmacokinetic-concepts-and-someclinical-applications/drug-distribution-and-drug-elimination
- https://www.drugs.com/drug-class/central-nervous-systemagents.html#:~:text=There%20are%20many%20different%20types,and%20NSAIDs) %2C%20and%20sedatives.
- 4. https://www.healthline.com/health/urinary-tract-infection-adults#risks-for-women
- 5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4034109/
- 6. https://www.healthline.com/health/anabolic-steroids

ETHNOMEDICINE (Subject Code:21UZOEC61)

Semester: VI EC	C: 6 Credits: 2
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Course coordinator: Dr.R. Azhagu Raj

Course Objective: To provide basic information on the therapeutic species and their uses in traditional medicine and conservation.

Course Outcomes: At the end of the course the students will be able to:

- 1. Describe the basics of Ethno taxonomy.
- 2. Learn the importance of therapeutic animals in traditional medicine
- 3. Examine the role of animals in ecological diversity
- 4. Categorize about the Ethno zoological practices in tribes.
- 5. Summarize the importance and conservation of animals
- 6. Generate awareness on ethno-medicine

Unit I: Ethno taxonomy and Zoo therapy

Introduction to Ethnotaxonomy; Ethnozoology -Traditional medicine; Tribes-Ethnic Groups and Indigenous people, Sacred Grooves and Sacred groove animals; Zootherapy; Zootherapeutic species in India.

Unit II: Ethno medicine

Folk medicine- Healers, local healer, Traditional healers, Bhopa; Method of preparation of ethnomedicine, Route of administration.

Unit III: Ethno zoological Practices

Animal byproducts from Arthropods and Molluscs, Ethno-entomological practices (mites, spiders and insects); Medical importance of Honey bee and its venom; Leech therapy; Ethnozoological practices in tribes in South Asian countries.

Unit IV: Ethno nutrition and medicine

Nutritional importance of animals and their products- Magico religious purpose, rituals, taboos and cultural practices; Thanatophobia; Role of animals and their parts in Siddha, Ayuervedha, Unani and Chinese medicine; Common herbals/metals/salts used in ethnozoology.

Unit V:Conservation of Traditional Knowledge and Systems.

Ethnozoology in India and other Countries, Conservation of ancient knowledge system-Traditional knowledge system- Indigenous knowledge system, local ecological knowledge, Conservation of therapeutic animals.

References:

- 1. Ethnobiology in India, A Status Report. 2014. AICRPE. Ministry of Environment and Forests, Govt. of India, New Delhi.
- 2. Balakrishnan, M.2010. Mammalian resources In: The Natural Resources of Kerala, Thampi, B.K., N.M. Nayar and C.S. Nair (eds.) WWF, Kerala.
- 3. Wilson, D.E. and E. O. Wilson (eds.), Biodiversity II: Understanding and Protecting our Biological Resources.

- 4. Jamir, N. S. and Lal P. 2005. Ethnozoological practices among Naga tribes, Indian J. of Traditional Knowledge. 4(1), 100-104.
- 5. Radhakrishnan, K. and Pandurangan, A.G. The Role of Tribal medicine in local health care with reference to Kerala. In: Proceedings of the Twelfth Kerala Science Congress, Kumily, Kerala.
- 6. Ranjit Daniels, R.J and JayashreeVencatesan. 1995. Traditional ecological knowledge and sustainable use of natural resources. Current Science. 69. 569-570.
- 7. Alves, R.R.N, Rosa,IL., 2007.Biodiversity, traditional medicine and public health: where do they meet? J EthnobiolEthnomed.

Certificate Courses

SERICULTURE (Subject Code: 21UZOCC31)

Semester. If $Certificate Course, f Creatis, 4 from the field of the $	Semester: III	Certificate Course: 1	Credits: 4	Hours: $60(T) + 15(P)$)
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Course coordinators : Dr. P. Selvaraj and Dr. T. Pushpanathan

Course Objectives: To make aware of the graduates about the economic importance of silkworm for income generation and to create a self employment venture.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain basic knowledge on sericulture and silk industry
- 2. Explain the cultural practices and pest management in mulberry garden
- 3. Demonstrate the life cycle of silk worm, rearing techniques and appliances
- 4. Classify the reeling techniques, appliances and quality parameters
- 5. Evaluate the economics and marketing of silk
- 6. Generate additional income by implementing sericulture skills.

Unit I: Moriculture

Morphology, characteristics and varieties of mulberry; Mulberry Cultivation Practices - Site selection, preparation of land and planting materials, maintenance of plants, harvesting and storage of leaf; Pest (sucking pest, leaf folder, root feeders, termite); Diseases -Bacterial, fungal (powdery mildew, leaf spot, leaf rust, leaf blight, root rot) and viral diseases, Symptoms, preventive and control measures.

Unit II: Silkworm larval rearing process

Mulberry leaf processing - Harvesting, Selection, preservation, cleaning; Sterilization of room & equipments; Larval rearing - young larval and grownup larval rearing; Rearing bed, Cleaning bed.

Unit III: Silkworm cocoon and adult sage

Maintenance of Pre-cocoon, cocoon and spinning stages of silkworm; spinning equipments; physical and chemical nature of silk; Maintenance of adults, seed production, processing of egg and voltinism

Unit IV: Pests and diseases of silkworm and their management

Pests - Life cycle, nature of damage, prevention and control of Indian uzifly, integrated management of Indian uzifly; Cocoon pests of silkworm -Dermestid beetle- life cycle; nature and extent of damage, Prevention and control measures; Protozoan disease – symptomatology, structure of pebrine spore, life cycle of *Nosema bombycid*; Bacterial diseases: Causative agents, symptoms, factors influencing flacherie; Viral diseases - Grasserie, infectious flacherie, cytoplasmic polyhedrosis, densonucleosis and gattine; Fungal diseases - White and green muscardine and aspergillosis.

Unit IV: Silk production technology and economics

Commercial qualities and selection of cocoon for reeling; cocoon processing; reeling (process and appliances) and commercial qualities of silk; Economics of sericulture, cocoon and yarn

12 Hours

12 Hours

14 Hours

10Hours

12 Hours

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marketing. Marketing organizations - role of Central Silk Board, Future prospects; Central and state organizations for sericutlrue.

Textbooks:

- 1. Madan, Mohan Rao G, (2000). Textbook of sericulture. CBS Publishers & Distributors.
- 2. Veda K, Nagai I, Horikomi M, (2000). Silkworm rearing (Japanese translated). Vivekananda Kendra Nardep.
- 3. Ganga, S. G. and Sulochana Chetty, J. 2008. Introduction to sericulture (II Ed.), Oxford and IBH Publishing House, New Delhi.

Reference books:

- 1. David, B.V. and Ramamoorthy, V.V. 2011. Elements of economic entomology. NP Namrutha Publications, Chennai.
- 2. Johnson M, Kesary M (2008). Sericulture. CSI Press.
- 3. Jaiswal, K., 2009. Moriculture. Aph Publishing Corporation, New Delhi.
- 4. Yasuji Hamamura, 2001. Silkworm Rearing on artificial diet- Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi & Calcutta.
- 5. Patnaik, R.K., 2008. Sericulture Manual. Astral International Pvt. Ltd., Delhi
- 6. Gangadhar MR (2000). Comprehensive sericulture. Vivekananda Kendra Nardep.

E-Resources:

- 1. http://csb.gov.in/assets/Uploads/documents/note-on-sericulture-2016-17.pdf
- 2. http://csb.gov.in/publications/annual-report/

Practicals

- 1. Planting materials and nursery bed preparation
- 2. Maintenance of mulberry garden
- 3. Identification of Mulberry varieties
- 4. Pests of mulberry (sucking pests, Leaf feeders, root feeders)
- 5. Mulberry diseases.
- 6. Incubation, egg hatching and brushing of newly hatched larvae
- 7. Cleaning and feeding trials in early and late instars
- 8. Mounting (in Chandrik) of final instars for spinning
- 9. Collection of cocoons, determination of cocoon shell ratio and quality check
- 10. Sex determination in Adult moths and oviposition
- 11. Preparation of egg cards
- 12. Observation of pests and diseases of mulberry (preserved specimens)
- 13. Observation of pests and diseases of silkworm (preserved specimens)

ORNAMENTAL FISH CULTURE (21UZOCC41)

Semester:IV	Certificate Course: 2	Credits: 4	Hours : 60 (T) + 15 (P)
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Course coordinators: Dr. A. Jeyaseeli and Dr. P. Raja

Course Objective: To make awareness of ornamental fishes, identification, culture, construction and maintenance of aquarium fishes.

Course Outcomes: At the end of the course the students will be able to:

- 1. List out the common ornamental fishes
- 2. Describe the basics of aquarium
- 3. Illustrate induced breeding in ornamental fish
- 4. Classify aquarium plants.
- 5. Evaluate food and feeding methods
- 6. Develop integrated methods to combat diseases and trade ornamental fish.

Unit I: Aquarium

Aquarium accessories - Aerators, filters and lighting; Design, construction, setting and maintenance of fresh water aquarium; Construction of ornamental fish unit.Selection of ornamental fishes, maintenance of water quality. Handling, care and transportation of fish, oxygen packing, method of packing, anesthetics use.

Unit II: Identification of common ornamental fishes

Identification, distribution and biology of common ornamental fishes, fighting fish, Gold fish, koicarp, Gourami, Rosy barbs, Tetras (Widow tetra, Jewel tetra, Buenos aires tetra, Neon tetra), Angel fish, Red tailed black shark, Bridle shark, cichlids (Oscar, firemouth, zebra, blue morph and Ram cichlid), Live bearer (Moon tail molly, sailfin molly, black molly, guppy, platy, red swordtail)

Unit III: Aquarium plants and Induced breeding

Importance of Aquarium plants their export potential, Morphology, multiplication of aquarium plants – different methods; Management of ornamental aquatic plants and its trading; Breeding in aquarium fishes -Breeding Habits, Maintenance of brood fishes, Secondary sex characters, Spawning; Induced breeding – Hypophysation, Synthetic hormone (Ovaprim) injection and stripping

Unit IV: Food and Feeding

Culture of live feed organism (Infusorians, Zooplankton, Rotifers, Copepods, Cladocerans, Brine shrimp, Blood worm, Tubifex), Artificial feeds. Methods of fish feeding, balanced diets for aquarium fishes

Unit V: Disease management and Economics

Identification of common parasites (argulus, lernaea, nematodes), bacterial, viral, fungal diseases of ornamental fishes and their control and prophylaxis; Economics of ornamental fish culture and trading.

12 Hours

12 Hours

12 Hours

12 Hours

12 Hours

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Textbook:

1. Jameson, J.D. and Santhanam. R. 1996, Manual of ornamental fishes and farming, Technologies Peejay, Thoothukkudi.

Reference Books:

- 1. Rath, R.K. 2000. Freshwater Aquaculture. Scientific Publishers (India). PO Box: 91, Jodhpur.
- 2. Mohan Kumar. C. 2008. Handbook on ornamental fish diseases, MPEDA, India
- 3. Arumugam, N. 2010, Home Aquarium, Saras Publication
- 4. Kholakia, A.D. 2009. Ornamental Fish Culture and Aquarium Management, Daya Publishing House, New Delhi, pp. 313.
- 5. H.S. Jagtap, S.N. Mukherjee and V.K. Garad, 2018. A Textbook of Pisciculture and Aquarium Keeping, Daya Book Publications, 2018, eighth Edition, PP. 264.

E-Resources:

- 1. https://www.researchgate.net/publication/282759544_Ornamental_Fishculture_Technologies
- 2. http://cifa.nic.in/sites/default/files/ORNAMENTAL%20FISH%20CULTURE_0.pdf
- 3. http://www.ccari.res.in/TB%20No.16.pdf
- 4. http://www.aces.edu/dept/fisheries/education/documents/Species_Module_Ornamental _Tropical.pdf
- 5. http://dev.ourworld.unu.edu/international-network-on-water-environment-and-health/unu-inweh-course-1-mangroves/Ornamental-fish.pdf
- 6. http://nsgl.gso.uri.edu/hawau/hawauw93001/hawauw93001chap6.pdf

Practicals

- 1. Construction and setting up of glass aquarium
- 2. Identification of common live bearer ornamental fishes: Guppy, Molly, Platy, Sword Tail
- 3. Identification of common Egg layer ornamental fishes: Angel, Neon tetra, Discus and Siamese fighter, Gold fish, Koi Carp, Danio- Zebra, and Flower Horn.
- 4. Identification and sexual dimorphism of ornamental fishes
- 5. Preparation of ornamental fish feed.
- 6. Setting-up of breeding tank for live bearers
- 7. Induced breeding
- 8. Fish feed formulation
- 9. Identification of ornamental fish diseases and prophylactic measures
- 10. Identification of aquarium plants
- 11. Fish farm visit

SEAFOOD PROCESSING (21UZOCC51)

Semester: V	Certificate Course:3 Credits: 4	Hours : 60 (T) + 15 (P)
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Course coordinators: Dr. P. Raja and Dr. R. SanthaKumari

Course Objective: To develop and strengthen human resource by infusing and imparting knowledge and skill in Value Added Fish Products, creating awareness and competency in the fish processing as well as fish products preparation and impart basic knowledge and technical proficiency in Post-Harvest Management, primary processing of fish, value addition, quality control and marketing.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain knowledge on commercial fishes
- 2. Comprehend the ways of fish spoilage
- 3. Apply preservation, packing and storing methods
- 4. Illustrate the functional properties of food components
- 5. Summarize the fish processing and quality assurance
- 6. Develop suitable ways of marketing fish.

Unit I: Introduction to Fishes and their spoilage

Fisheries and aquaculture industry in India; Categorization of resources -Inland and marine; Fin fishes and shell fishes - salient features, Body structure and functions of various body parts, nutritional and energy values; Composition of fish, Rigor mortis & stages of spoilage; Role of enzyme and bacteria in spoilage of fish, Intrinsic & extrinsic parameters controlling spoilage.

Unit II: Preservation, Packaging, storage of fishes

Preparation of fresh fish for processing; Principles and methods of preservation of fish-Drying, Canning, Salt curing, Smoking, Marinating, Fermentation, Irradiation, MAP & CAP, Freezing, Freeze drying, and Value addition; Packing methods; Types of freezing equipments: Air blast freezer, contact freezers, immersion and spray freezer, Band freezer, Rotary freezer, cryogenic freezer.

Unit III: Functional properties of food components

Functional properties of food components: Emulsification, buffering, water holding, gelling properties of food components; Factors affecting functional properties and food quality. Flavor loss during processing and storage; Common fish spoiling bacteria, Microbial limits in seafood; Hygiene and sanitation in fish processing plants: Good manufacturing practices, Standard sanitary operating procedure, Chlorination and cleaning schedule.

Unit IV: Fish processing and Quality Assurance

Concepts of Food safety management systems-Quality concepts, HACCP principles, risk assessment methods, quality costs, usefulness of quarantine and certification, guiding and mandatory standards, Role of Food Safety and Standards authority of India; Basic concepts of hygiene and sanitation: Sources of pathogens and food poisoning organisms, Carriers and vehicles of pathogens, conditions for their growth, their interaction with the food, methods of pathogen inactivation, Effect of disinfectants and principle of their dose calculation, Personal hygiene and periodicity of check.

12 Hours

12 Hours

12 Hours

12 Hours

Unit V: Value added products, Fish marketing & organization

12 Hours

Value added products: Fish soup powder, fish pickle, fish cutlet, fish wafers and fish sausage. Fishery by products: chitin and chitosan, Shrimp extract, fish meal, fish body oil and Isinglass; Marketing channels, Types of fish marketing, organization in aquaculture and fish trade.

Textbooks:

- 1. Gopakumar.K. Text book of Fish Processing Technology, ICAR, New Delhi P.K.
- 2. Mukhopadhay. 2013. Fish processing technology, Swastik publications,
- 3. Sen D. P. 2005. Advances in Fish processing Technology, Pub. Allied Publishers Pvt.

Reference Books:

- 1. T.K.Govindan . 1987. Fish Processing Technology –, Oxford &IBH Publishing Company, New Delhi
- 2. Balachandran.K.K, 2002. Post harvest Technology of Fish and Fish products, Daya Publishing House, Delhi
- 3. Training Manual on Sea food Quality Assurance -CIFT
- 4. Sen D P , 2005. Advances in Fish Processing Technology, Allied Publishers Pvt. Ltd. New Delhi
- 5. Malcolm Windsor and Stuart Barlaw.1981. Introduction to Fishery Byproducts Fishing News Books Ltd.

E-resources:

- 1. http://icpe.in/icpefoodnpackaging/pdfs/12_seafood.pdf
- 2. https://www.nap.edu/read/1024/chapter/7#144
- 3. http://nptel.ac.in/courses/120108002/module5/lecture9.pdf
- 4. http://agritech.tnau.ac.in/fishery/fish_valueaddition.html
- 5. http://www.fao.org/docrep/X5625E/x5625e0f.htm

Practicals

- 1. Evaluation of fish conditions
- 2. Evaluation of fishery products for organoleptic, chemical and microbial quality
- 3. Methods for analysis for bacterial quality parameters, chemical parameters and filth
- 4. Value added products preparation
- 5. Industrial visit to fish landing centres and fish processing plants.

Online Course

INDUSTRIAL ZOOLOGY

Course coordinators: Dr. P. Selvaraj, Dr. T. Pushpanathanand Dr. T.E.T. Sunitha

Course Objective: The online program has a primary objective to make education more entrepreneurial, to make the graduates aware of the importance of animals as resources for income generation and to create confidence for their self employment venture.

Course Outcomes: At the end of the course the students will be able to:

- 1. Gain knowledge about the economic importance and farming of animals.
- 2. Comprehend the trading on finfish culture
- 3. Demonstrate poultry and dairy farming
- 4. Classify methods of rearing and breeding.
- 5. Assess the trading on apiculture products
- 6. Develop appropriate strategies for marketing

Unit I: Finfish and shell fish culture

Scope of finfish culture; Cultivable Fin fishes (Types) - types of culture (Cage culture, Extensive culture, Pokkali culture and Semi intensive culture); Induced breeding in carps; Transport of fish seeds; Common cultivable shellfish species; culture of freshwater prawn; culture of edible oyster.

Unit II:Poultry and dairy farming

Poultry: Poultry breeds in India, poultry feed and its composition, broiler and layers, rearing, nutritive value of egg and meat. List of poultry diseases and their preventive measures, poultry farm management, Dairy farming: Popular breeds of cattle, nutritional requirements, milk and milk products, processing, preservation and marketing of milk, cattle breeding techniques, artificial insemination, breeding programs to improve local breeds.

Unit III: Apiculture

Honeybee morphology, structural adaptation of mouthparts, honey sac, wax glands and sting apparatus, social life, different species and races, management of bee keeping (modern methods), economic importance of honey, wax, pollen venom and bee pollination, a note on production of honey, its chemical composition and honey bee disease.

Unit IV: Sericulture

Components of sericulture: Moriculture –different species of mulberry, cultivation methods, silkworm rearing, life cycle and morphology of *Bombyxmori*, environmental conditions needed for rearing, modern rearing house; rearing appliances, chawki worm and adult worm rearing methods, non-mulberry silkworm, pest and predators, Silkworm diseases – pebrine, muscardine, flacherie and grasserie, types of commercial silk, importance of sericulture in India and by-products of sericulture.

Unit V: Vermiculture

Ecotypes of earthworms; collection and preservation of earthworm; composting material; small scale techniques of vermicomposting and economics; Value addition of vermicompost, Vermiwash preparation and its applications.

Textbooks:

- 1. Shukla, G. S. and Upadhay, V.B. 2000. Economic Zoology, Rastogi Publication, Meerut
- 2. Christy, A.M.V. 2008. Vermibiotechnology, MJB Publications, Chennai
- 3. UpadhyayV. B. and G. S. Shukla. 2014. Applied and Economic Zoology, Rastogi Publications.

Minimum educational qualification: + 2 Maths and Science Duration: 90 hrs Minimum eligibility: Any undergraduate student Course fee: 3,000/-Note: Practical includes field visits (only on Saturdays) No. of credits: 3

ALLOTMENT OF MARKS

CIA – 1 conducted for 50 marks CIA – 2 conducted for 50 marks Cumulative marks of CIA -1 and 2 will be converted to 70 marks Assignment – 15 marks *Viva voce* – 15 marks Aggregate marks – 100

Theory Question Pattern for CIA and Semester Examination

Examination	Section A	Section B	Section C	Section D	Total
type	(1 mark)	(2 marks)	(5 marks)	(15 marks)	
	No choice	No choice	Either or	Open Choice	
Internal	5 x 1 = 5	5 x 2 = 10	5 x 1 = 5	$2 \ge 15 = 30$	50
External	20 x 1 = 20	5 x 2 = 10	5 x 5 = 25	3 x 15 = 45	100

Note: The Internal and External marks will be computed for 50 for each paper and the consolidation of these Internal and External marks will be for 100.

Question Pattern and Marks for Practical examination

Type of questions	Marks
Major Practical	15
1. Dissection, display, flag labeling /Procedure-5;	
2. Performance of the experiment/observation, calculation and table	
or graph- (10 B.Sc.)	
Minor Practical / Instrumentation	10
Performance of the experiment/observation, calculation and table or	
graph- (10 B.Sc)	
Identification of animals / instruments / spotters (5 or 10)	5
Spotters (5 x 3) -Identification $-\frac{1}{2}$ mark, Diagram $-\frac{1}{2}$ mark,	15
Labeling – ¹ / ₂ mark; Unlabelled diagram carries no mark, explanation	
- 1½ mark	
Record note book	5
Total	50

ANIMAL STRUCTURE AND FUNCTION (Subject Code: 21UZOA31)

Semester: III	Allied Theory: 1	Credits: 4	Hours: 4
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Course Objective: To provide basic and advanced knowledge of animals on taxonomy, morphology and physiology of animals

Course Outcomes: At the end of the course the students will be able to:

- 1. Identify and classify animals
- 2. Distinguish the structural organization of an invertebrate from a vertebrate
- 3. Examine the process of digestion, respiration and excretion in humans
- 4. Illustrate circulatory and nervous system of human body
- 5. Summarize the role of hormones in reproduction.
- 6. Integrate animal structure with its functions.

Unit I: Invertebrata

Salient features of invertebrates, classification up to phyla with diagnostic features and examples. Type study: Cockroach

Unit II: Chordata

Classification up to classes of Vertebrata with diagnostic features and examples; Type study: Frog – External morphology, digestion, respiration and circulation, reproductive systems

Unit III: Digestion, Respiration and Excretion in man

Digestion – structure of alimentary canal, Physiology of digestion and absorption; Respiration – structure of lungs, respiratory pigments, transport of oxygen and carbon dioxide, respiratory quotient; Excretion - structure of kidney and nephron, mechanism of urine formation.

Unit IV: Circulation, Nervous system and Receptors in man

Circulation – structure of heart, composition and functions of human blood, cardiac cycle, blood pressure; Nervous system - structure of neuron, nerve impulse conduction, reflex action; Receptors - Structure of eye and physiology of vision.

Unit V: Endocrine Glands and Reproductive System

Structure and hormones of endocrine glands - Pituitary, thyroid, adrenal, islets of Langerhans; Human reproductive system, female reproductive cycle, contraceptives.

Textbooks:

- 1. Jordan, E.L., Verma, P.S. 2012. Invertebrate Zoology, S. Chand and Company.
- 2. Verma, Tyagi, Agarwal, 1997. Animal Physiology, S. Chand and Company.
- 3. Ayyar, E. 2009. A manual of Zoology, Volume 11, S. Visvanathan P Ltd., Chennai.

Reference books:

- 1. EkambaranathaAyyar M., Ananthakrishnan, T.N. 1995. A Manual of Zoology, Vol. I (Invertebrata) Part I & II. Viswanathan Pvt. Ltd.
- 2. Kotpal, R.L. 2000. Invertebrates, Rastogi Publications.
- 3. Rastogi, S.C. 2001. Essentials of Animal Physiology, New Age International Publications.

12 Hours

12 Hours

12 Hours

12 Hours

12 Hours

- 1. https://www.pmfias.com/classification-animalia-animal-kingdom/
- 2. http://www.biologydiscussion.com/invertebrate-zoology/21-general-characteristics-of-invertebrates/28088
- 3. http://biology.tutorvista.com/organism/vertebrates.html
- 4. http://www.arvindguptatoys.com/arvindgupta/human-body-systems.pdf
- 5. https://www.wsfcs.k12.nc.us/cms/lib/NC01001395/Centricity/Domain/8472/Body% 20Systems%20Interactions%20chart.pdf
- 6. http://www.cabrillo.edu/~jtice/HSERV%20162/FUNCTIONALOrganization%20of %20the%20Human%20Body.pdf
- 7. http://samples.jbpub.com/9781449652609/99069_ch05_6101.pdf
- 8. https://www.saylor.org/site/wp-content/uploads/2010/11/The-Endocrine-System.pdf
- https://www.scarsdaleschools.k12.ny.us/cms/lib5/NY01001205/Centricity/Domain/ 214/BRGT0390.pdf

ANIMAL STRUCTURE AND FUNCTION - PRACTICALS (Subject Code:21UZOAP31)

Semester: III Allied Practical: 1	Credit: 1	Hours: 2
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- 1. Virtual dissection of cockroach (Digestive system, Nervous system and Reproductive system).
- 2. Mounting of Cockroach, mosquito, houseful mouthparts
- 3. Mounting of prawn appendages
- 4. Collection, isolation of soil nematodes
- 5. Virtual dissection of frog (Digestive system, Nervous system and Reproductive system).
- 6. Effect of temperature on salivary amylase activity.
- 7. Qualitative estimation of excretory products.
- 8. Observation of cellular constituents of human blood.
- 9. Quantitative Estimation of haemoglobin using haemoglobin meter.
- 10. Demonstration of blood pressure.
- 11. Slide mounted specimens: Paramecium, Leucosolenia
- 12. Preserved specimens: Hydra, Taeniasolium, Ascaris, Megascolex, Palaemon, Pila globosa, Asterias, Amphioxus, Balanoglossus, Ascidian, Anguilla, Rhacophorous, Chamaeleon, Najanaja, Pelican, Parrot, Rabbit, Bat, Manis (pangolin),
- 13. 3-D Models: Human system / organs: digestive system, lungs, kidney, nephron, heart, neuron, eye, thyroid.

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY (Subject code: 21UZOA41)

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Semester: IV	Allied Theory: 2	Credits: 4	Hours: 4

Course Objective: To inculcate the fundamental aspects of the immune system, antigen antibody reaction as well as techniques involved in animal cell culture and gene manipulation.

Course Outcomes: At the end of the course the students will be able to:

- 1. Describe the concepts, components and principles of immune system
- 2. Explain primary and secondary lymphoid organs
- 3. Demonstrate antigen and antibody interactions and their techniques
- 4. Classify hypersensitivity and autoimmune disorders
- 5. Summarize animal cell culture techniques.
- 6. Design techniques in gene manipulation

Unit I: Immune system

Concepts, components and principles of innate and adaptive immune systems; Haematopoiesis; Cells of immune system - B cells, T cells and macrophages; Primary and secondary lymphoid organs.

Unit II: Antigen and Antibodies

Antigens – properties, types and determinants; Antibody (Immunoglobulin) – classes, structure, mechanism of action, functions; Monoclonal and polyclonal antibodies; ELISA and RIA techniques and their applications.

Unit III: Immuno-prophylaxis, Hypersensitivity and Autoimmunity 12 Hours

Vaccines-definite, types, mechanism of action, immunization schedule; Hypersensitivity - Definition, types, treatment of type I anaphylactic hypersensitivity; Autoimmunity - classification, disorders and therapy.

Unit IV: Animal cells culture

Characteristic features of animal cells in growth; Requirement - culture media, Equipments; Isolation of animal tissue- physical and chemical methods; Establishment of cell culture - primary, secondary cell culture and cell lines; Organ and embryo culture.

Unit V: Technique of gene manipulation in animals

Strategies of r-DNA technology; DNA finger printing ;Gene transfer methods; Cloning methods-Dolly; Transgenic animals; causes of infertility in male and female ; *in vitro* fertilization (IVF) and embryo transfer.

Textbooks:

- 1. Chakravarthy Ashik, K. 1996. Immunology Tata Mc Graw-Hill Publishing Company Ltd., New Delhi.
- 2. Purohit, S. S. 2000. Biotechnology Fundamentals and Applications, Agrobios, Jodhpur, India
- 3. Roitt I.M. 2000. Essential Immunology. Blackwell Scientific Publishers, London.

12 Hours

12 Hours – classes,

12 Hours

12 Hours

Reference Books:

- 1. Kuby, J. 1999. Immunology W.H. Freeman and Company, New York.
- 2. Roitt, Brostoff and Male, 1993. Immnunology, Mosby, London.
- 3. Gupta, P. K. 1999. Elements in biotechnology, Rastogi Publication, Meerut, India.

- 1. https://microbiologyinfo.com/antigen-properties-types-and-determinants-of-antigenicity/
- 2. http://www.kean.edu/~jfasick/docs/Fall%2009%20&%20SP10%20%20A&PII/Chapter%2 021b.pdf
- 3. http://jeeves.mmg.uci.edu/immunology/CoreNotes/Chap04.pdf
- 4. http://cdrwww.who.int/immunization/documents/Elsevier_Vaccine_immunology.pdf
- 5. http://www.lab.anhb.uwa.edu.au/hb313/main_pages/timetable/lectures/2007%20Tissue%2 0Culture%20Lecture%202%20combinedBjanka.pdf

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY - PRACTICAL (Subject code: 21UZOAP41)

Semester: IV	Allied Practical: 4	Credit: 1	Hours: 2
1. ABO Blood grouping and Rh factor.			
2. WBC count in human blood			
3. Double immuno diffusion technique			
4. Radial immuno diffusion			
5. Separation of lymphocytes			
6. Haemagglutination test			
7. Cell viability test			
8. Blood coagulation	/ Clotting time		
9. Rat lymphoid orga	ins		
10. Extraction of protein from animal tissue			

- 11. Extraction of genomic DNA from human blood
- 12. Tissue culture media preparation
- 13. Spotters: Immunoglobulins, Thymus, Bone marrow, Lymphnode, Macrophage, Spleen, Bursa of fabricius, Antigen and antibody reaction, Engineered vaccine, Transgenic mice, Animal cloning Dolly, Monoclonal antibodies, Cell growth curve, Embryo culture –*invitro* fertilization.