SEMESTER III			
Part III Core III: Developmental Zoology			
Code: 21UZOC31	**Hrs/Week: 4**	**Hrs / Sem: 60**	**Credits: 4**

Objectives

To acquire a greater appreciation of life and its development

To understand the complexity of developmental processes and the underlying mechanism

To attain knowledge on reproductive technology and stem cells

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO's addressed	CL
CO-1	expose to concepts and process in developmental biology	1,2	Un
CO-2	Illustrate the events occur during fertilization	8	Un
CO-3	Acquire knowledge about the developmental process andembryogenesis	6	Un
CO-4	explain the sequential changes from cellular grade of organization to organ grade of organization	7	Un
CO-5	describe the development of extra embryonic membrane and the nature and physiology of placenta	3	Un,An
CO-6	Create awareness on new technology in embryology and its relevance to Man	1,7	Cr
CO-7	Create awareness on advanced reproductive technologies	1,3	Un, Cr
CO-8	Analyse the causes of infertility in human and can take preventive measures.	2,3	An

SEMESTER III			
Core III: Developmental Zoology			
Code:21UZOC31	**Hrs/Week:4**	**Hrs/Sem:60**	**Credits:4**

Unit I **Gametogenesis**

Basic concepts of developmental biology -Gametogenesis – spermatogenesis, oogenesis- sperm and egg of chick and man

Unit II **Development of Chick**

Fertilization : Pre and post fertilization events - cleavage, gastrulation and fate Map of Chick

Unit III **Development of Human**

Cleavage – Fate map of human - gastrulation in human Organogenesis- Development of heart and brain in mammal

Unit IV **Organizer & Foetal membrane**

Organizer- primary and secondary organizers, morphogenetic fields and gradient hypothesis, embryonic stem cells- culture & applications, placenta in mammals – types and physiology

Unit V **Assisted Reproductive Technology**

Manipulation of reproduction in human - Infertility (Male & Female) - Poly Cystic Ovarian Disease (PCOD) - artificial insemination,test-tube babies - amniocentesis - Birth control- contraceptive devices–surgical, hormonal methods, physical barriers – IUCD, termination of gestation

Text Books

1. Arumugam. N. 2006 *Developmental Zoology*, Saras Publication
2. Mohan P. Arora 1991 *Organic Evolution*, Himalaya Publishing House.

Books for Reference

1. Berril. M.J. 1982. *Developmental Biology*, Tata McGraw- Hill Publishing Company Ltd.New Delhi.
2. Verma.P.S. and U.K. Agarwal, *Chordate Embryology* (10th Edition) S.Chand&

Company Ltd, New Delhi.

3. Balinsky, B. I. 1981. *Introduction to Embryology*. Saunders College, Philadelphia.
4. Jay M Savage, 1998, *Evolution*, Amerind Publishing House Co, New Delhi.
5. Paul Amos Moody ,1997, *An Introduction to Evolution*, Kalyani Publishers, Ludhiyana
6. Arumugam.N 2001 *Evolution* , Saras publication, Kottar, Nagercoil.

SEMESTER IV			
Core I	**Biochemistry and Bioinstrumentation**		
Course Code: 21UZOC41	**Hrs/ Week: 4**	**Hrs/ Sem: 60**	**Credits: 4**

Objectives

- To gain in-depth knowledge of molecular processes in Biology from chemical approach to understand the complexity of life.
- To impart fundamental chemical and biological principles to advance their understanding of living world, nutrition, better medical care, biotechniques to enhance the quality of life.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the structure of biomolecules such as carbohydrate, protein and lipids	4	Un
CO-2	evaluate the significance of biomolecules in the processes that occur within living cells	4	Ev
CO-3	analyse enzymes as biological catalysts and the mechanism of their action and develop the ability to comprehend life processes	4	An
CO-4	discuss the beneficial effects of vitamins and foods that contain vitamins required for the healthy functioning of the body	2	Cr
CO-5	recall, relate and deploy knowledge in identifying deficiency diseases of vitamins from symptoms and find the remedy	6	Ap
CO-6	understand the principle, working mechanism and application of standard laboratory equipments and modern instruments	6	Un
CO-7	develop proficiency in basic laboratory techniques in biochemistry and maintain records of lab activities	7	Ap
CO-8	apply appropriate biochemical techniques to plan and carry out experiments, test hypotheses and draw conclusions to conduct project works in near future	8	Ap

Unit I **Carbohydrates**

Carbohydrates – outline classification, properties, and biological significance - monosaccharides (glucose and fructose), glycoside linkage, disaccharides (sucrose, lactose) and polysaccharides(cellulose and glycogen).

Unit II **Protein**

Classification of amino acids based on the structure of side chain;
Protein - classification based on shape and structure, primary, secondary, tertiary and quaternary structure, properties, biological significance.

Unit III **Lipids**

Fatty acids - t y p e s - saturated, unsaturated fatty acids, essential, non-essential fatty acids; Lipids - classification, simple lipids (triglycerides and waxes), compound lipids (phospholipids, cerebrosides), derived lipids (steroids), properties, biological significance.

Unit IV **Enzymes and Vitamins**

Enzymes - classification and nomenclature, properties, mechanism of enzyme action, factors affecting enzyme activity,
enzyme inhibition, co-enzymes – functions of coenzyme.
Vitamins: fat soluble and water soluble, properties, sources, dietary requirements and deficiency symptoms.

Unit V **Instrumentation**

Principle, technique and applications of pHmeter, colorimeter, spectrophotometer, centrifuge, agarose gel electrophorosis and chromatography (Paper, TLC).

Text Book

1. Dulsy Fatima, L., Narayanan, R.P., Meyyan Pillai, K., Nallasivam, S., Prasanna Kumar and A. Arumugam. *Biochemistry*. Nagercoil: Saras Publication. 2013.

Books for Reference

1. Satyanarayana,V. and U. Chakrapani. *Biochemistry* – Elsivier – Division of Reed Elsivier India PVT. Ltd. and Books and Allied Pvt.Ltd.2013.
2. Ambika Shanmugam. *Fundamentals of Biochemistry for Medical student.* Chennai: Navabharat Offset Works. 2000.
3. David L. Nelson and Michael M. Cox, *Lehninger Principles of Biochemistry* USA :W.H. Freeman & Co Ltd; 8th edition. 2021
4. Denise R. Ferrier. *Biochemistry*. Philadelphia – Baltimore – Newyork–London: Wolters Kluwer/ Lippincott Williams and Wilkins. 2011
5. Srivastava, H.S. *Elements of Biochemistry*. Meerut: Rastogi Publications. 2006.

PRACTICALS

Course Code: 21UZOCR4

Hrs/ Week: 2 **Credit: 2**

1. Qualitative test for carbohydrate.
2. Qualitative test for proteins.
3. Qualitative test for lipid.
4. Determination of iodine number of dietary fat
5. Determination of saponification number of dietary fat.
6. Determination of acid value of dietary fat.
7. Separation of amino acid by paper chromatography / Iodine method.
8. Measurement of pH in different water samples.
9. Model/ chart – Structure of amino acid, glucose, fructose, sucrose and cholesterol, colorimeter, pH meter, centrifuge, agarose gel electrophoresis

Books for Reference

1. David T. Plummer. *An Introduction to Practical Biochemistry*. New Delhi: Fifth Reprint. Tata Mc Graw – Hill Publishing Company Limited, Third Edition. 1992.
2. Jayaraman J. *Laboratory Manual in Biochemistry*. New Delhi: New Age International (P) Ltd. Publishers, 2000.

SEMESTER III			
NME I	**Basic Biotechnology**		
Course Code: 21UZON31	**Hrs/ Week : 2**	**Hrs/ Sem: 30**	**Credit: 2**

Objectives

- To impart basic knowledge on biotechnology
- To develop skills in biology using various biotechniques
- To motivate the students to take up career in biotechnology related fields in their future

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the basic principles of Biotechnology	1	Un
CO-2	distinguish between prokaryotic and eukaryotic cells from their structural studies	2	An
CO-3	understand the restriction enzymes and cloning vectors and assess their use in genetic engineering.	4	Un, Ev
CO-4	analyse the structure of DNA, and use various techniques to visualize, manipulate and separate the DNA molecules	4, 5	Un, An
CO-5	apply the various gene manipulation techniques to generate genetically modified organisms	6	An
CO-6	evaluate techniques of gene delivery and cloning to adapt in manipulation of genes	5	Ev
CO-7	discuss the preparation and characterization of appropriate nano materials in the field of nanotechnology	7	Cr
CO-8	to perform biotechnology experiments to isolate separate and amplify DNA molecules	8	Cr

Unit I **Introduction to Basic Biotechnology**

Definition, history of Biotechnology - scope of Biotechnology; structure of cell - eukaryotic and prokaryotic cells.

Unit II **Basics of Gene Manipulation**

Structure of DNA - gene concept - central dogma of life - concept of genetic engineering - Type II Restriction enzymes and DNA ligases in genetic engineering - cloning vectors – definition - general characters - plasmid cloning vector – pBR322 - construction of recombinant DNA - basic steps in cloning.

Unit III **Techniques in Biotechnology**

Agarose gel electrophoresis, SDS PAGE, PCR - Gene delivery methods – transformation, transfection, methods, biolistic method (gene gun).

Unit IV **Genetic Modification of Organisms**

Transgenic animals and plants - methods of production of transgenic organisms - outline of microinjection mediated gene transfer to animals - outline of Agrobacterium mediated gene transfer to plants – GMOs – Super mouse, Gold fish, Golden rice, Bt Cotton.

Unit V **Demonstrations/ Model/ Chart**

DNA isolation, restriction digestion, agarose gel electrophoresis, SDS PAGE, PCR, Structure - DNA, tRNA (Model/ Chart).

Text Book:

Kumaresan, V. *Biotechnology*. Nagercoil: Saras Publication, 6th edition, 2012.

Books for Reference:

1. Dubey, R.C. *A Textbook of Biotechnology*. New Delhi: S. Chand and Company Ltd., 2009.
2. Rastogi, S.C. *Biotechnology Principles and Applications*. Chennai: Reprint, Narosa. Publishing House, 2020.
3. Singh, B.D. *Biotechnology*. New Delhi: Kalyani Publishers. 2015.
4. Sathyanarayana, V. *Biotechnology*. Kolkatta:. Books and Allied (P) Ltd. 15th Edition. 2020.
5. Harisha S. *Biotechnology Procedures and Experiments Hand Book*. New Delhi: Lakshmi Publications. First Edition. 2008.
6. Asish Verma, Surajit Das, Anchal Singh. *Laboratory Manual for Biotechnology*. New Delhi: S. Chand and Company, Ltd., 2008.

SEMESTER III			
Skill Based Elective	**A. Fishery Products**		
Course Code: 21UZOS31	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Objectives:

- To obtain knowledge on products of fisheries industry, their processing and preservation process.
- To encourage the students to follow hygiene in fish processing
- To develop entrepreneurial skills in the preparation of sea-food based convenience products in ready-to-eat or ready-to-cook forms

Course Outcome

CO. No.	Upon completion of this course, the graduates will be able to	PSO addressed	CL
CO-1	acquire knowledge on products and by-products of fisheries.	5	Un
CO-2	demonstrate various processing and preservation methods of fishery products	5	Un
CO–3	apply information on processing for the usage of fish by-products for industrial and domestic purposes.	7	Ap
CO–4	carry out study on sea weeds and analyse their usage as food for human consumption	2	An
CO–5	practice the preparation of value added fishery products.	8	Cr
CO–6	implement and discuss sanitation and quality control techniques.	7	Cr
CO–7	update the knowledge of preservation and processing techniques and recommend their use in day to day life.	7	Ev
CO-8	develop advanced techniques on fishery products.	8	Un, Cr

Unit I **Value Added Fishery Products**

Fish pickles, fish sauce, fish cutlets, fish balls, fish soup powder and fish sausage. Battered and braided products-fish finger, fish wafer.

Unit II **Fishery By Products**

Fishery by products - fish oil – isinglass – chitosan – pearl essence – shark fins

Unit III **Seaweed Products**

Uses of agar, algin and carrageenan. Use of sea weeds as food for human consumption.

Unit IV **Techniques of Preservation and Processing**

Freezing - quick, slow freezing; freezer - horizontal plate freezer, tunnel air blast freezer - cryogenic freezing; canning; smoking - hot, cold, electrostatic smoking; pickling; drying – natural, artificial; salting - dry, wet and mixed salting.

Unit V **Quality Control and Sanitation**

Sanitation in processing – environmental hygiene and personal hygiene in processing. Fishery guidelines for HACCP and FSSAI on fish and fish products.

Text Book

1. Dr. Surekha Gupta. *Textbook of Fishery*. New Delhi: Ane Books Pvt. Ltd. 2010

Books for Reference

1. Gopakumar, K. *A Textbook of Fish Processing Technology.* New Delhi: ICAR. 2002.
2. Gupta, S.K. and P.C Gupta. *General and Applied Ichthyology* [*Fish and fisheries*]. Ramnagar New Delhi: Chand and Company Ltd. 2006
3. K.R. Ravindranathan. *A Text book of Economic Zoology*. New Delhi*:* Wisdom Press. 2013.
4. Ayyapar, S. *Handbook of Fisheries and Aquaculture*. New Delhi: 2010
5. Srivastava, C.B.L. *A Text book of Fishery Science – Indian Fisheries.* New Delhi: Kitab Mahal. 2006.

SEMESTER III			
Skill Based Elective	**B. Aquarium Management**		
Course Code: 21UZOS32	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Objectives

- To provide information on setting up and maintenance of an aquarium.
- To promote the self-employment opportunities.
- To foster the importance of peaceful, educational and stress-free hobby.

Course Outcome

CO. No	Upon completion of this course, the students will be able to	PSO addressed	CL
CO-1	acquire knowledge about home aquarium	1	Un
CO-2	identify common aquarium fishes	1, 2	K
CO-3	explain the different kinds of equipment and accessories used in setting up an aquarium	6	K, Un
CO-4	critically analyze the different kinds of fish feed and aquarium plants	5	An
CO-5	examine the common diseases, symptoms and management of aquarium fishes	7	Ap
CO-6	demonstrate skills in maintenance of water quality parameters	3,5	An, Ap
CO-7	develop the hobby of having an aquarium at home	8	Cr
CO-8	promote self-employment opportunities	8	Ap

Unit I **Construction of Home Aquarium**

Construction of home aquarium - materials needed - wooden and metal frames - frameless tanks, sealants and gums

Unit II **Setting up of an Aquarium**

Setting up aquarium – gravel/ pebbles – plants – ornamental objects and fishes – popular ornamental fishes – gold fish, molly, angel fish, zebra fish, cichlids - aquarium accessories – aerators, filters

Unit III **Maintenance of Aquarium**

Maintenance of aquarium - water quality management – pH, temperature, lighting, hardness, salinity, oxygen, carbon dioxide – optimum conditions for the growth of aquarium plants

Unit IV **Feed Formulation**

Nutritional requirements of aquarium fishes - Different kinds of feed - live feed – artemia and chironomous larva – feeding formula, feeding methods and devices.

Unit V **Fish Diseases and Management**

Symptoms - treatment, prevention and control of common diseases of aquarium fishes - tail rot, fin rot, white spot, velvet disease – scoliosis.

Text Book:

1. Jameson J.D. and Santhanam R. *Manual of Ornamental Fishes and Farming Technologies.* Tuticorin: Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Science University, 1996.

Books for Reference

1. Yadav B.N. *Fish and Fisheries*. New Delhi: Daya Publishing House, 2002.
2. Thara Devi C.S and Jeyashree K.V. *Home Aquarium*, Nagercoil: Saras Publications, 2009.
3. Gupta S.K. and Gupta P.C. *General and Applied Ichthyology* (Fish and Fisheries). New Delhi: S. Chand and Company Ltd., 2006.
4. Sebastian J. *The aquarium Handbook*. Cochin, Kerala: Amity Aquatech Pvt. Ltd., 2002.
5. Amita Saxena. *Aquarium Management.* Delhi: Daya Publishing House, 200

SEMESTER IV			
Skill Based Elective	**A. Clinical Laboratory Technology**		
Course Code: 21UZOS41	**Hrs/ Week: 2**	**Hrs/ Sem: 30**	**Credits: 2**

Objectives

- To become skilled persons for employment.
- To learn the utility and the applications of the instruments.
- To study the etiology of various diseases affecting human beings.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the laboratory practices and know how to maintain the laboratory instruments	1	Un
CO-2	analyze and distinguish various types of blood cells	2	An
CO-3	understand the pathological diseases and explain the test for hepatitis, AIDS and intestinal parasite	3	An
CO-4	evaluate critical thinking of biochemical test	5	Un
CO-5	demonstrate the proficiency in basic methods of instrumentation and quantitative analytical skills used to conduct biological research	6	Un
CO-6	develop skills in various lab techniques	7	Cr
CO-7	acquire knowledge to handle clinical equipments	4	Un
CO-8	design, carryout and interpret scientific experiments	8	Ap

Unit I **Best Laboratory Practices and Instrumentation**

Best laboratory practices - norms to be followed in a clinical lab - sterilization - dry heat (hot air oven), moist heat (autoclave) and UV radiation (laminar flow chamber) – X- Ray - CT scan and MRI scan.

Unit II **Haematology**

Collection and storage of blood, preparation and use of blood components - blood groupings (A,B,O & Rh factor). Estimation of haemoglobin.

Unit III **Clinical Pathology**

Dialysis - hepatitis test – hemolytic jaundice - analysis of sputum - AIDS (ELISA Western blot test) Diagnosis of dengue and COVID-19.

Unit IV **Clinical Biochemistry**

Estimation of cholesterol, urea, uric acid, creatinine of blood - assay of enzyme alkaline phosphatase.

Unit V **Demonstration/ Charts/ Models/ Hands-on Training/ Hospital Visit**

Stethoscope, sphygmomanometer, electrocardiogram, EEG and echo cardiogram - analysis of urine - routine physical examination.

Text Book:

1. Ramnik Sood. *Medical Laboratory Technology*, Methods and Interpretations New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.2005.
2. Jyoti Saxena, Mamta Banuthiyal and Indu Ravi Laboratory. *Manual of Microbiology, Biochemistry, and Molecular Biology*. New Delhi: Scientific Publishers (India). 2015.

Books for Reference:

1. Biswajit Mohanty and Sharbari Basu. *Fundamentals of Practical Clinical Biochemistry.* New Delhi: B.I Publications Pvt. Ltd. 2006.
2. Estridge, B.H., Reynolds, A.P. and N.J. Walters. *Basic Medical Laboratory Techniques.* Banglore: Thomson Delmar Learing Fastern press (Bangalore) Pvt. Ltd. 4th edition 2000.
3. Kannai, L. Mukherjee. *Medical Laboratory Technology.* Chennai: Tata Mc Graw Hill Publishing Company Limited, Vol-I, Vol-II and Vol-III. 1997.

SEMESTER IV			
Skill Based Elective	**B. Nutrition and Health**		
Course Code : 21UZOS42	**Hrs /Week : 2**	**Hrs /Sem : 30**	**Credits : 2**

Objectives

- To familiarize the students with fundamentals of food, nutrients and their relationship to health.
- To create an awareness on nutrition related disorders.

Course Outcomes

CO. No.	**Upon completion of this course, students will be able to**	**PSO addressed**	**CL**
CO- 1	understand basic concepts of nutrients and their functions	1,2	Un
CO -2	outline the sources of micro and macro nutrients	1,2	Un
CO – 3	relate the nutritional significance and health benefits of macronutrients	3	Un
CO – 4	plan nutritional requirements during different stages of life	1,2	Ap
CO – 5	explain the recommended dietary allowances of micro and macro nutrients	4	Ev
CO – 6	analyse the role of various minerals important in maintaining health	4	An
CO – 7	discuss the etiologic and clinical features of nutrition related disorders	7	Cr
CO – 8	adopt dietary management for nutrition related disorders	8	Cr

Unit I Introduction

Definition - food, nutrition and health. Role of nutrition. Energy requirement.

Nutritional guidelines for health and fitness.

Unit II Micronutrients

Definition - sources, functions and recommended dietary allowance.

Vitamins and minerals (calcium, phosphorus and magnesium).

Unit III Macronutrients

Definition- sources, functions and recommended dietary allowance.

protein – carbohydrate – lipid.

Unit IV Balanced diet

Nutritional requirements of different age groups – infants – children –

adolescents – pregnant and lactating women – calorific value of food.

Unit V Life style related diseases

Weight imbalances – overweight and obesity, underweight.

Eating disorders – anorexia nervosa and Bulimia.

Hypertension and coronary heart disease.

Food allergy – Etiology, clinical features and nutritional management.

Text Book

1. Sri Lakshmi B. *Dietetics*. New Delhi: 6th Edition New Age International Ltd. Publications 2011.

Books for Reference

1. Sherman. *Chemistry of Food and Nutrition*. Jodhpur: Agrobios Publications 2010.
2. Blank F.C. *A Text Book of Foods and Nutrition*. Jodhpur : Agrobios Publications 2013.

SEMESTER III	
Self Study (Compulsory) **Wildlife Conservation**	
Course Code : 21UZOSS1	**Credits: 2**

Objectives:

- To recognize the importance of wildlife conservation.
- To study the techniques of wildlife census.
- To learn the role of Sanctuaries and National Parks in wildlife conservation.

Course outcome

CO. No	upon completion of this course, students will be able to	PSO addressed	CL
CO-1	acquire knowledge on the need for conservation of wildlife	1	Un
CO-2	explain about the status and conservation of endangered species.	1	Un
CO-3	be aware of wildlife wealth of India and the threatened species	1	Un
CO-4	apply principles of wildlife management in protecting the threatened species	3	Ap
CO-5	analyse the values, benefits of wildlife and cause for wildlife depletion	3	An
CO-6	understand the Wildlife Conservation Policies and to improve the conservation strategies.	8	Un, Cr
CO-7	assess wildlife population by learning the various census techniques	6	Ev
CO-8	discuss the role of Wildlife Sanctuaries and National Parks in wildlife conservation	3	Cr

Unit I **Wildlife Census Techniques**

Wildlife census techniques - direct method - line transect method – block count method- indirect method - pellet analysis method - pugmark techniques.

Unit II **Need for Conservation**

Wildlife values and benefits - causes of wildlife depletion – need for conservation - endangered species of reptiles, birds and mammals in India.

Unit III **Wildlife and their Management**

Principles of wildlife management - wildlife wealth of India - threatened wildlife, threats to survival and management of Red Panda, Musk deer, Great Indian Bustard, Olive Ridley turtle, Nilgiritahr, Nilgiri langur.

Unit IV **Sanctuaries and National Parks**

Definition – importance – Vedanthangal, Koonthankulam Bird Sanctuary – Mudumalai Sanctuary- Anamalai Sanctuary - National Parks - Guindy Deer Park – Gulf of Mannar Biosphere Reserve.

Unit V **Wildlife Conservation Policies**

The World Conservation Union (IUCN), Red Data Book.
World Wildlife Fund (WWF), Indian Board of Wildlife (IBWL) – National Board for Wildlife (NBWL), Man and Biosphere Programme (MAB), Project Tiger. Wildlife Protection Act 1972, Significance of NGO's in wildlife conservation.