UG Zoology (2020 Board)

Semester I

Major Core I - Invertebrate Zoology

Course Code: ZC2011

No. of hours/ week	No. of credits	Total number of hours	Marks
4	4	60	100

Learning Objectives

1. To know the difference between protozoa and metazoa, and to study the structure, functional organization, adaptations of invertebrates.
2. To develop the skill of identification of invertebrates and to promote employability in museum, consultancy firms and educational institutions.

Course Outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	identify the fundamental principles of systematics and classify according to their characters.	PSO - 1	R
CO - 2	compare functional organization and their relationship withthe environment.	PSO - 2	U
CO - 3	apply and communicate the information about Invertebratesfor life - long learning.	PSO - 4	Ap
CO - 4	analyse the ecological and economic importance of invertebrates.	PSO - 3	An
CO - 5	evaluate animal diversity and initiate their career opportunities.	PSO - 2	E
CO - 6	observe, draw and synthesize information about invertebrates in laboratory and field conditions to enhance research.	PSO - 4	C

Unit I Zoological nomenclature – Rules and regulations, Classification of Animal Kingdom. Levels of organization: Grades of organization, symmetry and coelom. **Protozoa**: General characters and classification up to classes with names of examples only. Type study: Paramecium – Structure, osmo-regulation and reproduction (binary fission and conjugation). Locomotion and Nutrition in Protozoa. Malaria and Amoebiasis (causes, symptoms, prevention and control).

Unit II **Porifera:** General characters and classification up to classes with names of examples. Type study: Leuco solenia – external morphology – body wall - reproduction. Canal system in sponges. **Coelenterata:** General characters and classification up to classes with names of

examples only. Type study: Obelia- Polymorphism and metagenesis. Corals, Coral reefs and their significance.

Unit III **Platyhelminthes:** General characters and classification up to classes with names of examples only. Type study: Liver fluke (structure and life cycle), Tape worm (structure). **Aschelminthes:** General characters and classification up to classes with names of examples only. Pathogenicity and control measures of Ascaris lumbricoides, Wuchereria bancrofti, Enterobius vermicularis, Ancylostoma duodenale and Dracunculus medinensis. Parasitic adaptations of Helminthes.

Unit IV **Annelida:** General characters and classification up to classes with names of examples only. Type study: Earthworm (structure and nephridia). Metamerism in Annelida. **Arthropoda:** General characters and classification up to classes with names of examples.Type study: Penaeus - external characters, appendages, compound eye, reproductive system and life cycle. Mouthparts of insects. Pest of Paddy (Leptocorisa varicornis), Coconut (Oryctes rhinoceros).

Unit V **Mollusca:** General characters and classification up to classes with names of examples only. Type study: Pila - external characters – shell - pallial complex - digestive system - respiratory system. Cephalopods as advanced molluscs. **Echinodermata:** General characters and classification with names of examples only. Type study: Star fish – external characters and water vascular system. Larval forms of Echinoderms and their phylogenetic significance.

Textbook

Jordan, E.L. and Verma, P.S. (2010). Invertebrate Zoology. New Delhi: S. Chand & Co.Ltd.

Reference Books

1. Kotpal, R.L. (2004). Modern Textbook of Zoology- Invertebrates **(**9th ed.). Meerut: Rastogi Publications.
2. Ayyar, E.K. and Ananthakrishnan, T.N. (1995). Manual of Zoology, Vol. I (Invertebrata), Part I & II. Madras: S. Viswanathan Printers and Publishers Pvt. Ltd.
3. Dhami, P.S. and Dhami, J.K. (1979). Invertebrate Zoology. Ram Nagar, New Delhi: S. Chand & Co. Ltd.
4. Jain, A.P. (2002). Biology of Invertebrates (4th ed.). New Delhi: Tata McGraw-Hill Publishing Company Ltd.
5. George Gaylord Simpson (2018). Principles of Animal Taxonomy. India: Scientific Publishers.
6. Lal, S.S. (2004). A Text Book of Practical Invertebrate Zoology. Meerut: Rastogi Publications.

Allied Zoology: General Zoology

Course Code: CA2011

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on Animal diversity, Cell Biology, Genetics,Developmental Biology, Evolution and Physiology.
2. To instill interdisciplinary skills for availing employment opportunities.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	recall the classification of animals, cells, genetic disorders in man, development of frog, structure and function of vital organs.	PSO – 1	R
CO – 2	outline the diversity of animal forms and their cellular organization, genetic makeup, evolution and physiology.	PSO – 1	U
CO – 3	correlate the physiological processes of animals and relationshipof organs system, inheritance of characters.	PSO - 3	Ap
CO – 4	recognize the major functions of organ systems in the human body and the role played by animals and evolution of animal life.	PSO – 2	An
CO – 5	evaluate the characters, functions and genetics of diverse animals.	PSO – 4	E

Unit I Invertebrate Zoology: General characters of Invertebrates – classification up to phylum with two examples for each. Paramecium – external features, conjugation. Obelia – external features, polymorphism. Ascaris- external features, parasitic adaptations. Penaeus – external features**. Starfish – external features, water vascular system.**

Unit II Chordate Zoology: General characters of chordates - outline classification up to classes with one example. Migration of fishes.Identification of poisonous and non-poisonous snakes, first-aid for snake bite.Flight adaptations in birds. Rabbit – external characters. Dentition in human.

Unit III **Cytogenetics**: Difference between plant and animal cells. Chromosomes - structure - types and function. Human - Simple Mendelian traits, Genetics of blood groups, sex linked inheritance - colour blindness and haemophilia, Non-disjunction - Klinefelter's, Turner's and Down's syndrome.

Unit IV **Developmental Zoology and Evolution**: Frog - structure of sperm and ovum - fertilization. Early development in frog - cleavage, blastulation and gastrulation.Biochemical origin of life - Urey Miller Experiment, Natural selection theory and Modern synthetic theory of evolution.

Unit V Human Physiology: Digestion – structure and functions of the digestive system. Respiration - structure and functions of lungs. Circulation - structure and function of the heart. Excretion - structure and functions of kidney.

Textbook

Arumugam, N. (2011). Allied Zoology, Vol.I to III.Nagercoil: Saras Publications.

Reference Books

1. EkambaranathaAyyer, M.A. (1986).*Manual of Zoology*Vol.I& II. Chennai:
2. S. Viswanathan Printers and Publishers Pvt. Ltd.
3. Jordan, E.L. and Verma, P.S. (1988). *Chordate Zoology* New Delhi: S. Chand and Co. Ltd.
4. Kotpal, R.L. (2004). *Modern Text Book of Zoology – Invertebrates* (9th ed.). Meerut: Rastogi Publications.
5. Kotpal, R.L. (2004). *Vertebrates.* Meerut: Rastogi Publications.
6. Nagabhushanam, R., Kodarkar, M.S. and Sarogini, R. (1982). *Textbook of Animal Physiology* (2nd ed.). New Delhi: Oxford and IBH Publishing Co. Pvt.Ltd.
7. Verma, P.S. &Agarwal, V.K. (2003). *Chordate embryology* (10th ed.). New Delhi: S. Chand and Co. Ltd.
8. Rastogi, V.B. &Jayaraj, M.S. (2000). *Textbook of Genetics*. Meerut: KedarnathRamnath Publishers.
9. Verma, P.S. &Agarwal, V.K. (2010). *Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology.* New Delhi: S. Chand & Co.

Semester I

Add on Course - Professional English for Life Sciences

Course Code: ALS201

No. of hours/week	No. of credits	Total number of hours	Marks
2	2	30	100

Learning Objectives

1. To enhance the lexical, grammatical and socio-linguistic and communicativecompetence in an increasingly complex, interdependent world.
2. To develop intellectual flexibility, creativity and critical thinking skills of students by offering adequate practice in professional contexts.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognise the words used in life science and improve their competence in using the language.	1	R
CO - 2	Comprehend unfamiliar texts and describe biological processes.	2	U
CO - 3	apply language for speaking and writing with confidence in an intelligible and acceptable manner.	3	Ap
CO - 4	apply critical and theoretical approaches to the reading and analysis of various texts in life sciences.	3	Ap
CO - 4	analyze critically, negotiate and present without committingerrors and develop entrepreneurship skills.	4	An

Unit I **Communication**

1. Listening to Audio Text & answering Questions
2. Pair Walk
3. Comprehension passage
4. Developing a story with pictures
5. Vocabulary

Unit II Description

1. Listening to Process Description – Online shopping
2. Speaking – Role play – sample 1
3. Reading Passages on Products

4. Process Description – Compare & Contrast

5. Vocabulary

Unit III **Negotiation Strategies**

1. Listening to interviews of specialists

2. Brainstorming (Mind mapping)

3. Economic System (Longer Reading Text)

4. Why learn the skill of writing an essay

5. Vocabulary

Unit IV **Presentation Skill**

1. Listening to Lecture – I

2. Short Talks – I

3. Reading comprehension – passage I

4. Writing Recommendations

5. Vocabulary

Unit V

Critical Thinking Skills

1. Listening Comprehension

2. Speaking – Making Presentation – Task 1 & 2

3. Reading – Comprehension Passages, Note making

4. Writing - Problem & Solution Essays, Creative writing

5. Vocabulary

Textbook

Tamil Nadu State Council for Higher Education (TANSCHE). Professional English for Life Sciences – I.

Semester I

NMEC I - Public Health and Hygiene

Course Code: ZNM201

No. of hours/week	No. of credits	Total number of hours	Marks
2	2	30	100

Learning Objectives

1. To understand the various aspects of health and hygiene and to practice a healthy life.
2. To develop skill for personal care and maternal health for the betterment of society.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	describe personal health with respect to skin, hair, eye, ear and teeth.	PSO - 1	R
CO - 2	explain the concepts of health and nutrition in relation tophysical, mental, social and spiritual fitness.	PSO - 1	U
CO - 3	analyse BMI and personal hygiene.	PSO - 3	An
CO - 4	evaluate food quality, housing standards and good sanitation.	PSO - 2	E
CO - 5	apply the knowledge of maternity, child health and SwachhBharat Mission.	PSO - 4	Ap

Unit I Nutrition and health: Concept of health. Food pyramid. Snacking and Fast food.BMI - obesity - malnutrition (Kwashiorkor and Marasmus). Food hygiene, food toxicants and adulterants.

Unit II Personal health care: General care of skin, hair, teeth, eye and ear. Personalhygiene. **Unit III Maternal and Child health:** Motherhood -pregnancy confirmation - commonproblemsduring pregnancy - labour and delivery - postnatal care. Vaccination schedule in India. Family planning.

Unit IV Environment and Health: Standards of housing. Sanitary health measuresduring fairs and festivals. Swachh Bharat Mission and Swachhata Hi Seva. Precautions during pandemic situations.

Unit V First aid: First aid procedures for dehydration, heart attack, poisoning, electricshocks, drowning, snake bite, road accidents and fire accidents.

Textbook

Sorna Raj, R., Kumaresan, V. (2012). Public Health and Hygiene**.** Nagercoil: Saras Publication.

Reference Books

1. Park, K. (2005). Park's Textbook of Preventive and Social Medicine (18th ed.).Jabalpur: M/S. Banarsidas Bhanot Publishers.
2. Lakshmana Sarma, K. & Swaminathan, S. (2011). Speaking of Nature Cure. NewDelhi: Sterling Publications Pvt. Ltd.
3. Hoon, R.S. (1983). First aid to the Injured. New Delhi: Published by St. JohnAmbulance Association, Printed at The Statesman‟s Press.
4. Rae Bains (1984). Health and hygiene. USA: Troll Associates Publisher.

Semester II

Major core II: Chordate Zoology

Course Code: ZC2021

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Learning Objectives

1. To impart knowledge on the systematic position, structure, functional rganization, adaptation and the economic importance of chordates.
2. To develop real time skills on identification of major groups of chordates to gain employment in academic and research institutions.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the systematic position and describe the biological significance of chordates.	PSO - 1	R
CO - 2	recognize different chordates based on their salient features.	PSO - 1	U
CO - 3	compare the morphology and anatomy of selected chordates.	PSO - 3	An
CO - 4	assess the structural, physiological, ecological and behavioural adaptations pertaining to their mode of life.	PSO - 2	E
CO - 5	design experiments to relate chordates with their environment.	PSO - 2	C
CO - 6	disseminate knowledge on chordates to excel in research and entrepreneurship initiatives.	PSO - 4	Ap

Unit I Introduction to Chordata: General characters of chordates and classification up to classes with names of examples. **Prochordata**: General characters and classification up to classes with examples. Type study: Amphioxus - external features, digestive system and excretory system. External features and biological significance of the following: Ascidian, Balanoglossus, Salpa.Agnatha: Petromyzon - externalmorphology, Ammocoeteslarva.

Unit II Pisces: General characters and classification up to subclasses with names of the examples. Type study: Scoliodon- external characters, placoid scales, digestive system, respiratory system, circulatory system, nervous system, receptor organs, urino-genital system. Accessoryrespiratory organs in fishes, Migration of fishes, Lungfishes - Dipnoi.

Unit III Amphibia: General characters and classification up to orders with names of the examples. Type study: Frog – external characters, endoskeleton: skull, typical vertebra, atlas, girdles and limbs. Biological significance of Axolotl larva, Ichthyophis.Parental care in Amphibia.**Reptilia:** General characters and classification up to orders with names of the examples only. Type study: Calotes – external characters, circulatory system and excretory system. Identification and study of poisonous snakes in India - first aid for snake bite and anti-venom.

Unit IV Aves: General characters and classification up to sub classes with names of the examples. Type study: Columba livia - external characters, exoskeleton, flight muscles, digestive system, respiratory system and urino-genital system. Migration of birds, flight adaptation in birds, flightless birds (Ratitae): general characters and examples.

Unit V **Mammalia:** General characters and classification up to subclasses with names of the examples. Type study: Rabbit - external morphology, structure of skin, dentition, digestivesystem, respiratory system, urinogenital system. Structure of heart and brain.Egg laying mammals. Pouched mammals.Adaptations of aquatic mammals.

Textbook

Jordan, E.L. and Verma, P.S. (2010). Chordate Zoology(11th ed.). New Delhi: S. Chand and Company Ltd.

Reference Books

1. EkambaranathaAyyar, M. and Ananthakrishnan, T.N. (1995).A Manual of Zoology, Volume II(PartI& II).Chennai: S. Viswanathan Pvt. Ltd.
2. Kotpal, R. L. (2014). Modern text book of Zoology – Vertebrates **(**3rd ed.). Meerut: RastogiPublications.
3. Dhami P.S and Dhami J.K. (1972).Chordate Zoology. New Delhi: S. Chand and Company Ltd.
4. Kardong, K. (2002). Vertebrates: Comparative Anatomy, Function and Evolution. Chennai: TataMcGraw Hill Publishing Company Ltd.
5. Young, J. Z. (2004). The Life of Vertebrates (3rd ed.). London: Oxford University Press.
6. Verma P.S. (2010).A manual of Practical Zoology (Chordates).New Delhi: S. Chand & Co.Ltd

Semester II

Major Practical I: Invertebrate Zoology & Chordate Zoology

Course Code: ZC20P1

(Conducted during Semester I & II)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

1. Objectives

1. To impart practical knowledge on morphology and anatomy of invertebrates and chordates.
2. To reinforce the basic laboratory skills including microscopy, dissection and observation of animal diversity.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the systematic position of selected invertebrates and chordates through observation of live and preserved specimens.	PSO - 1	R
CO - 2	describe the external morphology and biological significance of invertebrates and chordates.	PSO - 4	U
CO - 3	apply technical and creative skills through teamwork.	PSO - 3	Ap
CO - 4	analyse the different taxonomic groups based on anatomy and structural arrangements.	PSO - 2	An

Chordate Zoology

1. Mounting: Placoid, Cycloid and Ctenoid scales.
2. Fish: Digestive system
3. Frog: Arterial system*.
4. Frog: Brain*.
5. Frog: Urinogenital system*
6. Reptiles: Key for identification of poisonous and non-poisonous snakes.
7. Pigeon:
8. Identification of feathers.

9. Digestive system*

10. Respiratory system*

11. Submission of “Animal Album” containing photographs or paper cuttings of locally available chordates of different taxa with brief write-up.

12. Maintenance of campus Bird-watcher’s Diary (group work).

13. Field visit to places of Zoological importance.

14. Grouping of given chordate as per their systematic position.

* Models/ Chart/ CD can be used. Students have to draw the diagram and write detailedaccount in the observation notebook.

Museum specimens / slides / charts:

Amphioxus, Balanoglossus, Ascidian, Petromyzon, Ammocoetes larva, Narcine, Hippocampus, Anguilla, Rhacophorus, Axolotl larva, Ichthyophis, Salamander, Chamaeleon, Draco, Chelone, Cobra, Woodpecker, Pelican, Penguin, Pangolin, Kangaroo, Bat, Loris, Whale. Endoskeleton of Frog - typical vertebra, atlas, pectoral girdle, pelvic girdle, forelimb skeleton and hind limb skeleton.

Virtual laboratory / CD can be used as and when necessary.

Semester II

Allied Zoology: Applied Zoology

Course Code: CA2021

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To empower the students with the culture practices of economically important animals.
2. To enable the students to become an entrepreneur.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	recall the principles of api-, seri-, and aquaculture, poultry and dairy farming.	PSO - 1	R
CO - 2	explain the tools and techniques used in rearingpractices.	PSO - 3	U
CO - 3	practice the fundamental concepts of applied zoology in research and animal farms.	PSO - 3	Ap
CO - 4	inspect the quality of honey, silk, egg, milk and fish.	PSO - 2	An
CO - 5	evaluate the profitability of animal farms.	PSO - 4	E
CO - 6	extend the entrepreneurial skills in establishing animal farms.	PSO - 4	C

Unit I Apiculture: Classification and kinds of bees, bees and their society - caste distinctionand their functions. Food of honey bees.Beekeeping methods - primitive and modern. Honey bee products - honey, bee wax, bee venom. Common diseases -nosemosis, acariasis, bee septicemia and management.

Unit II **Sericulture:** Moriculture - methods of propagation - Common species of Silkworm - Life cycle of mulberry silkworm - egg, larva, pupa and adult. Rearing of silkworm -mounting, spinning, harvesting of cocoons, silk reeling and marketing. Common diseases - pebrine, grasserie, muscardine, flacherie and management

Unit III Aquaculture: Aquaculture in India - Important cultivable organisms and their qualities, culture of Indian major carps, Marine prawn culture, Pearl culture. Integratedfish culture - Paddy cum fish culture.Ornamental fish culture.Common diseases - Ichtyophthirius, Dropsy, Fin Rot soft shell syndrome and management.

Unit IV Poultry Farming: Poultry housing - types of poultry houses - management of chick, growers, layers and broilers. Sexing in chicks, Nutritive value of egg and flesh.Diseasesof poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis and management.

Unit V Dairy Farming: Breeds of Dairy animals - Establishment of a typical Dairy farm - Management of cow - Newborn, calf, Heifer, milking cow. Diseases - Mastitis,RinderPest, Foot and Mouth Disease and management. Nutritive value of milk.Pasteurization. Dairy products - Standard milk, skimmed milk, toned milk and fermented milk - curd, ghee, cheese.

Textbook

Arumugam, N., Murugan, T., Johnson Rajeshwar, J. & Ram Prabhu, R. (2011).

*Applied Zoology.*Nagercoil: Saras Publications.

Reference Books

1. Johnson, J. &Jeya Chandra, I. (2005). *Apiculture.*Marthandam: Olympic Grafix.
2. Ganga, G. &SulochanaChetty (1997). *An Introduction to Sericulture.* New Delhi:Oxford and IBH Publishing Co. Pvt. Ltd.
3. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. HitonePublications.
4. Santhanakumar, G. &Selvaraj, A.M. (2002). *Concepts of Aquaculture.*Nagercoil:Meenam Publications.
5. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
6. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.
7. Shukla, G.S. &Upadhyay, V.B. (1998). *Economic Zoology.* Jaipur: RastogiPublications.

Allied Zoology Practical: General Zoology & Applied Zoology

Course code: CA20P1

(Conducted during Semester III & IV)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To develop practical skills in basic concepts of biology.
2. To enhance practical skills on agro-based animal farms.

Course outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	recognize museum specimens, stages of cleavage, vital organs, genetic diseases of human and culturable organisms.	PSO - 1	R
CO - 2	explain the economic importance of animals, clinical procedures, dominant and recessive characters of humans.	PSO - 2	U
CO - 3	use the skills relevant to general and applied Zoology.	PSO - 3	Ap
CO - 4	analyse the clinical samples, nutritive value farms productsand water quality parameters.	PSO - 4	An

Applied Zoology

1. Identification of cells in the honey bee comb.
2. Mounting mouthparts of a mosquito.
3. Testing of purity of Honey in three different samples.
4. Dissection of silk gland of *Bombyxmori* (virtual).
5. Measurement of shell ratio of mulberry silk cocoon.
6. Testing milk using a lactometer.
7. Qualitative analysis of milk - Methylene reductase test.
8. Estimation of protein in hen’s egg.
9. Estimation of oxygen in water samples.
10. Estimation of salinity in water samples.

11. Spotters / Models / Charts / Bookplates

Honey bee - worker, queen and drone, Newton's bee-hive, silkworm - egg, larva, pupa and adult, Chandrika, Rearing stand, Poultry feeders, Fowl pox, Coccidiosis, dairy products – skimmed milk, curd, cheese, ghee, *Catla*, *Rohu*, *Mrigal*.

Virtual laboratory / CD can be used as and when necessary.

Part IV

Add on Course- Professional English for Physical Sciences-II

Course Code: APS202

Hours/ Week	Credit	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcomes

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligibleand acceptable manner	**PSO - 6**	Ap
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spellingor grammar	**PSO - 7**	An

Unit I Communication:

1. .Listening to instruction2.Small Group Work
2. Comprehension- Difference between facts & opinions
3. Developing a short poem with pictures
4. Vocabulary

Unit II Description:

1. Listening to Process Description - Cartographic Process2.Speaking – Role play – sample
2. Reading Passages on Equipments& gadgets
3. Paragraph: Sentence Definition & Extended Definition, Free writing
4. Vocabulary

Unit III Negotiation Strategies:

1. Listening to interviews of inventors in fields
2. .Small Group Discussion – Specific.Longer reading text –The Art of Loving
3. .Essay Writing – Solidarity
4. Vocabulary

Unit IV Presentation Skill:

1. Listening to Lecture – 2
2. Short Talks – Poverty and the need to alleviate it
3. Reading comprehension – passage 2
4. Interpreting Visual Inputs
5. Vocabulary

Unit V Critical Thinking Skills:

1. .Listening for Information

2. .Making Presentation task

3. Motivational Articles on Professional Competence, Professional Ethics &
4. Life SkillProblem & Solution Essays, Summary Writing
5. .Vocabulary

Reference Book

1. TANSCHE (2020).Professional English for Physical Sciences, First edition

NMEC II: Common Ailments and Simple Remedies

Course Code: ZNM202

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Learning Objectives

1. To create awareness on the changing lifestyle and its impact on human health.
2. To develop skills on disease management to form a healthy society.

Course outcomes

CO	Upon completion of this course the students will beable to:	PSO addressed	CL
CO - 1	enumerate the symptoms of common diseases.	PSO - 1	R
CO - 2	summarise common health problems like anaemia, diabetes, skin and dental problems and old age ailments.	PSO - 1	U
CO - 3	apply preventive strategies to develop healthy society.	PSO - 3	Ap
CO - 4	analyse the problems of changing lifestyle and its impacton human health.	PSO - 4	An
CO - 5	evaluate the simple remedies for common ailments.	PSO - 2	E

Unit I Blood related ailments: causes, symptoms and control of anaemia, blood pressure, diabetes and jaundice.

Unit II Digestive disorders: causes, symptoms and control of dental caries and pyorrhea,typhoid, diarrhea and chronic constipation.

Unit III Respiratory diseases: causes, symptoms and control of common cold, cough, primary complex, asthma and headache.

Unit IV Vector borne diseases: causes, symptoms and control of dengue fever, malaria and epidemic conjunctivitis.

Unit V Old age related ailments: causes, symptoms and treatments of osteoporosis, Parkinson's disease, Alzheimer's disease and arthritis.

Textbook

John M. Fowler (1970). Radiant Living. Pune: Oriental Watchman Publishing House.

Reference Books

1. Chugh, S.N. (2006). Emergency Medicine (2nd ed.). India: PeePee Publishers and Distributors Pvt. Ltd.
2. Clifford R. Anderson (1999). Your Guide to Health. Pune: Oriental WatchmanPublishing House.
3. Chawla, N.P.S. (1994). Penguin India Family Medical Encyclopaedia.New Delhi: Penguin Book Publication.
4. ValantineFuster, R. & Wayne Alexander (2001). The Heart (10th ed.). USA: McGraw-Hill Publications.
5. Anne McIntyre (1994). Simple Home Remedies for Common Ailments. USA: Gaia Books Publisher.

Semester III

Major core III: Cell Biology

Course Code: ZC2031

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To give a perception on the general structure and functions of cellular organelles.
2. To develop skills on microscopy and cytological techniques.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the types of microscope, cell, cell organellesand cell division.	PSO - 1	R
CO - 2	outline the role of cell organelles, nucleic acid andtheir interactions.	PSO - 4	U
CO - 3	apply knowledge in cellular research using cytological and modern techniques.	PSO - 3	Ap
CO - 4	differentiate cell types, chromosomes, cell stages,normal and abnormal cells.	PSO - 2	An

Unit I **Cell, Microscope and microtechniques**: Cell theory. Prokaryotic and eukaryotic cells. Cytological techniques - Fixation, sectioning and staining. Microscopy – Resolving power and uses of Compound, Phase contrast and electron microscope.Micrometry.

Unit II **Plasma membrane & Cell organelles**: Ultrastructure and functions of Plasma membrane, mitochondria, Ribosomes, Endoplasmic reticulum, Golgi complex, lysosomes, centrosomes.

Unit III **Nucleus and nucleic acids**: Ultrastructure and functions of nucleus and nucleolus. Chromosomes - types, structure, giant chromosomes. Nucleic acids – structure, types and functions. Nucleosomes.DNA replication in prokaryotes.

Unit IV **Gene expression and regulation**: Characteristics of Genetic code. Fine structure of gene. Protein synthesis in prokaryotes - transcription and translation. Regulation of gene expression - Lac operon.

Unit V **Cell division and significance:** Cell cycle, Mitosis, Meiosis, Regulation of cellcycle cdk dependent. Cancer - properties, types, diagnosis and treatment. Proto- oncogenes, Oncogenes, tumour suppressor genes. Ageing and apoptosis.

Textbook

Powar, C.B. (2013). *Cell Biology*. Bombay: Himalaya Publishing House.

Reference Books

1. Verma, P.S. &Agarwal, V.K. (2016).*Cell Biology* (*Cytology, Biomolecules and Molecular Biology*). New Delhi: S Chand and Company Ltd .
2. De Robertis, E. M. F. (2011). *Cell Biology* (8th ed.). New York: Lippincott Williams & Wilkins Publication.
3. Arumugam, N. (2015). *Cell Biology*.Nagercoil: Saras Publications.
4. Singh, S.P. &Tomar, B.S. (2014). *Cell Biology* (10th ed.). New Delhi: Rastogi Publications.
5. Rastogi, S.C. (2008). *Cell Biology* (2nd ed.). New Delhi: New Age International (P) Limited Publishers.
6. Prakash S. Lohar (2009). *Cell and Molecular Biology*, (5th ed.). Chennai: MJPPublishers.

Semester III
Major Elective I: (a) Biochemistry, Biophysics and Biostatistics
Course Code: ZC2032

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To enrich the knowledge of students on the structure, classification andmetabolism of biomolecules and to learn the principle and functions of specified bio-instruments.
2. To enlighten students on the nature of life and basic methods in statistics to be used in future biological research.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the structure of atoms, biomolecules, bioinstruments,and biological data.	PSO - 1	R
CO - 2	describe the interactions of biomolecules; importance of buffer systems, enzymes, light, bioinstrumentation andcollection of biological data.	PSO - 2	U
CO - 3	apply basic scientific methods and analysis in the fields of biochemistry, biophysics and biostatistics.	PSO - 3	Ap
CO - 4	classify biological macromolecules, the techniques used inbiological study, and analyse biological data using appropriate statistical methods.	PSO - 3	An
CO - 5	evaluate the significance of biomolecules, principle of bioinstruments, statistical concepts.	PSO - 4	E

Unit I **Bonds, Buffers and Protein:** Atoms - Isotopes- Chemical bonds - Hydrogen ion concentration – pH and its measurement. Acids and bases – Acidosis and alkalosis. Buffers - Biological buffer systems - Significance of buffers. Proteins – Classification, structure and biologicalfunctions.Enzymes - Classification and properties.

Unit II **Carbohydrates and Lipids:** Carbohydrates - classification, Monosaccharaides –glucose, Disaccharides - lactose, Polysaccharides - glycogen, biological functions of carbohydrates. Lipids - classification, simple lipids - waxes, Compound lipids – lecithin, Derived lipids - cholesterol, biological functions of lipids**.**

Unit III **Light and Separation Techniques:** Nature and properties - electromagnetic spectrum - Absorption and Emission spectrum, Fluorescence and Phosphorescence.Colorimeter and spectrophotometer - principle, instrumentationand application. Centrifuge -principles, types and applications. Chromatography- principle and applications of paper and column chromatography.

Unit IV **Introduction to Biostatistics:** Population, Data, Sample and variable. Collectionof data - sampling methods. Processing of data - classification and tabulation. Presentation of data - Diagrams and graphs.

Unit V **Statistical Methods:** Measures of central tendency -Mean, Median, Mode, Dispersion - standard deviation and standard error. Probability - apriori andaposteriori. Test of significance: Chi square test and Student's 't' - test.

Textbooks

1. Annie &Arumugam, N. (2015). *Biochemistry and Biophysics*.Nagercoil: Saras Publications.
2. Arumugam, N. (2011). *Basic concepts of Biostatistics*.Nagercoil: Saras Publications.
3. ***Reference Books***
4. Jain J.L., Sunjay Jain &Nitin Jain (2007). *Fundamentals of Biochemistry* (6th ed.). New Delhi: S. Chand and Company Ltd.
5. Satyanarayana, V. (2005). *Essentials of Biochemistry*. Calcutta: Books and Allied (P)Ltd.
6. Narayanan, P. (2000). *Essentials of Biophysics.*New Delhi: New Age International Publishers.
7. Daniel, M. (2000). *Biophysics for Biologists.*New Delhi: Agrobios.
8. Pranav Kumar (2016). *Fundamentals and Techniques of Biophysics and Molecular Biology.*New Delhi: Pathfinder Publications.
9. VasanthaPattabhi& N. Gautham (2002).*Biophysics*. New Delhi: Narosa Publishing House.
10. Ramakrishnan, P. (2015). *Biostatistics.*Nagercoil: Saras Publications. 8. Pranab Kumar Banerjee (2005). *An Introduction to Biostatistics.*New Delhi: S. Chand andCompany Ltd.
11. Gurumani, N. (2005). *An Introduction to Biostatistics.*Chennai: MJP Publishers

Semester III
Major Elective I: (b) Bioinformatics
Course code: ZC2033

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To create awareness about bioinformatics databases, databanks and data format, data retrieval from the online sources.
2. To develop the basic skills of data browsing as a strong foundation for performing research**.**

Course Outcomes

CO	Upon completion of this course the students will beable to:	PSO addressed	CL
CO - 1	describe the computer programming languages, biological databases, search engines, sequence alignment.	PSO - 1	R
CO - 2	differentiate internet, World Wide Web, search engines, databases and bioinformatics search engines.	PSO - 2	U
CO - 3	retrieve nucleotide, protein sequences using bioinformatics tools.	PSO - 3	Ap
CO - 4	analyse the similarity between different sequences using pairwise and multiple alignment tools.	PSO - 4	An
CO - 5	evaluate the phylogeny of organisms using bioinformatics tools.	PSO - 3	E
CO - 6	design drugs through data mining.	PSO - 2	C

Unit I **Introduction to bioinformatics:** Bioinformatics – Scope and applications. Biological Databases - Nucleic acid databases - NCBI, EMBL. Protein databases – Primary and Secondary. Specialized Genome databases – SGD and TIGR. Structure databases - CATH, SCOP and PDBsum. File Format - Genbank, DDBJ, FASTA, and SwissProt.

Unit II Sequence Alignments: Multiple alignment programs.Pairwise alignment - BLAST and FASTA Algorithm. Gene identification - sequence based gene prediction and molecular pathways.

Unit III Multiple Sequence Alignment: Programs, Phylogenetic Analysis - Concept of dendrograms, Strings and Evolutionary trees, Methods of Construction of Phylogenetic trees- Maximum Parsimony Method, Maximum likelihood method and Distance Methods, Reliability of trees.

Unit IV **Genomics and proteomics:** Introduction to Medline, PubMed, OMIM. Basic conceptsof Genomics and proteomics, Data mining, 3D structure viewers - Rasmol, SPDBv, Chime, Cn3D, PyMol and Anatomical visualization.

Unit V **Gene mapping and applications:** Genome assembly and annotation - Prediction of Genes, Promoters, Splice sites, Next Generation Sequencing.

Textbook

Rastogi, S. C. Mendiratta, N. &Rastogi, P. (2011).*Bioinformatics*.New Delhi: PHI Learning Private Limited.

Reference Books

1. Stuart M. Brown (2013). *Next-Generation DNA Sequencing Informatics.* New York: CSHL Press.
2. Martina Bremer and Rebecca W. Doerge (2015).*Using R at the Bench: Step-by-StepData Analytics for Biologists*. New York:CSHL Press.
3. David Mount (2004). *Bioinformatics: Sequence and Genome Analysis* (2nded.). NewYork: CSHL Press.
4. Attwood, T.K. & Parry-Smith, D.J. (2006). *Introduction to Bioinformatics*. Delhi:Dorling Kindersley Publication.
5. Gladis Helen Hepsyba, S. &Hemalatha, C.R. (2009).*Basic Bioinformatics.* Chennai:MJP Publishers.
6. John De Britto, A. (2011).*Bioinformatics*.Sivakasi: Anto Art Craft Printers.
7. Sundaralingam, R. &Kumaresan, V. (2008). *Bioinformatics*.Nagercoil: SarasPublication.
8. Jin Xiong (2006). *Essential Bioinformatics.* UK: Cambridge University Press.
9. Hooman H. Rashidi& Lukas K. Buehler (2000).*Bioinformatics Basics: Application in Biological Science and Medicine.* New York: CRC Press.
10. Mohan Bansal, A.S. (2003). *Medical Informatics – A primer.* New Delhi: TataMcGraw-Hill Publishing Company Ltd.

Semester III

Major Elective I: (c) Wildlife Biology

Course Code: ZC2034

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To familiarize the behaviour and conservation of wild animals and techniques of census.
2. To develop skills for pursuing higher studies and competence in wildlife conservation strategies.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify wild life, their habitat, behavior and conflict with man.	PSO - 1	R
CO - 2	interrelate human-wildlife conflict and its conservation.	PSO - 2	U
CO - 3	apply census techniques and conservation methods.	PSO - 3	Ap
CO - 4	survey wildlife and related natural resources.	PSO - 4	An

Unit I **Importance of wildlife and Forestry:** Wildlife: Scope - Causes of wildlife depletion, Economic importance and conservation. Forest types in India- identification, deforestation and impacts, afforestation - agro- and social forestry. Seed technology - collection, storage, pretreatment and germination.

Unit II Behaviour of wildlife: Instinctive behaviour – learning – imprinting - habituation. Analysis of behaviour pattern - taxis, kinesis and reflexes - types of animal communications - courtship, display, sexual selection and parental care in mammals and birds- Social behaviour in animals –elephants, monkeys, hyenas and wild buffalo.

Unit III Wildlife census techniques: Planning census – sample counts – direct count - total counts, drive count, roadside count, transect methods, Point counts, pellet count, camera trap, visual encounter survey, waterhole survey. Indirect count - call count, track and signs, pugmark,

The king strip method, sight and resight method. Identifying animals based on indirect signs, Capture-recapture techniques.

Unit IV **Human-wildlife conflicts:** ***Human-elephant, bear, tiger, bison, monkey and crocodile conflict, reasons for conflicts, Identification of damages and control measures. Translocation of wild animals – principles, methods and applications.Wildlife crimes-Wildlife forensics and its applications in detecting wildlife crimes.***

Unit V **Conservation of wildlife: in-situ and ex-situ conservation.** Zoos and Zoological Parks

- formation and management - Central Zoo Authority of India, Captive breeding - aims, principles, methods - role of Government and Non-Government organizations in conservation. Wildlife Projects - Tiger, Elephant, Lion and Kashmir stag.

Textbooks

Goutam Kumar Saha &SubhenduMazumdar (2017). *Wildlife Biology: An Indian Perspective*. New Delhi: PHI Learning Pvt. Ltd.

Singh, S.K (2015). *Textbook of wildlife management* (2nd ed.). Delhi: CBS Publishers and Distributors Pvt. Ltd.

Reference Books/ Website

1. TajRawat (2012). *Biodiversity Conservation and Wildlife Tourism*. Delhi: Discovery Publishing House Pvt. Ltd.
2. Kumar, U. &Asija, M.J. (2007). *Biodiversity - Principle and Conservation* (2nd ed.). Jodhpur: Student Editors.
3. SeshadiriBalakrishnan, (1969). *The Twilight of India's Wildlife*. Chennai: Oxford University Press.
4. Gee, E.P. (1969). *Wildlife in India* (1sted.). London: Collins Foundation Books.
5. Anthony R.E. Sinclair, John M. Fryxell& Graeme Caughley (2006). *Wildlife Ecology, Conservation, and Management* (2nd ed.). USA: Blackwell Publishing.

1. https://www.iaszoology.com/wildlife-management-conservation/
2. http://web.mnstate.edu/stockram/WildlifeEcol/wildlife_ecology.htm

Semester III

Allied Zoology: General Zoology

Course Code: ZA2031

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on Animal diversity, Cell Biology, Genetics,Developmental Biology, Evolution and Physiology.
2. To instill interdisciplinary skills for availing employment opportunities.

Course outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO – 1	recall the classification of animals, cells, genetic disorders in man, development of frog, structure and function of vital organs.	PSO – 1	R
CO – 2	outline the diversity of animal forms and their cellular organization, genetic makeup, evolution and physiology.	PSO – 1	U
CO – 3	correlate the physiological processes of animals and relationshipof organs system, inheritance of characters.	PSO - 3	Ap
CO – 4	recognize the major functions of organ systems in the human body and the role played by animals and evolution of animal life.	PSO – 2	An
CO – 5	evaluate the characters, functions and genetics of diverse animals.	PSO – 4	E

Unit I Invertebrate Zoology: General characters of Invertebrates – classification up to phylum with two examples for each. Paramecium – external features, conjugation. Obelia – external features, polymorphism. Ascaris- external features, parasitic adaptations. Penaeus – external features. Starfish – external features, water vascular system.

Unit II Chordate Zoology: General characters of chordates - outline classification up to classes with one example. Migration of fishes.Identification of poisonous and non-poisonous snakes, first-aid for snake bite.Flight adaptations in birds. Rabbit – external characters. Dentition in human.

Unit III Cytogenetics: Difference between plant and animal cells. Chromosomes - structure - types and function. Human - Simple Mendelian traits, Genetics of blood groups, sex linked

inheritance - colour blindness and haemophilia, Non-disjunction - Klinefelter's, Turner's and **Down's syndrome.**

Unit IV Developmental Zoology and Evolution: Frog - structure of sperm and ovum - fertilization. Early development in frog - cleavage, blastulation and gastrulation.Biochemical origin of life - Urey Miller Experiment, Natural selection theory and Modern synthetic theory of evolution.

Unit V Human Physiology: Digestion – structure and functions of the digestive system. Respiration - structure and functions of lungs. Circulation - structure and function of the heart. Excretion - structure and functions of kidney.

Textbook

Arumugam, N. (2011). Allied Zoology, Vol.I to III.Nagercoil: Saras Publications.

Reference Books

1. EkambaranathaAyyer, M.A. (1986).*Manual of Zoology*Vol.I& II. Chennai:
2. S. Viswanathan Printers and Publishers Pvt. Ltd.
3. Jordan, E.L. and Verma, P.S. (1988). *Chordate Zoology* New Delhi: S. Chand and Co. Ltd.
4. Kotpal, R.L. (2004). *Modern Text Book of Zoology – Invertebrates* (9th ed.). Meerut: Rastogi Publications.
5. Kotpal, R.L. (2004). *Vertebrates.* Meerut: Rastogi Publications.
6. Nagabhushanam, R., Kodarkar, M.S. and Sarogini, R. (1982). *Textbook of Animal Physiology* (2nd ed.). New Delhi: Oxford and IBH Publishing Co. Pvt.
7. Ltd.
8. Verma, P.S. &Agarwal, V.K. (2003). *Chordate embryology* (10th ed.). New Delhi: S. Chand and Co. Ltd.
9. Rastogi, V.B. &Jayaraj, M.S. (2000). *Textbook of Genetics*. Meerut: KedarnathRamnath Publishers.
10. Verma, P.S. &Agarwal, V.K. (2010). *Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology.* New Delhi: S. Chand & Co.

Semester III / V

UG Self Learning Course: Ornamental Fish Culture

Course Code: ZC20S1

No. of Credits	Marks
2	100

Objectives

1. To learn the culture techniques of aquarium fishes.
2. To develop skills in ornamental fish culture so as to enable the students to become an entrepreneur.

Course Outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	choose materials necessary for setting an aquarium, accessories, popular ornamental fishes, feed, anesthetics and diseases.	PSO - 1	R
CO - 2	demonstrate the construction of fish tanks, culture techniques and feed preparation.	PSO - 2	U
CO - 3	establish and maintain an aquarium for commercialization.	PSO - 4	Ap
CO - 4	analyse the types of tanks, physico-chemical parameters and feed relevant for ornamental fishes.	PSO - 3	An

Unit I Construction of fish tanks: Scope of ornamental fish culture. Fish tanks - Seating thetank – ornamental fish tank as a biological filter.Setting up of tanks - bottom gravel, planting with plants, filling with water, maintenance of water quality, stocking of fishes.

Unit II Accessories for fish tanks: hood and light source – nets – suction tube – scraper tool – aerator – lights – filters – Underwater bottom filter - Under gravel filter – Poly foam filter – Overhead trickle purification system (OTP) - Filter with activated charcoal (Carbon filter) - filtration. Aquarium plants - Floating, rooted and submerged.

Unit III Popular ornamental fishes: Ornamental fishes - Egg laying fishes (Zebra fish, Gold fish, Barbs, Gourami, Fighter), Live bearing fishes (Guppies, Mollies, Platys and Swordtails). Breeding methods in egg layers - Breeding of live bearing ornamental fishes - Culture techniques – Stocking tank. ingredients and feed formulations, Feeding, Balanced diet for aquarium fishes, Holiday or vacation feed.

Unit IV

Food and feeding:

Live feed organisms and culture – Cyclops, Tubifex, Brine shrimp (*Artemia*), Cladoceran (*Daphnia*), Blood worm (*Chironomus* larva). Artificial feeds - feed ingredients and feed formulations, Feeding, Balanced diet for aquarium fishes, Holiday or vacation feed.

Unit V Transport and diseases management: Transport of fishes - Oxygen packing, Anesthetics used in fish transport, Mechanism of action of anesthetics, Transport of export consignment, Preparing of fishes, Methods of sedation, Role of Carbonic acid and Tertiary butyl alcohol. Diseases and treatment methods – Protozoan, Fungal, Bacterial, Viral, Ectoparasites and endoparasites.Economics of commercial farming.

Textbook

Jameson, J.D. &Santhanam, R. (1996).*Manual of Ornamental fishes and Farming Technologies.*Thoothukudi: Fisheries College and Research Institute.

Reference Books

1. Butcher, L. (1992).*Manual of Ornamental Fish.* Gloucestershire: British Small Animal Veterinary Association Publications.
2. Jameson, J.D., Srinivasan, A. &Venkataramanujam (1995). *Ornamental Fish Culture Technology*. Chennai: TANUVAS Publications.
3. Hawkins, A.D. (1981). *Aquarium Systems*. New York: Academic Press.
4. KishoriLalTekriwal& Andrew ArunavaRao (1999).*Ornamental Aquarium Fish ofIndia*. England: Kingdom Books.
5. Dawes, J.A. (1984). *The*
6. *Freshwater Aquarium.* London: Roberts Royee Ltd.

Semester III

Add on Course: Professional English for Life Sciences

Course Code: ALS203

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To enhance the creative and academic writing skills and workplace communication.
2. To develop competence and competitiveness and thereby improve the employabilityskills and life-long learning.

Course Outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	define concepts related to communicative and digital competence.	1	R
CO - 2	illustrate academic writing and creativity in digital media.	2	U
CO - 3	apply communicative skills with digital competence in the workplace.	3	Ap
CO - 4	analyse a variety of formats, including essays, researchpapers, reflective writing, and critical reviews of life sciences.	4	An
CO - 5	analyze lectures, scripts, blogs, e-content and short films related to biology.	4	An

Unit I Communicative Competence

Listening – Answering comprehension exercises Speaking – Reading passages – open ended questions

Reading – One subject based reading of text followed by comprehension activities /exercises

Writing – Summary writing based on the reading passages (semi-guided)

Unit II Persuasive Communication Listening – Announcement Speaking – Just a minute activitiesReading – Analyzing Ads

Writing – Dialogue writing

Unit III Digital Competence

Listening – Listening to interviews (subject based)

Speaking – Interview with subject teachers / professionals (using video conferencingskills)

Reading – Selected sample of web pageWriting – Creating web pages

Reading Comprehension – Essay on Digital competence for academic andprofessional life

Unit IV Creativity and Imagination

Listening – General videos (lifestyle and values)Speaking – Movie review, book review

Writing – Poster making – writing slogans / captions (subject based) Reading – Essay on creativity and imagination

Unit V Workplace Communication & Basics of Academic Writing

Speaking – Presentation using PowerPoint

Reading / Writing – Circulars, minutes of meeting, paraphrasing

Textbook

Tamil Nadu State Council for Higher Education (TANSCHE).Professional English for Life Sciences – II.

Semester IV

Major Core IV: Genetics

Course Code: ZC2041

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To enable the students to understand the basic principles of inheritance and population genetics.
2. To enhance skills to interpret hereditary, mutation and syndromes and extend genetic counseling to society.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	Recall the key concepts of heredity, population genetics, karyotyping and genetic counselling.	PSO - 1	R
CO - 2	Describe Mendelian, polygenic and cytoplasmic inheritance, chromosome mapping, nondisjunction, gene frequency and eugenics.	PSO - 1	U
CO - 3	apply the principles of heredity to real life situations.	PSO - 2	Ap
CO - 4	execute and analyze the results of genetic experimentation in animal and plant models.	PSO - 3	An
CO - 5	evaluate the genetic data of a population.	PSO - 4	E

Unit I ***(12 hrs.)***

Mendelian inheritance

- Monohybrid and dihybrid - back cross and test cross. Complete, incomplete and codominance. Interactions of genes: Complementary genes-flower colour in sweet pea, Supplementary genes – inheritance of comb in fowl, Epistasis – inheritance of colour pattern in poultry and coat colour in mice, Lethal genes-sickle cell anemia. Polygenic inheritance - Skin colour in man, Multiple alleles: ABOblood group in man, Rh factor in man, coat colour in rabbit.

Unit II ***(12 hrs.)***

Chromosome mapping and Syndromes: Linkage – types, groups and theories.Crossing over - mechanism, theories, cytological evidence - Stern's experiment and Tetrad analysis, significance. Chromosome map - two point and three point cross, construction of chromosome map.Sex determination in man and Drosophila.Nondisjunction - Primary and secondary nondisjunction in *Drosophila*. Syndromes in man: Turner's, Klinefelter's and Down syndrome.

Unit III ***(12 hrs.)***

Cytoplasmic inheritance and Mutation: Cytoplasmic inheritance - Kappa particles in *Paramecium,* milk factor in mice, shell coiling in *Limnaea*. DNA as genetic material - Bacterial transformation, conjugation, F- factor and transduction. Mutation: Chromosomal mutation - changes in structure and number, aneuploidy and euploidy, Gene mutation - mutagens. DNA repair mechanisms.

Unit IV ***(12 hrs.)***

Human chromosomes and genetic diseases: autosomes and allosomes – Karyotype and idiogram. Simple Mendelian traits in man. Twins - types, development and application. Inborn errors of metabolism - Phenylketonuria, Alkaptonuria, Albinism. Sex-linked genes and their inheritance - X-linked genes - Colour blindness and Haemophilia, Y-linked genes - holandric genes.

Unit V ***(12 hrs.)***

Population genetics: Hardy Weinberg equilibrium – calculation of gene frequency – factors affecting gene frequency – selection, mutation, genetic drift and migration. Inbreeding, out breeding and heterosis.Eugenics, Euthenics and Euphenics.Pedigree analysis. Genetic prognosis - Genetic counselling.

Textbook

Meyyan, R. P. (2011). *Genetics.*Nagercoil: Saras Publications.

Reference Books

1. Verma, P.S. &Agarwal, V.K. (2009). *Genetics,* Revised ed. New Delhi: S. Chand &Co.
2. Peter Snustad, D. & Michael J. Simmons (2010). *Principles of Genetics* (2nd ed.). USA: John Wiley and Sons.
3. Chatterjee, S. (2009).*Genetics.* New Delhi: APH Publishing Corporation.
4. Singh, B.D. (2008). *Fundamentals of Genetics* (4th ed.). Ludhiana: Kalyani Publishers.
5. Gardner, Simmons &Snustad (2006). *Principles of Genetics* (8th ed.). USA: JohnWiley & Sons.
6. Ahluwalia, K.B. (2009). *Genetics* (2nd ed.). New Delhi: New Age International

Semester IV

Major Elective II: (a) Clinical Laboratory Technology

Course Code: ZC2042

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on the laboratory techniques adopted in clinical laboratories.
2. To develop skills for gaining employability in hospitals and research laboratories.

Course outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	describe the laboratory principles applied in diagnosis of disease.	PSO - 1	R
CO - 2	classify the clinical specimens and use appropriate laboratory protocol.	PSO - 2	U
CO - 3	prepare reagents, handle instruments, perform clinicalanalysis and validate the results.	PSO - 3	Ap
CO - 4	develop skills necessary for higher studies or placement in clinical laboratories.	PSO - 4	An

Unit I ***(12 hrs.)***

Essential pre-requisites of a Clinical Laboratory: Safety measures and first aid in the laboratory. Sterilization – physical and chemical methods. Preparation of Normal, Molar and Percentage solution.Biomedical waste management.

Unit II ***(12 hrs.)***

Laboratory Instruments and their applications: Microscope, Balance, pH meter, Colorimeter, Autoanalyser, Centrifuge, Incubator, Water bath, Haemocytometer, Sahli's haemoglobinometer.

Unit III ***(12 hrs.)***

Clinical Haematology: Collection of blood - Venous and capillary, Blood grouping, Separation of plasma and serum, Blood cell count – Total count and differential count, Haemoglobin estimation by Sahli's method, Erythrocyte sedimentation rate (ESR). Analysis of blood glucose, serum creatinine, alkaline phosphatase, cholesterol, High density lipid (HDL) and low density lipid (LDL), Triglycerides.

Unit IV ***(12 hrs.)***

Examination of sputum and body fluids: Collection, Physical, chemical and microscopic examination of cerebrospinal fluid and sputum. Serous fluid - pleural, pericardial and peritoneal, Synovial fluid.

Unit V ***(12 hrs.)***

Urine and Stool Analysis: Urine – collection, composition, volume, colour and transparency. Analysis of urine for glucose, albumin, bilirubin, urobilinogen and ketone. Microscopic examination for bacteria, organized and unorganized deposits andblood. Pregnancy test. Stool - collection, types, microscopic examination - identificationof intestinal parasites using saline wet mount – faecal blood occult blood.

Textbook

Rajan, S. (2012). *Manual for Medical Laboratory and Technology* (1st ed.). Chennai: Anjanaa Book House.

Reference Books

1. Kanai, L. Mukherjee (2005). *Medical Laboratory Technology, A procedure manual for routine diagnostic tests*, Vol I, II & III (19th ed.). New Delhi: Tata McGraw - Hill Publishing Company Ltd.
2. John Bernard Henry (2001). *Clinical diagnosis and management by laboratory Methods* (20th ed.). Philadelphia: Saunders & Co.
3. RamnikSood, M.D. (2003). *Medical Laboratory Technology, Methods and Interpretation* (4th ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.
4. Mary Vijaya, T., Mini, M.L., SunithaKumari, K., Asha, K.R.T. (2003).*PracticalClinical Biochemistry Manual*.Kaliakkavilai: Rishi Publications.
5. Himadri Panda (2019). *Biomedical Waste Management, Recycling and Applications*
6. (1st ed.). India: Discovery Publishing

Semester IV

Major Elective: (b) - Animal Care and Services

Course Code: ZC2043

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on care and management of domestic, pet and laboratoryanimals.
2. To develop skills on animal care services.

Course Outcomes

CO	Upon completion of this course the students will beable to:	PSO addressed	CL
CO - 1	recall animal breeds and their management practices.	PSO - 1	R
CO - 2	explain the nutritional requirement and maintenance of domestic, laboratory and pet animals.	PSO - 1	U
CO - 3	apply animal care skills in farm practices and research laboratories.	PSO - 2	Ap
CO - 4	analyze the general management of domestic, pet and laboratory animals.	PSO - 3	An
CO - 5	assess the prophylactic measures against commondisease of domestic, pet and laboratory animals.	PSO - 4	E

Unit I **(12 hrs.)**

Animal care: Care of common breeds of cattle – cow, goat, domestic animals – hen and duck, pet animals - dog and love birds, laboratory animals – rabbit and guinea pig.

Unit II **(12 hrs.)**

Nutrition: Feeds and fodders - livestock, pet, laboratory animals - feeding schedule - feed additives, silage making. Diet formulation for newborn, growing, pregnant, lactating and sick animals.

Unit III **(12 hrs.)**

Reproduction: Domestic animals – pregnancy diagnosis, gestation, functional infertility, anestrous, repeat breeding in farm animals. Parturition, Care and management of newborn. Routine management practices for calves, heifers, pregnant and lactating animals.

Unit IV **(12 hrs.)**

Epidemiology and Public Health: Common zoonoses and their management. Disposal of cadaver and clinical waste.Guidelines for control of contagious diseases and infectious diseases.Notifiable diseases and disease outbreaks.Prevention of crueltyto animals.

Unit V **(12 hrs.)**

Wounds Management and Care Services: Wound - causes, classification, drainage - wound dressings and wound protection. Clinical use of antiseptics, fly repellents and anti-maggot. First aid - sick animals and fracture cases.

Textbook

Sastry, NSR and Thomas, (2017).*Livestock Production Management*, Chennai: KalyaniPublisher

Reference Books

1. William C. Skelley (2011). *Beef Cattle Management - With Information on Selection, Care, feeding and Fattening of Beef Cows and Bulls.*England: Cooper Press
2. Roberts Morris H Jr. (2013). *Feeding and Management of Dairy Cattle for Official Production.*New York: Franklin Classics.
3. John Webster. (2013). *Animal Husbandry Regained: The Place of Farm Animals in Sustainable Agriculture.*New York: Routledge.
4. Richard O. Kellems& David C. Church (2002).*Livestock Feeds and Feeding.* N.J.: Prentice Hall.
5. JannHau, Steven J. Schapiro & Boca Raton (2010). *Handbook of Laboratory Animal Science*. FL: CRC Press.
6. Wilson G. Pond & Kevin R. Pond (2000).*Introduction to Animal Science*. New York: Wiley.
7. Mathialagan. P. (2007).*Textbook of Animal Husbandry & Livestock Extension*.Lucknow: International Book Distributing Co.

Semester IV

Major Elective II: (c) - Entomology

Course code: ZC2044

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To enable the students to gain knowledge about insect diversity, structure and functions of organ system, importance of beneficial insects, pest of cultivable cropsand their control measures.
2. To develop skills to identify and differentiate crop pests, productive insects, and their management.

Course Outcome

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	identify locally available insects, the pests of crops, stored products and medical importance.	PSO - 1	R
CO - 2	interrelate the salient features of insect orders and utility value of various productive and beneficial insects.	PSO - 1	U
CO - 3	apply various methods of pest management in the fields of agriculture and research.	PSO - 4	Ap
CO - 4	analyse the morphology and physiology of insect pests and suggest appropriate control measures .	PSO - 2	An
CO - 5	appraise the culture of productive and beneficial insects.	PSO - 3	E

Unit I **(12 hrs.)**

Classification and morphology of Insects: Outline classification of class Insecta up to orders. Morphology - structure and modification – head, types of mouthparts and antennae; thorax and its appendages; abdomen, segmentation of appendages andgenitalia.

Unit II **(12 hrs.)**

Anatomy and physiology: Integument, digestive, circulatory, respiratory, excretory, nervous and reproductive system. Special organs.Endocrine gland, Role of hormones -moulting, growth, metamorphosis and diapause.

Unit III **(12 hrs.)**

Pest of agriculture and Insects of medical important: Symptoms and management of pests ofrice– *Nilaparvatalugens* and *Leptocorisaacuta*, brinjal– *Leucinodesorbonalis,* tomato– *elicoverpaarmigera*and *Spodopteralitur*a, banana -*Cosmopolites sordidus.*Pest of Stored grains *Callosobruchus chinensis* and *Sitophilus oryzae.* Pest of medical importance – mosquitoes and head louse.

Unit IV **(12 hrs.)**

Productive and Beneficial insects: Bionomics and economic importance of Silkworms, Honeybee and Lac insects; Biological control agents - Lacewings, ladybird beetles, *Trichogramma*; Pollinators, weed killers, scavengers, insects as food and feed.

Unit V **(12 hrs.)**

Crop pests and management: Physical, chemical, cultural, biological, genetic control of pests. Classification of insecticides - chemical nature, mode of entry and mode of action.Pesticide poisoning and first aid. Integrated Pest Management and biopesticides, *Bt* - concepts and application.

Textbooks

1. David, B.V. &Ananthakrishnan, T.N. (2016). *General and Applied Entomology*. New Delhi: Tata-McGraw Hill Publishing Company.
2. Kalyanasundaram, S. &Kalyanasundaram, M. (2003). *Pest management in field Crops / Horticultural Crops*. Vellore: KeranDeskTop Publisher.
3. Mike W. Service (2004). *Medical entomology for students* (3rd ed.). USA: Cambridge University Press.

Reference Books

1. Ambrose, D.P. (2017). *The Insects: Structure, Function and Biodiversity* (2nd ed.). Ludhiana: Kalyani Publishers,
2. David, B.V. &Ramamoorthy, V.V. (2011). *Elements of economic entomology*. Chennai: NP Namrata Publications.
3. Pedigo, L.P. (2002). *Entomology and pest Management*. Singapore: PearsonEducation.
4. Robert F. Morris, Edward P. Caswell-Chen & Marcos Kogan (2002). *Concept in Integrated Pest Management*. New Delhi: Prentice-Hall of India P. Ltd.
5. Chapman R.F. (1998). *The Insects: Structure and Function*. Cambridge: CambridgeUniv. Press.
6. Romoser, W.S &Stoffolano, J.G. (1998). *The Science of Entomology*. New York: McGraw-Hill Company.
7. Wigglesworth V.B.(1984). *Insect Physiology* (8th ed.). New York: Chapman & Hall.

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Semester IV

Major Practical II

III & IV Semester

Major Core & Electives Course Code: ZC20P2

(Conducted during III & IV Semester)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To impart practical skills in selected fields of biology.
2. To develop skills to apply the principles of biological techniques.

Course outcomes

CO	**Upon completion of this course the students will beable to:**	**PSO addressed**	**CL**
CO - 1	Identify biomolecules, cells, chromosomes, genetic disorders and animals.	PSO - 1	**R**
CO - 2	illustrate cells and its structure, biomolecules and theprinciples of biotechniques.	PSO - 2	U
CO - 3	handle analytical instruments and biological samples.	PSO - 3	Ap
CO - 4	analyse biochemical constituents, biological sequences and disorders.	PSO - 4	An

Cell Biology

1. Observation of mitosis in onion root tip.

2. Observation of giant chromosomes in *Chironomus*larva.

3. Measurement of cells using stage and ocular micrometer.4. Drawing of a cell/ organism by using Camera Lucida.

5. Smear preparation of squamous epithelium.

Charts/ Models/ Bookplates: Compound microscope, Camera Lucida, Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes, Lysosomes (polymorphism), Interphase nucleus, DNA (Watson & Crick model), tRNA.

Biochemistry, Biophysics and Biostatistics

3. Preparation of standard acid and alkali (normal, molar and percent).

4. Quantitative estimation of protein by Biuret method.

3. Determination of pH using pH meter.

4. Separation of amino acids using ascending paper chromatography.

5. Demonstration of osmosis using raisins.

6. Analysis of data (ungrouped) - mean, median, mode, standard deviation.

Charts/ Models/ Bookplates: Glucose, Amino acid, Cholesterol, ATP, EM

Semester IV

Allied Zoology: Applied Zoology

Course Code: ZA2041

No. of Hours/ Week	No. of Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To empower the students with the culture practices of economically important animals.
2. To enable the students to become an entrepreneur.

Course Outcome

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	recall the principles of api-, seri-, and aquaculture, poultry and dairy farming.	PSO - 1	R
CO - 2	explain the tools and techniques used in rearingpractices.	PSO - 3	U
CO - 3	practice the fundamental concepts of applied zoology in research and animal farms.	PSO - 3	Ap
CO - 4	inspect the quality of honey, silk, egg, milk and fish.	PSO - 2	An
CO - 5	evaluate the profitability of animal farms.	PSO - 4	E
CO - 6	extend the entrepreneurial skills in establishing animal farms.	PSO - 4	C

Unit I **(12 hrs.)**

Apiculture: Classification and kinds of bees, bees and their society - caste distinctionand their functions. Food of honey bees.Beekeeping methods - primitive and modern. Honey bee products - honey, bee wax, bee venom. Common diseases -nosemosis, acariasis, bee septicemia and management.

Unit II **(12 hrs.)**

Sericulture: Moriculture - methods of propagation - Common species of Silkworm - Life cycle of mulberry silkworm - egg, larva, pupa and adult. Rearing of silkworm -mounting, spinning, harvesting of cocoons, silk reeling and marketing. Common diseases - pebrine, grasserie, muscardine, flacherie and management.

Unit III **(12 hrs.)**

Aquaculture: Aquaculture in India - Important cultivable organisms and their qualities, culture of Indian major carps, Marine prawn culture, Pearl culture. Integrated fish culture - Paddy cum fish culture.Ornamental fish culture.Common diseases - Ichtyophthirius, Dropsy, Fin Rot soft shell syndrome and management.

Unit IV **(12 hrs.)**

Poultry Farming: Poultry housing - types of poultry houses - management of chick, growers, layers and broilers. Sexing in chicks, Nutritive value of egg and flesh.Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis and management.

Unit V **(12 hrs.)**

Dairy Farming: Breeds of Dairy animals - Establishment of a typical Dairy farm - Management of cow - Newborn, calf, Heifer, milking cow. Diseases - Mastitis, RinderPest, Foot and Mouth Disease and management. Nutritive value of milk.Pasteurization. Dairy products - Standard milk, skimmed milk, toned milk and fermented milk - curd, ghee, cheese.

Textbook

Arumugam, N., Murugan, T., Johnson Rajeshwar, J. & Ram Prabhu, R. (2011). *Applied Zoology.*Nagercoil: Saras Publications.

Reference Books

1. Johnson, J. &Jeya Chandra, I. (2005). *Apiculture.*Marthandam: Olympic Grafix.
2. Ganga, G. &SulochanaChetty (1997). *An Introduction to Sericulture.* New Delhi:Oxford and IBH Publishing Co. Pvt. Ltd.
3. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. HitonePublications.
4. Santhanakumar, G. &Selvaraj, A.M. (2002). *Concepts of Aquaculture.*Nagercoil:Meenam Publications.
5. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
6. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.
7. Shukla, G.S. &Upadhyay, V.B. (1998). *Economic Zoology*. Jaipur: RastogiPublications.

Semester III &IV
Allied Zoology Practical: General Zoology & Applied Zoology

Course code: ZA20P1

(Conducted during Semester III & IV)

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2 + 2	2	60	100

Objectives

1. To develop practical skills in basic concepts of biology.
2. To enhance practical skills on agro-based animal farms.

Course outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	recognize museum specimens, stages of cleavage, vital organs, genetic diseases of human and culturable organisms.	PSO - 1	R
CO - 2	explain the economic importance of animals, clinical procedures, dominant and recessive characters of humans.	PSO - 2	U
CO - 3	use the skills relevant to general and applied Zoology.	PSO - 3	Ap
CO - 4	analyse the clinical samples, nutritive value farms productsand water quality parameters.	PSO - 4	An

Applied Zoology

1. Identification of cells in the honey bee comb.
2. Mounting mouthparts of a mosquito.
3. Testing of purity of Honey in three different samples.
4. Dissection of silk gland of *Bombyxmori* (virtual).
5. Measurement of shell ratio of mulberry silk cocoon.
6. Testing milk using a lactometer.
7. Qualitative analysis of milk - Methylene reductase test.
8. Estimation of protein in hen's egg.
9. Estimation of oxygen in water samples.
10. Estimation of salinity in water samples.

Spotters / Models / Charts / Bookplates

Honey bee - worker, queen and drone, Newton's bee-hive, silkworm - egg, larva, pupa and adult, Chandrika, Rearing stand, Poultry feeders, Fowl pox, Coccidiosis, dairy products – skimmed milk, curd, cheese, ghee, *Catla*, *Rohu*, *Mrigal*.

Virtual laboratory / CD can be used as and when necessary.

Semester IV / VI

Self-Learning Course II - Nutrition and Dietetics

Course Code: ZC20S2

No. of Credits	Marks
2	100

Objectives

1. To make the students aware of the various food stuffs and nutrition-related diseases.

2. To develop skills to become health fitness advisors and apply the knowledge in their life.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify the nutrients in various food stuff, balanced diet, nutritional diseases, importance of diet in diseases.	PSO - 1	R
CO - 2	compare the nutrient constituents among various food groups, nutritional requirements of different age groups and dietary management.	PSO - 2	U
CO - 3	apply and communicate the information in their life as a dietician.	PSO - 4	Ap
CO - 4	analyse the nutritional requirements and nutritional deficiency diseases.	PSO - 3	An
CO - 5	evaluate the nutritive value of the food, BMR, BMI, causes and prevention of nutritional diseases.	PSO - 3	E

Unit I

Nutrients: Basic concept of nutrition - functions of food. Food groups - ICMR system. Macronutrients – carbohydrates, fats, proteins, water. Micronutrients: vitamins and minerals. Dietary fibre.

Unit II

BMR and Dietary guidelines: Basal Metabolic Rate (BMR) - carbohydrates - proteins and fats - Factors affecting BMR. Recommended Dietary Allowances (RDA) and guidelines.Food preservation, food adulteration, food spoilage and poisoning.

Unit III

Balanced diet: Food guide pyramid - Nutritional and food requirements of different age groups – infants, Pre Schoolers, Schoolers, Adolescents, Adults, Pregnant and lactating women and during old age.

Unit IV

Malnutrition: Causes and prevention of malnutrition - under nutrition and its effects. Protein energy malnutrition (PEM) - Obesity and underweight, Body Mass Index (BMI), Weight management guidelines for a dietitian.

Unit V

Therapeutic Diets: Importance of diet in disease - therapeutic diet planning. Predisposing factors, symptoms and dietary management of Fever - Constipation - Gall and Kidney stone, Peptic ulcer - Liver cirrhosis.

Textbooks

1.Joshi S.A. **(**2001). *Nutrition and Dietetics.* New Delhi: Tata McGraw Hill Publishing Co. Ltd.

2. PoojaVerma (2015). *Food, Nutrition and Dietetics.*Chennai: CBS Publishers and Distributors Pvt. Ltd.

Reference Books

1. Swaminathan, M. (2006). *Handbook of Food and nutrition.* Bangalore: The Bangalore
1. Printing and Publishing Co. Ltd.
2. Srilakshmi, B. (2014). *Dietetics* (7th ed). New Delhi: New Age International (P) Ltd.
3. Joan Webster-Gandy, Angela Madden, Michelle Holdsworth (2011). *Oxford*
4. *Handbook of Nutrition and Dietetics.*New York: Oxford University Press.
5. SumatiMudambi, R. (2012).*Fundamentals of Foods and Nutrition* (6thed.) New
6. Delhi: New Age International (P) Ltd.
6. SangeetaKarnik (2010). *Nutrition and Diet therapy*. Chennai: Biotech Pharma
7. Publications.

Semester IV

Add on Course: Professional English for Life Sciences

Course Code: ALS204

No. of Hours/ Week	No. of Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To enhance the creative and academic writing skills and workplace communication.
2. To develop competence and competitiveness and thereby improve the employability skills and life-long learning.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define concepts related to communicative and digitalcompetence.	1	R
CO - 2	illustrate academic writing and creativity in digital media.	2	U
CO - 3	apply communicative skills with digital competence in the workplace.	3	Ap
CO - 4	analyse a variety of formats, including essays, research papers, reflective writing, and critical reviews of life sciences.	4	An
CO - 5	analyze lectures, scripts, blogs, e-content and short films relatedto biology.	4	An

Unit I ***(6 hrs.)***

Communicative Competence

Listening – Listening to two talks / Lectures by specialists on selected subjects Speaking – Small Group Discussions

Reading – One Subject Based Reading text followed by comprehension activities /exercises

Writing – Summary writing based on the reading passages (Free Writing)

Unit II (6 hrs.)

Persuasive Communication Listening – Product Launch Speaking – Debates

Reading – Reading Texts on advertisements (On products relevant to the subjectareas) and answering inferential questions

Writing – Writing an argumentative / persuasive essay

Unit III (6 hrs.)

Digital Competence

Listening – Interview by a famous celebrity

Speaking –Interviewing any professional / Creating Vlogs (How to become vloggerand use vloging to nurture interest – subject related)

Reading – Blog

Writing – Blog Creation

Unit IV **(6 hrs.)**

Creativity and Imagination

Listening – Listening academic videos (Prepared by EMRC Other MOOC videos on Indian academic sites)

Speaking – Making oral presentations through short films – subject based

Reading – How is creativity possible in Science (Continuation of essay in semesterIII)

Writing – Creating flyers and Brochures (Subject Based)

Unit V **(6 hrs.)**

Workplace Communication & Basics of Academic Writing

Speaking – Presentation (Without Aids)

Reading & Writing – Product Profiles / Writing an Introduction.

Textbook

Tamil Nadu State Council for Higher Education (TANSCHE).*Professional English for Life Sciences – II*.

Semester V

Major Core V - Physiology

Course Code: ZC2051

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Learning Objectives

1. To enable the students to gain insight knowledge on the functional significanceof the different organs and organ systems.
2. To develop skills to relate the normal and abnormal functions of vital organs.
3. To train future researchers academically and intellectually in the area of physiology.
4. Enable to perform, analyse and report on experiments and observations in physiology;

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the basic anatomy of digestive, respiratory, excretory, homeostatic, neuromuscular, endocrine and reproductive system.	PSO - 1	R
CO - 2	describe the important physiological systems and internal regulation.	PSO - 1	U
CO - 3	compare various organ systems and adaptations exhibited by animals.	PSO - 2	Ap
CO - 4	infer the integration of activities of different organ and organ system.	PSO - 3	An
CO - 5	interrelate different organ systems to diseases for a holistic approach to human health.	PSO - 2	E

Unit I

Nutrition and Digestion: Nutrition - types, composition of food - importance of nutrients. Balanced diet. Basal Metabolic Rate (BMR) and Body Mass Index (BMI), Malnutrition - Marasmus, Kwashiorkor, Obesity. Mechanical& chemical digestion and absorption –system of man, digestion of carbohydrate, protein and fat - absorption and assimilation of digested food materials.Physiology of ruminating stomach.

Unit II

Respiration, Osmo- and thermoregulation: Respiration - respiratory organs, respiratory pigments. Respiratory system of man - transport of O2 and CO2,oxygen dissociation curve, Bohr's effect, chloride shift.Anaerobiosis, Respiratory Quotient.Osmoregulation - osmoconformers and osmoregulators, osmoregulation in crustaceans, fishes and mammals. Thermoregulation - poikilotherms and homeotherms, thermoregulatory mechanisms.

Unit III

Circulation and Excretion: Circulation - composition of blood and lymph, myogenic and neurogenic heart, structure of human heart, heart beat - origin and conduction, pace maker, cardiac cycle and ECG, blood pressure. Heart diseases - atherosclerosis, acute coronary occlusion, myocardial infarction. Excretion -patterns of excretion, excretory organs in invertebrates, structure of kidney in man, nephron, counter current mechanism of urine formation, composition of urine. Nephritis and dialysis.

Unit IV

Muscle and Neuro-physiology: Muscle physiology - types of muscles, ultrastructure and properties of skeletal muscle, mechanism of muscle contraction and Rigor mortis. Neurophysiology - structure and types of neurons, neurotransmitters, conduction of nerve impulse through non-myelinated nerve and synapse. Reflex action. Receptors - types, physiology of phonoreception.

Unit V

Endocrine and Reproductive Physiology: Endocrine physiology - hormones and pheromones, hypothalamus and endocrine glands – pituitary, thyroid, parathyroid, adrenal, islets of Langerhans. Biological clock and rhythms.Reproductive physiology - male reproductive system – female reproductive system, structure of graffianfollicle.Menstrual cycle and menopause.Hormonal regulation of menstruation, pregnancy and lactation.

Textbook

Arora, M.P. (2007). *Animal Physiology* (6th ed.). Mumbai: Himalayan Publishing House.

Reference Books – update latest

1. Goel, K. A. and K.V. Sastry (2016). *A Text Book of Animal Physiology* (7thed.).Meerut: Rastogi Publications.
2. Singh, H.R. ShobanLalNagin (2017). *Animal Physiology and Related Biochemistry.*
3. New Delhi: S. Chand and Co.
4. Agarwal R.A., Srivastava, A.K. and Kaushal Kumar (2015). *Animal Physiology and Biochemistry* (5thed.). New Delhi: S. Chand and Company Ltd.
5. William S. Hoar (1999). *General and Comparative Physiology.* (3rded.). New Delhi: Prentice Hall of India Publications.
6. Nagabhushan, R. Kodarkar, M.S. and Sarojini, R. (1982). *Text book of Animal Physiology* (2nded.). New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

Semester V

Major Core VI – Biotechnology

Course Code: ZC2052

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Objectives

1. To inculcate the basic conceptsand various techniques pertaining to biotechnology.
2. To provide interdisciplinary skills for research and employability in biotech industries.

Course Outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	explain the basic concepts of biotechnology and nanotechnology.	PSO - 1	R
CO - 2	reciterDNA, hybridoma technology, tissue engineering and applications of nanotechnology.	PSO - 1	U
CO - 3	apply appropriate tools and techniques in biotechnological manipulation and problems ethically.	PSO - 2	Ap
CO - 4	examine the transgenic animals, microbial and biotechnological products.	PSO - 3	An
CO - 5	priorities biotechnological techniques for the welfare of environment and society.	PSO - 4	E

Unit I

Introduction to Biotechnology: Scope of biotechnology,Genetic Engineering – Enzymes for cutting and joining DNAs, cloning vectors - pBR322, SV40, Ti plasmid. *In vitro* construction of rDNA, Introduction of rDNA into host cell - selection of recombinants.DNA library.Molecular markers - RAPD and RFLP.Polymerase Chain Reaction (PCR).Southern blotting.DNAsequencing - Maxam and Gilbert's method – Sanger's .

Unit II

Cell culture: Culture media - cell culture technique - establishment of cell culture – primary and sub-culture - explant culture, callus culture, somatic hybridization and micro-propagation. Celllines - large scale culture of cell lines -organ culture - artificial skin and cartilage–3D culture – *Invitro* organ development - embryo culture. Stem cells - characteristics, types and applications.

Unit III

Transgenic animal technology: Transgenesis – methods of transgenesis, knock out gene, applications of transgenic animals.Bioethics - ethical implications of transgenic animals.

Hybridoma technology -production of hybridoma, monoclonal antibodies - production and applications.Bioreactors - stirred tank and air–lift bioreactor.

Unit IV

Metabolite production and Bioremediation: Production - primary metabolite –L. glutamic acid and L. glutamine,secondary metabolite –penicillin, Biofuel- ethanol. Immobilization ofenzymes and their applications. Biosensors – types and applications. Bacterial SCP and its applications.Sewage and waste water treatment. Bioremediation - types, degradation of xenobiotics (hydrocarbon, pesticide), super bug – construction and application.Biomining and bioleaching**.**Biocontrol – *Bacillus thuringiensis.*Biosafety: Possible dangers of Genetically Engineered Organisms (GEOs) and biohazards of rDNA technology.

Unit V

DNA applications: Disease diagnosis – DNA probes, disease treatment – production of human insulin. Gene therapy – types and methods.Finger printing and its application in forensic medicine.Human Genome Project.Nanobiotechnology **–**Nano drug, Drug delivery system, DNA microarray, gene chip, Diagnosis and screening.

Textbook

Dubey, R.C. (2014). *A Text book of Biotechnology*(6thed.). New Delhi: S. Chand and Co. Ltd.

Reference Books

1. Dubey, R.C. (2006). *A Text book of Biotechnology*(4thed.). New Delhi: S. Chand and Co.Ltd.
2. Satyanarayana, V. (2005). *Biotechnology*. Kolkata: Books and Allied (P) Ltd.
3. Rema L.P. (2006). *Applied Biotechnology*. Chennai: MJP Publishers.
4. Prakash S. Lohar (2005). *Biotechnology*. Chennai: Kalyani Publishers.
5. Gupta P.K. (2004). *Elements of Biotechnology*. Meerut: Rastogi Publications.
6. Singh B.D. (2007). *Biotechnology - Expanding Horizon*, Chennai: Kalyani Publishers.
7. Trevan, M.D. Boffey, S., Goulding, K.H. and Stanbury, P. (2004). *Biotechnology - The Biological Principles*. New Delhi: Tata McGraw - Hill Publishing Company Limited.

Semester V

Major Core VII - Ecology and Toxicology

Course Code: ZC2053

No. of hours/ week	No. of credits	Total number of hours	Marks
6	5	90	100

Objectives

1. To develop a deep understanding on the interaction between the environment and the living organisms.
2. To develop skills to assess the toxicants and its impacts, environmental standards and apply that knowledge to current environmental issues for wise environmental management.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define abiotic, biotic and limiting factors, community structure, ecological succession, wild life conservation and toxicants.	PSO - 1	R
CO - 2	comprehend the physical and chemical properties of environment, biological effects, biogeochemical cycles, wild life conservation, environmental pollution and toxicology.	PSO - 1	U
CO - 3	identify the biotic factors, characteristics of communities, endangered species and causes for environmental problems.	PSO - 2	Ap
CO - 4	assess the structure and function of ecosystem, community, habitat for sustainable management of environmental system and for the remediation.	PSO - 3	An
CO - 5	evaluate the impact of environment changes on the biosphere.	PSO - 4	E
CO - 6	design and execute independent research in environmental science.	PSO - 4	C

Unit I

Introduction to ecology: Scope-Branches of ecology. Autecology and synecology.Environment – atmosphere, lithosphere, hydrosphere and biosphere.Biological effects of temperature and light.Concept of limiting factors - Liebig's law of minimum, Shelford's law of tolerance.Interspecificrelationship - mutualism, commensalism, antagonism - antibiosis, parasitism, predation and competition. Habitat ecology- adaptations of deep sea and desert living animals.

Unit II

Ecosystem and Population ecology: Ecosystem –Structure, abiotic and biotic factors. Functions

- Detritus and grazing food chains, food web, trophic levels, energyflow - Linear and Y-shaped,

ecological pyramids. Biogeochemical cycle – types, nitrogen and phosphorous cycle. Population ecology - density, natality, mortality, age distribution, population growth, population equilibrium, population fluctuations, biotic potential, population dispersal and dispersion, regulation of population - density independent and density dependent factors, population interaction.

Unit III

Community Ecology: Concept of community, Community- structure, composition and stratification. Ecological niche, Ecotone and Edge effect, Ecotype, Ecological indicators. Ecological succession - types, general process, Concepts of climax- theories of climax, patterns ofsuccession. Ecological effects of dams, hydroelectric projects.Animal distribution – continuousand discontinuous.Parallelism, Endemism.Zoogeographical regions of world.Remote sensing and its applications in agriculture, fisheries, forest management and food management.

Unit IV

Toxicology: Scope and sub-divisions of toxicology.Toxicants – classification, toxicity - lethal, sublethal, LC50, and LD50.Toxic agents and their mode of action – toxicokinetics – toxicodynamics

– toxic responses - ADME.Toxic effects of heavy metals, pesticides, carcinogens, food additives,cosmetics, micro plastics and radiations.Factors affecting toxicity.Dose-effect and dose-response relationship - acute toxicity, chronic toxicity reversible and irreversible effects.Toxicity bioassay-*invivo* experiments – determination of LC50 and LD50, *exvivo* experiments – haematological andbiochemical parameters.Application of toxicology.

Unit V

Ecotoxicology: Types – measurement of ecotoxicological effects. Pollution - pollutants, xenobiotics, greenhouse effect, ozone depletion, acid rain, photochemical smog, Bhopal episode, Chernobyl disaster, BOD, Eutrophication, Red tide, Minamata disease, bioaccumulation, biomagnifications, biotransformation, biomonitoring. Waste water

treatment and solid waste management. Environmental Auditing and Environmental Impact Assessment (EIA).

Text book

Mercy, P.D. and Basil Rose, M.R. (2003).*Ecology and Toxicology*.Nagercoil: Sathana Publications.Arumugam, N. (2014). *Ecology and Toxicology*.Nagercoil: Saras Publications.

Reference Books

1. Sharma, P.D. (1999). *Ecology and Environment.* Meerut: Rastogi Publications.
2. Dash, M.L., Tata M.C. (1996). *Fundamentals of Ecology.* New Delhi: McGraw Hill Publishing Company Ltd.
3. Trivedi, R.N. (1993). *Textbook of Environmental Sciences.* New Delhi: Anmol Publications Pvt. Ltd.
4. Shukla, S.K. and Srivastava, P.R. (1992). *Water Pollution and Toxicology.* New Delhi:Common-Wealth Publishers.
5. Subramanian, M.A. (2004). *Toxicology: Principles and methods.* Chennai: M. J. P. Publishers.
6. Verma, P.S. and Agarwal V. K. (1986). *Principles of Ecology*. New Delhi: S. Chand & Co.Pvt. Ltd.
7. Bhattacharya, S. (2011). *Environmental Toxicology*. Kolkata: Books and Allied (P) Ltd.

Semester VI

Major Core VIII– Developmental Zoology

Course Code: ZC2061

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Objectives

1. To impart knowledge on the sequential changes during the embryonic development of animals andhuman reproductive health.
2. To develop skills on observation of developmental stages, regeneration and nuclear transplantation.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define the concepts of reproduction, embryonic development, nuleo-cytoplasmic interaction and birthcontrol.	PSO – 1	R
CO - 2	outline the patterns of cleavage, morphogenetic movements, fate map, the reproductive disorders and treatment.	PSO - 1	U
CO - 3	execute the principles of embryology in applied sciencesand birth control measures.	PSO – 3	Ap
CO - 4	analyze clinical implications of the development, gender based reproductive disorders and intervening mechanism.	PSO - 3	An

Unit I

Reproduction: Sexual reproduction - spermatogenesis, Structure and types of sperm. Oogenesis, types of egg, egg membranes, Structure of egg- frog, chick and human. Fertilization -types, chemical and cytological factors involved in fertilization, physiological changes in fertilization, significance, Prevention of polyspermy. Asexualreproduction. Parthenogenesis - types and significance.

Unit II

Cleavage and Gastrulation: Planes and patterns of cleavage, factors controlling cleavage,cleavage and blastulation in frog. Fate map of frog.Morphogeneticmovements.Gastrulation in frog. Organizer –Spemann's experiments - organizer in amphibian embryo, embryonic induction - neural induction. Competence. Gradient theory - gradient system - types, experimental evidences, mechanism.

Unit III

Organogenesis: Development of eye, heart, digestive system in frog. Extra embryonic membranes

- development of fetalmembranes.Placenta in mammals - classification, functions anddevelopmentStem cells, Preservation of cord blood stem cells. Principles of collections of Umbilical cord, gametes and embryos.

Unit IV

Metamorphosis and Regeneration: Types, Insect and Amphibian metamorphosis - hormonal control.Regeneration - types, regeneration in Planaria, amphibia and human liver, factors influencing regeneration, physiological changes involved in regeneration. Nucleo-cytoplasmic interaction - Acetabularia.Ageing- concepts and theories.Synthetic biology – synthetic life.

Unit V

Embryological Techniques: Infertility – causes and diagnostic parameters – hormonal imbalance, Poly Cystic Ovarian Diseases (PCOD). Rh factors and incompatibility.*Invitro* fertilization, artificial insemination, cryopreservation of sperm and ovum - test tube babies – amniocentesis.Teratogenesis- agents and their effects.Birth control - physical barriers - contraceptive devices - IUCD, surgical method, hormonal therapeutic methods.

Textbook

Jain,P.C. (2013). *Elements of developmental biology*(7thed.). Jalandhar: Vishal publishing Co.

Reference Books

1. Verma, P.S. and Agarwal, V.K. (2010). *Chordate Embryology*. New Delhi: NarosaPublishingHouse.
2. Sastry, K.V. and Shukla, V. (2003). *Developmental Biology*. Meerut: Rastogi Publications.
3. Balinsky, B. I. and B.C. Fabian (1981). *An Introduction to Embryology* (5thed.).New York:Saunders Publishing College.
4. GayatriPrakash (2007). *Reproductive Biology*. New Delhi: Narosa Publishing House.
5. Gilbert S. F. (2010). *Developmental Biology*. IX Edition, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, USA.

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Semester VI

Major Core IX - Immunology and Microbiology

Course Code: ZC2062

No. of hours/week	No. of credits	Total number of hours	Marks
6	6	90	100

Objectives

1. To enable the students to know about the immune system and the microbes around us.
2. To developthe analytical skill on invading microbes and immune response.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define the components of the immune system, mechanisms of immune response, microbial diversity, infectious diseases and microbial application.	PSO - 1	R
CO - 2	discuss the types of immune cells, immune response,taxonomic classification of microbes and their role in industries.	PSO - 1	U
CO - 3	apply the concepts of Immunology and Microbiologyforinterdisciplinary research and life-long learning.	PSO - 3	Ap
CO - 4	analyze the role of microbes in food, air, water, soil and immune response to infection.	PSO - 4	An

Unit I

Immunity and Lymphoid organs: History and scope. Types of immunity - Innate, acquired, passive and active.Cells of immune system (T cells and B cells, macrophages), Primary and Secondary lymphoidorgans - Thymus, Bone marrow, Bursa of Fabricius, Spleen, Lymph node, Mucosa Associated Lymphoid Tissue. Lymphoid and myeloid lineage.

Unit II

Antigen and Antibodies: Haemopoietic stem cells and haemopoiesis. Antigen, immunogens, hapten and adjuvants. Immunoglobulin - types, structure and functions of IgG. Antigen – Antibodyreactions. Secondary antibody, purification of antibody.

Unit III

Immune Response: Primary and secondary immune response, immunity to bacterial infections (humoral and cell-mediated immune response). Hypersensitivity - Allergens and types of hypersensitivity. Autoimmunity– Rheumatoid arthritis.Immunobiotics– definition, respiratory anddigestiveailments. Vaccines and Immunization schedule.

Unit IV

General Microbiology: History and scope. Whittaker's and Bergy's classification of microbes. Bacteria - structure of *E. coli*, bacterial growth kinetics, culture media, culture techniques – batch culture. and continuous culture (chemostat and turbidostat). Virus: structure (SARS and T4 phage) – reproduction of T4 phage (lysogenic and lytic). Synthetic Biology.

Unit V

Applied Microbiology: Food poisoning,Food spoilage and preservation.Industrial microbiology - Scope and applications – Fermentation process – Fermenter -Wine and Vinegar production. Medical microbiology - Bacterial diseases – Leptospirosis, Syphilis, Pneumonia, viral diseases – COVID -19, Herpes, Hepatitis B, Rabies, fungal diseases – Tineacorporis, Mucormycosis - Mycotoxicosis and Aspergillosis.

Textbook

Arumugam, N., Mani, A., Narayanan, L.M., Dulsy Fatima and Selvaraj, A.M. (2013).*Immunology and Microbiology*.Nagercoil: Saras publications.

Reference Books

1. Kuby, T. (1994). *Immunology*. New York: W.H. Freeman and Company.
2. Tizard, I.R. (1995). *Immunology - an Introduction* (4thed.). Philadelphia: Saunders CollegePublications.
3. Prescott, Lansing, M. John, P. Harley and Donald A. Klan (2005). *Microbiology*. NewYork: McGraw Hill Publishing Co. Ltd.
4. Pelczar, Michael J. E.C.S. Chan and Noel R. Krieg (2006). *Microbiology*. New York: TataMcGraw – Hill Publishing Co. Ltd.
5. Roger, Y. Stanier, John L. Ingraham, Mark L. Wheelis and Pager R. Painter (1988).
6. *General Microbiology*. New Delhi: Macmillan India Ltd.
7. David M., Jonathan B., David R.B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby:Elsevier Publication.
8. Subash Chandra Parija (2012). *Microbiology and Immunology*, Elsevier.

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Semester VI

Major Core X – Organic Evolution

Course Code: ZC2063

No. of hours/week	No. of credits	Total number of hours	Marks
6	5	90	100

Objectives

1. To discern the evolutionary significance of animals and origin of species.
2. To provide skills for tracing fossil records, interpreting animal evolution and analysingphylogenetic tree.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the concepts of evolution, origin of life, geological timescale, natural selection, speciation and evidences of evolution.	PSO - 1	R
CO - 2	discuss on the theories of evolution, isolation, variation, speciation, fossils and phylogram.	PSO - 2	U
CO - 3	generalise experimental and natural evidences in support of evolution, genetic equilibrium, speciation, and rate of evolution.	PSO -3	Ap
CO - 4	analyse the major transitions in evolution and phylogeny ofanimals.	PSO - 3	An
CO - 5	assess and report the evidences in support of natural selection, speciation and evolution.	PSO - 4	E

Unit I

Concepts and Evidences of Evolution: History of evolution - theory of preformation, epigenesist, recapitulation, germplasm and Bear's law.Origin of earth.Origin of life - theories and experiments,origin of prokaryotic and eukaryotic cell.Evidences in support of evolution – morphology and comparative anatomy, embryology, physiology and biochemistry, palaeontology.Geological timescale.

Unit II

Theories and Natural selection: Lamarckism, Neo-Lamarckism. Darwinism, Neo-Darwinism. Natural selection – Stabilizing, directional and disruptive selection.Mutation theory of De Vries.Modern synthetic theory. Variation – types and sources. Hardy-Weinberg law and elemental forces of evolution - mutation, recombination, hybridization, isolation, natural selection, Founder's principle and genetic drift.Fishers' theorem, Genetic load and genetic death.

Unit III

Isolating mechanisms and Speciation: Isolating mechanisms - **t**ypes, origin and evolution of isolating mechanisms, role of isolation in speciation. Species concept - morphological, genetic and biological. Salient features of species, sibling species, subspecies and demes. Speciation - Phyletic and true speciation, mechanism of speciation. Patterns of speciation – allopatric, sympatric, quantum and parapatric.Adaptive radiation (Darwin finches) - Convergent and divergent evolution.

Unit IV

Modes of Evolution, Mimicry and Colouration: Modes of evolution – micro, macro, mega andquantum evolution. Coevolution.Molecularevolution.Heterochrony- Paedomorphosis and Peramorphosis.Rate of evolution.Human Evolution – organic, cultural and future evolution.Mimicry and colouration. Extinction - types, causes and significance. Fossils - Types offossils. Dating of fossils.

Unit V

Phylogenetic analysis: Phylogenetic trees – structure and types. Tools for sequence alignment – BLAST, FASTA.Methods of phylogenetic analysis - phenetic and cladistic,methods for determining evolutionary trees – maximum parsimony, distance and maximum likelihood.Mutations as data source for evolutionary analysis.

Textbook

Arumugam, N. (2019). *Organic Evolution.*Nagercoil: Saras Publications.

Reference books

1. Arora, M.P. (2003). *Evolutionary Biology.* Chennai: Himalaya Publishing House.
2. SanjibChattopadhyay (2012). *LIFE: Evolution, Adaptation and Ethology.* Kolkata: Booksand Allied (P) Ltd.
3. Verma, P.S. and V.K. Agarwal (1998). *Concept of Evolution.* New Delhi: S. Chand andCompany Ltd.
4. Verma, P.S. and V.K. Agarwal (1982). *Principles of General Biology (Evolution).* NewDelhi: S. Chand and company Ltd.
5. Gladis Helen Hepsyba, S. and Hemalatha, C.R. (2009). *Basic Bioinformatics.* Chennai:MJP Publishers.
6. John Britto, A. (2011). *Bioinformatics.*Palayamkottai: St. Xavier' College.
7. Hooman H. Rashidi and Lukas K. Buehler (2000). *Bioinformatics Basics: Application inBiological Science and Medicine*. USA: CRC Press.

Semester VI

Major Elective III – (a) Economic Zoology

Course code: ZC2064

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To acquaint the students with the applied aspects of Zoology.
2. To develop entrepreneurial skills inthe area of applied zoological sciences.

Course Outcomes

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO - 1	recall the importance of applied area of biological sciences.	PSO - 3	R
CO - 2	explain the rearing techniques of economically important animals.	PSO -3	U
CO - 3	apply the different strategies adopted in rearing of honey bee, lac insect, silkworm, fishes, fowls and dairy animals.	PSO -4	Ap
CO - 4	choose the profitable culture practices.	PSO -4	An
CO - 5	evaluate the profitability of animal farms.	PSO - 4	E
CO - 6	extend the entrepreneurial skills in establishing animal farms.	PSO - 4	C

Unit I

Apiculture and Lac culture: Apiculture - scope, varieties of honey bees,bees and their society, communication in honey bees.Bee pasturage, food of honey bees, relationship between plants andbees.Methods of bee keeping - primitive and modern.Economic importance of honey bee products-honey, bee wax, bee venom, pollen, royal jelly, andpropolis.Enemies and diseasesof honey bees.Honey extraction and processing. Steps involved in starting apiary. Funding sources for beekeeping projects.Lac culture - life history of lac insect- host plants- rearing of lac insect- processing of lac, composition of lac.Economic importance of lac.

Unit II

Sericulture: Scope, Silk Road, CSB. Moriculture - varieties of mulberry, methods of propagation, harvesting of leaves. Types of silk and silkworms. *Bombyxmori*- life cycle, rearing, mounting, spinning, harvesting of cocoons. Silk reeling techniques, and marketing. Diseases of silkworm - pebrine, grasserie, Flacherie, sotto diseases, muscardine. Insect pest of silkworm -uzifly. EconomicImportance of sericulture.

Unit III

Poultry: Scope, Poultry industry in India, commercial layers and broilers. Poultry housing - types. Management of chick, growers, layers and broilers .Sexing in chicks, debeaking, Diseases of poultry – Ranikhet, Fowl pox, Coryza, Coccidiosis, Polyneuritis, Vaccination .Duck farming- introduction- duck breeds – housing - feed management breeding – disease management – marketing. Economic importance of poultry farming.

Unit IV

Dairy Farming: Scope, indigenous and exotic breeds, establishment of a typical dairy farm. Management of cow - New born, calf,Heifer, milking cow.Diseases -Mastitis, Rinder Pest, FMD.Nutritive value of milk,dairy products - standard milk, skimmed milk, toned milk and fermented milk - curd, ghee, cheese.Dairy Farming**:** Pasteurization.Goat farming – common breeds– construction and maintenance of shed.Economic importance of dairy farming.

Unit V

Aquaculture: Aquaculture in India, important cultivable organisms and their qualities. Culture – types, Indian major carps, marine prawn and pearl oyster. Diseases of fishes – bacterial gill rot, viral hemorrhagic septicemia, saprolegniasis. Fish parasites – Argulus and *Ichthyophthirius*.Integrated fish culture - paddy cum fish culture (Pokkali), fish cum poultry farming, fish cum dairy farming, fish cum pig farming. Ornamental fish culture – setting an aquarium, aquarium fishes.Economic importance of aquaculture.

Textbook

Shukla, G.S. and Upadhyay, V.B. (2016).*Economic Zoology.* Jaipur: Rastogi Publications.

Reference Books

1. Vasantharaj David, B. (2004). *General and Applied Entomology*(2nded.). New Delhi: TataMcGraw-Hill Publishing Company Ltd.
2. Johnson, J. and Jeya Chandra, I. (2005). *Apiculture.*Marthandam: Olympic Grafix.
3. Tharadevi, C.S., Jayashree, K.V. and Arumugam, N. (2014). *Bee Keeeping.* Nagercoil :Saras Publications.
4. Johnson, M. and Kesary, M. (2015). *Sericulture* (5thed.).Marthandam: CSI Press.
5. Ganga, G. and SulochanaChetty (1997). *An Introduction to Sericulture.* Delhi: Oxford andIBH Publishing Co. Pvt. Ltd.
6. Gnanamani, M.R. (2005). *Profitable Poultry Farming*. Madurai: J. Hitone Publications.
7. John Moran (2005). *Tropical Dairy Farming.* Australia: Landlinks Press.
8. Uma Shankar Singh (2008). *Dairy Farming.* New Delhi: Anmol Publishers.
9. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. **(**2011). *AppliedZoology*. Nagercoil: Saras Publications.

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7. https://megcooperation.gov.in/duck_farming/Modern_Duck_Farming_Practices.pdf
8. https://www.agrifarming.in/duck-farming-business-plan-beginners
9. https://www.agrifarming.in/goat-farming-in-india-a-step-by-step-guide

Semester VI

Major Elective III – (b) Sericulture

Course Code: ZC2065

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on mori-and sericulture.
2. To develop entrepreneurial skill and create business opportunities.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recognise mulberry varieties, silkworms, cocoons and silk.	PSO - 1	R
CO - 2	interpret the importance of sericulture, nutritive value of mulberry, diseases and pest of mulberry and silkworm, grainage technology, cocoon and silk marketing.	PSO - 2	U
CO - 3	practice sericulture and produce ecofriendly byproducts.	PSO - 4	Ap
CO - 4	analyse the practices of mori- and sericulture, the quality of cocoon and silk.	PSO - 3	An

Unit I

Introduction and Moriculture: Importance of Sericulture, Silk Road, CSB, Training facilities in sericulture, Sericulture as cottage industry. Moriculture- common varieties of mulberry, optimumconditions for mulberry growth, planting system, methods of propagation, irrigation, biofertilizers, green manuring - Triacontanol and Seriboost, pruning, harvesting and preservation of leaves. Nutritive value of mulberry leaves.

Unit II

Diseases and Pests of Mulberry: Fungaldiseases - white root rot, fusarium root rot, stem canker disease, wilt disease, leaf spot disease and powdery mildew diseases.Bacterial diseases - leaf blight disease androtdisease.Viraldiseases - dwarf disease and leaf mosaic disease.Nematode - root knot disease. Deficiency diseases - Nitrogen, Phosphorus, Magnesium, Iron and Potassium. Pests - termites, Bihar hairy caterpillar, thrips, almond leaf borer, stem girdler beetleand papaya mealy bug.

Unit III

Biology of silkworm: Taxonomic position of *Bombyxmori*.Races and classification of *B. mori*,lifecycle of *B. mori* - morphology of egg, larva, pupa and adult.Diseases of silkworm – Protozoan - pebrine, Bacterial – bacterialflacherie and septicemia, Viral -

infectiousflacherie and Gattine, Fungal – muscardine. Pest - Uzi fly and Tachinidfly. Grainage technology -grainages, procedures in a grainage.Diapause and non-diapausingeggs.Transport of eggs.

Unit IV

Silkworm rearing: Mulberry silkworm – rearinghouse, rearing appliances, rearing operations - disinfection, brushing, maintenance of optimum conditions for rearing, feeding, bed cleaning, spacing, care during moulting. Rearing methods -chawki rearing and rearing of late age larvae - shelf, floor and shoot rearing.Sampoorna.Mounting - methods of mounting, precautions to be taken during mounting, harvesting of cocoons. Non - mulberry silkworm rearing: Eri, Tasar and Muga.

Unit V

Cocoon and Silk marketing: Transport of cocoons, physical and commercial characteristic of cocoons, defective cocoons, cocoon markets. Silk reeling: stifling -sun drying, steam stifling, hot air stifling, storage of stifled cocoons, sorting of cocoons, deflossing, cocoon riddling, cocoon mixing, cocoon cooking - open pan and three pan system, brushing, reeling operations.Reeling appliances: country charka, cottage basin and, filature. Re-reeling, lacing, skeining,raw silk testing, marketing.By products and wealth from Seri-wastes.

Textbook

Johnson, M. and Kesary, M. (2015).*Sericulture*.Marthandam: CSI Press.

Reference Books

1. Ganga, G. and J. SulochanaChetty (1997). *An Introduction to sericulture*. Delhi: Oxfordand IBH Pub. Co. Pvt. Ltd.
2. Food and Agriculture organization (1976). *Manual on sericulture I, II & III*. Delhi: Oxfordand IBH Pub. Co. Pvt. Ltd.
3. Jolly,M.S. (1987). *Appropriate Sericulture Techniques.* Mysore: CSR & TI.
4. Ullal,S.R. and M.N. Narasimhanna (1987). *Hand book of practical sericulture.* Bangalore:CSB.
5. Narasimhanna,M.N. (1988). *Manual on silkworm egg production.* Bangalore: CSB.
6. Dandin,S.B. and Giridhar, K. (2000). *Hand book of Sericulture Technologies.* Bangalore:CSB.

Semester VI

Major Elective III – (c) AquacultureCourse Code: ZC2066

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To familiarize the basic aspects of culture practices of fin and shellfishes.
2. To develop skills on aquaculturepractices for income generation and to create a self-employmentventure.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the culture practices of cultivable aquatic organisms and their management.	PSO - 3	R
CO - 2	explain the culture techniques of fin fish, shell fish and seaweeds.	PSO - 3	U
CO - 3	Apply the different strategies adopted in aquaculture.	PSO - 4	Ap
CO - 4	assess the growth of culturable organism in all season to get extra profit *via* integrated farming.	PSO - 4	An
CO - 5	evaluate the nutritive value and marketability of culturable organisms.	PSO - 4	E
CO - 6	establish an aqua industry for self-employment.	PSO - 4	C

Unit I

Aquaculture and its types: Scope, importance of aquaculture in India. Types of aquacultures – freshwater, brackish water/coastal and marine, rice-fish culture or integrated fish farming.Construction of ponds.Types of fish ponds – nursery, rearing and culture ponds.Ornamental fish culture– prerequisites – aquarium – types of aquaria.

Unit *II*

Culture practices and Feed: Extensive, intensive, semi – intensive. Water quality management. Culture practices in India - cold water fish culture, warm water fish culture, monoculture, poly culture, cage culture, pen culture, Pokkali culture, tank system and raceway system.Weedcontrol.Fish feed - types, formulation and preparation.Live feed and their culture – *Artemia*, diatoms,rotifers and algae.Seaweed culture.

Unit III

Fin and Shellfish culture: Characteristics of cultivable fishes. Fin fish culture -culturable organisms– culture of Indian major carps and murrel. Shellfish culture - cultivable organisms

– Culture of crab, freshwater prawn, pearl culture and edible oyster. *Biofloc* technology - culture,applications, advantages and disadvantages.

Unit IV

Diseases: Bacterial - Fish Tuberculosis, Cotton mouth disease. Viral - Infectious pancreatic necrosis, Spring Viremia of Carp, Viral Haemorrhagic Septicemia. Fungal – Dermatomycosis, Branchiomycosis.Parsitic diseases – Whirling Disease, Diplostomosis, Costiasis.Miscellaneous diseases - Epizootic Ulcerative Syndrome.Diseases of ornamental fishes –Viral -Lymphocystis, Bacterial - Fin and Tail Rot, Fungal - Saprolegniasis, Protozoan parasite - *Ichthyophthirius*, *Costia*,*Argulus*and*Ergasilus.*

Unit V

Harvesting and Marketing: Crafts and gears - post-harvest technology – Transportation - Rigor mortis - fish spoilage - Fish preservation techniques. Fish marketing - Co-operative marketing in fisheries.Governmental agencies in aquaculture -CMFRI, MPEDA, ICAR, CIFA, CAA, NFDB, CIBA, FFDA and Department of Animal Husbandry and dairying.

Textbook

Arumugam, N. (2010). *Aquaculture.*Nagercoil: Saras Publications.

Reference Books

1. Chandral, Lily Premila and Latha. (2009). *Aquaculture.* Nagercoil: C.S.I. Diocesan Press
2. Santhana Kumar, G and A. M. Selvaraj (2002). *Concepts of Aquaculture.* Nagercoil:Meenam Publications.
3. Santhanam, R. (1995). *Fisheries Science.* New Delhi: Daya Publishing House.
4. Jhingran, V.G. (1997). *Fish and Fisheries of India.* New Delhi: Hindustan Publishing Co.
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2. https://www.agrifarming.in/aquaculture-in-india-types-of-aquaculture-a-full-guide).
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4. %2024-28-9-19.pdf
5. https://www.agrifarming.in/biofloc-technology-bft-in-aquaculture-india-a-full-guide
6. https://www.nfdb.gov.in/PDF/Biofloc%20booklet%20v6.pdf
7. https://www.shaikhinsuranceinvestment.com/post/biofloc-fish-farming-benefit-investment-profit

Semester V

Major Practical III – Physiology and Biotechnology

Course Code: ZC20P3

No. of hours/ week	No. of credits	Total number of hours	Marks
4	2	60	100

Objectives

1. To develop skills to perform physiological experiments and report the results.
2. To train the students to familiarize biotechnological experimental protocols.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	selectappropriate methods in physiology and biotechnology experiments.	PSO - 1	R
CO - 2	describe the principles of analytical instruments and its uses in physiology and biotechnology.	PSO - 2	U
CO - 3	demonstrate scientific experiments and interpret the biological data.	PSO - 3	Ap
CO - 4	estimate the effect of abiotic factors on physiological process and quantify genomic DNA.	PSO - 2	An
CO - 5	select appropriate physiological and biotechnological techniquesto analyse the biological samples.	PSO - 4	E

Physiology

1. Rate of oxygen consumption in a fish.
2. Effect of temperature on the opercular movement of a fish and calculation of Q**10.**
3. Estimation of salt loss and salt gain in a fresh water fish.
4. Identification of nitrogenous excretory products – ammonia, urea, uric acid
5. Action of salivary amylase in relation to pH.
6. Action of salivary amylase in relation to enzyme concentration.
7. Estimation of haemoglobin - demonstration.
8. Counting of blood cells using haemocytometer (Demonstration).
9. Determination of blood clotting time (Demonstration).
10. Determination of Body mass index of students.

Slides/ Models/ Charts

Haemoglobin, ECG,kwashiorkordisease,Obesity, Sphygmomanometer, Kymograph, Cardiac muscle, Striated and Non-striated muscle, Simple muscle curve.

Biotechnology

1. Isolation of genomic DNA from *E. coli.*
2. DNA – Agarose Gel Electrophoresis (Demonstration)
3. Estimation of DNA by Diphenylamine (DPA) Method.
4. Measurement of degradation: Estimation of COD in sewage.
5. Measurement of Bioremediation:Estimation of BOD in Sewage.
6. Immobilization of enzyme (Amylase/ Invertase/ Protease) using sodium alginate.
7. Polymerase Chain Reaction – Demonstration.
8. Production of Hybridoma and Monoclonal antibodies – Flow chart.
9. Isolation of B and T lymphocytes using kits.
10. Animal cell culture media preparation.

Models/ Charts/ Photos

pBR322, Recombinant DNA, Electroporation unit, Southern blotting, RFLP, Dolly, Fermenter,Human genome sequence, Penicillin, Biogas production.

Semester V& VI

Major Practical IV -Ecology and Toxicology & Organic Evolution

Course Code: ZC20P4

(Conducted during Semester V & VI)

No. of hours/week	No. of credits	Total number of hours	Marks
4	2	60	100

Objectives

1. To investigate the relationship between the organisms and their environment.
2. To develop skill to identify variation, speciation and phylogeny.

Course Outcomes

CO	Upon completion of this course the students will be ableto:	PSO addressed	CL
CO - 1	recall the protocols to analyze water quality and variation in finger prints.	PSO - 1	R
CO - 2	identify the zooplankton, serial homology, mutant forms of *Drosophila*, mimicking animals and fossils.	PSO - 2	U
CO - 3	interpret the evolutionary concepts, natural selection, variations, gene frequency and prodigality of nature through experiments.	PSO - 3	Ap
CO - 4	analyze physical and chemical factors of natural ecosystemand lethal concentration of pesticide.	PSO - 4	An

Ecology and Toxicology

1. Detection of transparency of water by Secchi disc.
2. Quantitative estimation of oxygen in water samples.
3. Estimation of salinity of water samples.
4. Estimation of CO_2 in water samples.
5. Mounting of plankton.
6. Study of food chain and food web in a terrestrial ecosystem.
7. Estimate insect population using quadrate method.
8. Preparation of different concentrations of toxicants (percentage, ppt, ppm).
9. Determination of LC_{50} of a pesticide (toxicity curve method).
10. Study of pond ecosystem and field report of the visit (compulsory).

Museum specimens/ Slides/ Models/ Charts:

Water sampler, Water cycle, Ecological Pyramids, Energy Flow, Edge effect, Mutualism - Hermitcrab and Sea anemone, Commensalism - *Echeneis* and Shark, Parasitism - Sacculina on Crab, Competition – prey and predator, Cyclomorphosis - *Daphnia*.

Organic Evolution

1. Observation of Serial homology in prawn.
2. Study of Analogy – wings of animals (charts/ models/ specimen)
3. Demonstration ofprodigality of nature - Frog.
4. Observation ofmutant forms in *Drosophila*.
5. Observation of variation in finger prints.
6. Observation of variations in the markings of Umbonium shells.
7. Demonstration of the effect of natural selection on gene frequency using beads.
8. Demonstration of the effect of genetic drift on gene frequency using beads.
9. Demonstration of sequence alignment by BLAST and construction of cladogram.
10. Identification of types of fossils.

Models / Charts / Specimen

Homology - fore limbs of vertebrates, Vestigial organs, Nautiloid fossil, *Limulus, Peripatus, Archaeopteryx*, Darwin finches, Industrial melanism, Ancon sheep, Monarch and Viceroy butterfly, Stick insect, Krait and *Lycodon*, Phylogenetic tree.

Semester VI

Major Practical V –Developmental Zoology & Immunologyand Microbiology

Course Code: ZC20P5

No. of hours/week	No. of credits	Total number of hours	Marks
4	2	60	100

Objectives

1. To familiarize the students with various immunological and microbiological techniques.
2. To implement experimental protocols and adapt them to carry out usingbiologicaltechniques.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	identify developmental stages, immune cells, lymphoid organs and microorganisms	PSO - 3	R
CO - 2	explain immunological and microbiological protocols.	PSO - 2	U
CO - 3	develop skills needed for future research in developmental Zoology, immunology and microbiology and biotechnology.	PSO - 1	Ap
CO - 4	differentiate the types of eggs, placenta, parts of immune system, Gram positive and negative bacteria and microbial and immunological assay applicable to clinical research.	PSO - 4	An

1. **Developmental Zoology**
2. Temporary mounting of Frogegg and sperm.
3. Temporary mounting and observation of Chick embryo.
4. Demonstration of induced ovulation in frog(virtual demonstration).
5. Effect of thyroxine on Amphibian metamorphosis (demonstration).
6. Observation of developmental stages in an insect.
7. Observation of frog's sperm motility.
8. Observation of regeneration in earthworm (demonstration).
9. Submission of report on chick embryo development.
10. Identification of types of egg based on shell and yolk.
11. Embryonic development of egg of Zebra fish (demonstration).

Museum specimens/ Slides/ Models/ Charts

Sperm and egg of Human, Cleavage (2, 4, 8 and 16 cell stage), blastula and gastrula of frog, Placenta – Diffuse, Discoidal, Zonary and Cotyledonary, Condoms, copper T, *Invitro* fertilization, budding in hydra.

Immunology & Microbiology

1. Dissection of Lymphoid organs of Rat (Virtual demonstration).
2. Demonstration of Radial immuno diffusion.
3. Demonstration of Hemagglutination.
4. Observation of immune cells – Blood smear preparation.
5. Preparation of culture media for bacteria and fungi.
6. Demonstration of Serial dilution technique.
7. Examination of bacterial motility by Hanging drop technique.
8. Identification of bacteria by simple staining.
9. Identification of bacteria by Gram staining.
10. Study of the effect of pH on growth of bacteria based on turbidity.

Charts/ Models/ Instruments

Escherichia coli, T4phage, Zika virus, Bacterial growth curve, Chemostat, Autoclave, Hot airoven, Inoculation loop, Haemocytometer, Micrometer- Stage and Ocular.

Semester V

Skill Based Course (SBC) – Vermitechnology

Course Code: ZSK206

No. of hours/week	No. of credits	Total number of hours	Marks
2	2	30	100

Learning Objectives

1. To impart knowledge on the production of vermicompost, a nutrient rich fertilizer.
2. To enable the students to generate and promote employment and organic farming.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	discuss the classification and categories of earthworms.	PSO - 1	U
CO - 2	explain the biology of earthworms.	PSO - 1	U
CO - 3	assess the importance of earthworms in soil fertility, medicine and pharmaceutics.	PSO - 5	E
CO - 4	design the methodology for vermiculture and for the production of vermicompost and vermiwash.	PSO - 8	Ap
CO - 5	prepare and market the vermicompost.	PSO - 7	Ap

Unit I

Vermitechnology: Definition and importance. Earthworm – Systematic position and salient features. Categories of earthworm – Anecic, Endogeic, Epigeic species. Biology of *Eisenia fetida, Lumbricus terrestris, Eudrilus eugenia, Megascolex mauritii.*

Unit II

Role of earthworms: soil fertility and productivity. Earthworm and microorganisms, Pest and diseases of earthworm, Economic and medicinal importance.

Unit III

Vermiculture: Collection and preservation. Vermiculture techniques -Types (monoculture and polyculture). Vermicast - formation, shape, composition and importance. Vermiwash – preparation, composition and applications.

Unit IV

Vermicomposting: Requirements – earthworm, site, bed, feed, moisture and oxygen. Steps of vermicomposting - selection of site, containers, species, food, preparation of vermibed, inoculation of worms, feeding, watering the wormbed. Methods of vermicomposting,

Unit V

Harvesting and marketing: Harvesting of earthworms and vermicompost. Packaging, storing, and marketing of vermicompost. Economic viability of vermicomposting. Vermi-remediation. Financial Support by Government and Non-Government funding agencies.

Text book

Seetha Lekshmy, M. and Santhi, R. (2012). *Vermitechnology*. Nagercoil: Saras Publications.

Reference Books

1. Mary Violet Christy, A. (2008). *Vermitechnology*. Chennai: MJP. Publishers.
2. Sultan Ahmed Ismail (2005). *The Earthworm* (2nd ed.). Goa: Other India Press.
3. Gupta, P.K. (2003). *Vermicomposting for sustainable Agriculture.* Jodhpur: Agrobios.
4. Ekambaranatha Ayyer (1989). *A Manual of Zoology, Part I, Invertebrata*. Chennai: S. Viswanathan Printers & Publishers Pvt. Ltd.
5. Dohama, A.K. (2004). *Vermicompost*, New Delhi: Vivekananda Kendra (NARDEP).
6. Dahama, A.K. (2009). *Organic farming for sustainable Agriculture* (2nd ed.). Jodhpur: Agrobios.

	Content addressed with Local Needs
	Content addressed with NationalNeeds
	Content addressed with Regional Needs
	Content addressed with Global Needs

M.Sc. Syllabus (2020 Board)

Semester I

Core I – Biochemistry

Course Code: PZ2011

No. of hours/ week	No. of credits	Total number of hours	Marks
6	4	90	100

Objectives

1. To impart knowledge on chemical structure, functions and metabolic process of biomolecules in living system.
2. To develop analytical and communicative skills to conduct experiments and interpret the results.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	L
CO - 1	efine structure and types of chemical bonds in biomolecules uch as hydrogen ions, water, protein, carbohydrate, lipid, ucleotides, enzymes and vitamins.	PSO - 1	R
CO - 2	xplain the fate of biomolecules in different metabolic pathways.	PSO - 1	U
CO - 3	pply cognitive, technical and creative skills to pursue higher udies and employability in industrial, biomedical and research boratories.	PSO - 4	p
CO - 4	nalyse biomolecules in biological systems and relate deficiency isorders.	PSO - 3	n
CO- 5	esign biochemical experiments and publish the results through ffective written and oral communication after drawing accurate onclusions.	PSO - 2	E

UNIT I (Ref. 1, 2, 3) **Basic concepts of biochemistry:** Scope. Atoms - molecules - chemical bonds - primarybonds and secondary bonds - pH and Hydrogen ion concentration - buffers - 'Henderson- Hasselbalch' equation - buffer systems in blood - mechanism of buffer action - acid basebalance - regulation of acid base balance - acidosis and alkalosis. Water – colligative properties - water turnover and balance - electrolyte balance - dehydration and waterintoxication.

UNIT II (Ref. 1, 2, 3**) Carbohydrates:** Classification, structure, properties of mono, oligo and polysaccharides and biological role of carbohydrates - Carbohydrate metabolism - glycogenesis, glycogenolysis, glycolysis, Krebs cycle, Electron transport and Oxidative phosphorylation, Energetics of glucose metabolism - Pasteur effect–HMP shunt - gluconeogenesis - glyoxylate pathway - Cori cycle - Regulation and hormonal control of carbohydrate metabolism - glycogen storage diseases - blood sugar level - Glycosuria - Glucose tolerance test - Diabetes.

UNIT III (Ref. 1, 2, 3) **Proteins:** Classification, structure, Ramachandran plot, properties and biological role. Amino acids - classification, structure and properties - metabolism of proteins - deamination, transamination - transmethylation and decarboxylation of amino acids -

glycogenic and ketogenic amino acids - formation and transport of ammonia - glucose- alanine cycle - Ornithine cycle - metabolism of phenylalanine, tyrosine and tryptophan. Porphyrins.

UNIT IV (Ref. 4, 5, 6) **Lipids**: Classification, structure and biological role - chylomicrons, VLDL, LDL, HDL - Lipid metabolism - theories of oxidation of fatty acids - oxidation of any one fatty acid andits bioenergetics (palmitic acid) -ketogenesis - biosynthesis of palmitic acid - metabolism of cholesterol - lipid storage diseases - role of liver in fat metabolism. Prostaglandins.Integration of carbohydrate, protein and lipid metabolism.

UNIT V (Ref. 4, 5, 6) **Nucleotide, Enzymes and Vitamins:** Biosynthesis and degradation of purines and pyrimidines**.** Enzymes: classification, nomenclature, enzyme kinetics, Michaelis - Menten constant, enzyme inhibition, mechanism of enzyme action, factors affecting enzyme activity, isozymes, coenzymes. Vitamins: Classification (fat soluble and water soluble), occurrence and biochemical role. Detoxification: mechanism of detoxification (oxidation, reduction, conjugation) - cytochrome P450 system.

Textbook

Ambika Shanmugam (2012). *Fundamentals of Biochemistry for Medical Students,* (7th ed.). Published by Wolters Kluwer. Madras: Navabharat Offest Works. Satyanarayana, U. and Chakrapani, U. (2013). *Biochemistry* **(**4th ed). India: Elsevier.

Reference Books

1. Chatterjea**,** M.N. andRanaShinde (2012). *Textbook of Medical Biochemistry* **(**8th ed.). New Delhi: Jaypee Brothers Medical Publishers Pvt. Limited.
2. Vasudevan, D. M., SreeKumari, S. andKannanVaidyanathan (2013). *Textbook of Biochemistry for Medical Students* (7th ed.). New Delhi: Jaypee Brothers Medical Publishers Pvt. Limited.
3. Nitin Jain, Jain, J.L. and Sunjay Jain (2014). *Fundamentals of Biochemistry*. New Delhi: S. Chand & Co. Ltd.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2006). *Biochemistry* (6th ed.). SanFrancisco: Freeman & Co. Publishers.
5. David L. Nelson and Michael M. Cox (2004). *Lehninger Principles of Biochemistry* (4th ed.). New York: W.H. Freeman and Company.
6. Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil (2018).*Harper's Illustrated Biochemistry* (31st ed.) New York: McGraw-Hill Education.

Semester I

Core II - Ecobiology

Course Code: PZ2012

o. of hours/ week	o. of credits	otal number of hours	Marks
6	4	90	100

Objectives

1. To impart knowledge on ecosystem, population, community, environmental pollutions and natural resources.
2. To develop the skill to sensitize environmental issues and work productively within and beyond the academy for sustainable environment.

Course Outcomes

CO - 1	efine various laws of ecology, components of ecosystem, haracteristics and dynamics of population and community, natural sources and environmental pollutants.	SO - 1	R
CO - 2	assify different types of ecosystem, habitat, environmental factorsand terpret the population processes, ecological succession, iological clock, biogeochemical cycles, biogeography, natural isasters and causes of pollution.	SO - 1	U
CO - 3	evelop cognitive, technical and creative skills which enable students r life-long learning and participate in environmental protection and onservation activities for sustainable environment nd gain employability.	SO - 3	Ap
CO - 4	nalyse the nature of ecosystem, habitat, population, community, atural resources and environmental pollutions.	SO - 2	An
CO - 5	ssess the environmental issues like population explosion, rbanization, depletion of natural resources, pollution and waste anagements.	SO - 2	E
CO - 6	rmulate hypotheses and test them by designing appropriate xperiments, analyze, interpret the data and communicate the results rough effective written and oral communication.	SO - 4	C

UNIT I(Ref. 1, 5)

Ecosystem and Habitat ecology: Scope of Ecobiology.Environmental concepts – laws and limiting factors. The environment – physical factors (climatic factors,topographic factors, edaphic factors), biotic factors and their interactions (symbiosis, commensalism, parasitism and competition- prey-predator interactions - Scramble and contest competition). Ecosystem: Concepts of ecosystem – structure and functions. Energy flow – single channel energy model, Y - shaped energy flow models. Productivity – Primary production, secondary production, measurement of primary productivity. Homeostasis of the ecosystem.Habitat ecology: freshwater, marine, estuarine, terrestrial and desert.

UNIT II (Ref.1, 2, 3, 10)

Population and Community: Population - structure and regulation, growth form, population fluctuations, population processes, life history strategies - diagrammatic and conventional life tables.Concept of Metapopulation. Community - basic terms, community structure, composition and stratification. Ecological niche, Ecotone and Edge effect, Ecotype.Ecological succession - types, general process, concept of climax.

UNIT III (Ref. 1, 6, 7, 11, 12)

Biogeochemical cycles: water cycle, carbon cycle, nitrogen cycle, sulphur cycle and phosphorous cycle. **Natural resource ecology**: classification of resource, mineral resource, land resource, forest resource, water resource, energy resource- conventional and non-conventional.**Remote sensing**: physical basis – information extraction – role in ecological research.**Natural Disaster Management**: Floods, earthquakes, cyclones, landslides, Tsunami, Mitigation and Disaster Management.

UNIT IV (Ref. 1, 9, 11, 12)

Biogeography: patterns of distribution (continuous, discontinuous, endemic), descriptive zoogeography, zoogeographical regions of the world. Dynamic biogeography (dispersal dynamics, dispersal pathways, migration, ecesis). **Biodiversity**: Importance, Human impact on biodiversity, Endangered wildlife species - special projects in India - IUCN red list - hot spots.Levels of diversity - species, genetic, ecosystem. GIS and satellite imaging in biodiversity assessment. Biodiversity indices**:** Shannon-Weiner index, Simpson index, Similarity and dissimilarity index, Association index. Conservation of species: *In situ* and *Ex situ*- Wildlife sanctuaries, national parks and biosphere reserves - Indian Board of Wild Life (IBWL) - National Board for Wild Life (NBWL) - Wild Life Conservation Laws and Trade Laws (CITES) in India.

UNIT V (Ref. 1, 4, 7, 11)

Pollution ecology: Green House gas emission and Global warming. Impact of chemicals on biodiversity - Pesticides and fertilizers in agriculture. Bio-indicator and biomarkers of environment. Carbon footprint, Carbon sink. Waste management: solid, liquid and gaseous wastes. e-wastes. Toxicology: Biomagnification and bioaccumulation, toxicants, classification, toxicity (LC50 and LD50), OECD Test Guidelines for the Chemicals (420, 423), mode of action of toxicants. **Urbanization**: Possible advantages of urbanization – problems, solutions – satellite villages- biovillages. Environmental ethics.Central and StatePollution Control Boards. Environmental auditing, Environmental impact assessment, Legislations for environmental Protection.

Textbook

Eugene P. Odum, Murray Barrick, Gary W. Barret (2005). *Fundamentals of Ecology* (5thed.). UK: Brooks/Cole Publishers.

Trivedi, P.C. and Sharma, K.C. (2003).*Biodiversity Conservation*. Jaipur: Avishekar Publishers.

Reference Books

1. Sharma, P.D. (2017). *Ecology and Environment* (13th ed.). Meerut: Rastogi Publications.
2. Begon and Mortimer (1992).*Population Ecology.* Delhi: UBS Publishers.
3. Dash, M.L. (1996). *Fundamentals of Ecology.* New Delhi: Tata McGraw Hill Publishing Company Ltd.
4. Subramanian, M.A. (2004). *Toxicology: Principles and methods.* Chennai: MJP Publishers.
5. Tyler Miller, G. (2004).*Environmental Sciences* (10thed.).Thomson Brooks,Chennai: ChennaiMicroprint Pvt. Ltd.
6. Prabu, PC.,Udayasoorian and G. Balasuramanian (2009). *An Introduction to Ecology and Environmental Science*. Delhi: Avinash Paperbacks.
7. Biswarup Mukherjee (2011). *Environmental Biology and Toxicology*. Faridabad: Silver LinePublications.
8. Benny Joseph (2005). *Environmental Studies* (2nded.).Delhi: Tata McGraw Hill Companies.
9. Bhatia, A.L. (2010). *Textbook of Environmental Biology*. New Delhi: I.K. International Publishing House Pvt. Ltd.
10. AnupamPandey (2012). Population Ecology. New Delhi: I.K. Discovery Publishing HousePvt. Ltd.
11. Ignacimuthu S.J. (2012). *Environmental Studies.*Chennai: MJP Publishers.
12. SupriyoChakraborty (2004). *Biodiversity.* Jaipur: Pointer Publishers.

Semester I

Core III - Structure and Function of Invertebrates

Course Code: PZ2013

No. of hours/ week	No. of credits	Total number of hours	Marks
5	3	75	100

Objectives

1. To provide knowledge on the functional aspects of systems of invertebrates on a comparative basis.
2. To empower students with skills to comprehend the taxonomical and physiological functions of vital systems in invertebrates.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	cognise the organisation of coelom, mode of locomotion, utrition, respiration, excretion and significance of larval forms f invertebrates.	PSO - 1	R
CO - 2	omprehend the systematic position and physiological functions f vital systems in invertebrates.	PSO - 4	U
CO - 3	pply the cognitive skills to pursue higher studies and mployability relevant fields.	PSO - 3	Ap
CO - 4	xplore the structure and functions of vertebrates.	PSO - 2	An

UNIT I (Ref.2, 5, 7)

Principle of Animal taxonomy: Species concept. International code of zoological nomenclature - Taxonomic procedures. New trends in taxonomy - Animal collection, handling

and preservation. Organization of coelom - Acoelomates -Pseudocoelomates- Coelomates. Protostomia and Deuterostomia.

UNIT II (Ref.1, 2, 3)

Locomotion and Nutrition: Pseudopodia – Flagella and ciliary movement in protozoa - hydrostatic movement in Coelenterata, Annelida and Echinodermata. Nutrition and digestion - patterns of feeding and digestion in lower metazoan – Filter feeding in polychaeta, Mollusca and Echinodermata.

UNIT III (Ref.1, 2, 3, 4)

Respiration and Excretion: Organs of respiration - gills, lungs and trachea -respiratory pigments - Mechanism of respiration. Excretion – organs of excretion - coelom, coelomoducts, nephridia and Malpighian tubules – mechanisms of excretion and osmoregulation.

UNIT IV (Ref.1, 2, 3, 4)

Nervous system: Primitive nervous system - Coelenterata and Echinodermata, Advance nervous system - Annelida, Arthropoda (crustacean and insects) and Mollusca (Cephalopoda). Endocrine organs in Invertebrates.

UNIT V (Ref.1, 2, 3)

Invertebrata larvae and Minor Phyla: Larval forms of free living invertebrates - Larval forms of parasites- Strategies and evolutionary significance of larval forms. Minor Phyla (structural features and affinity) - significance -organization and general characters.

Textbook

Jordan, E.L. and Verma, P.S. (2010).*Invertebrate Zoology***.**New Delhi: S. Chand & Co. Ltd.

Reference Books

1. Kotpal, R.L. (2004). *Modern Textbook of Zoology- Invertebrates* **(**9th ed.). Meerut: RastogiPublications.
2. Ayyar, E.K. and Ananthakrishnan, T.N. (1995). *Manual of Zoology, Vol. I (Invertebrata),Part I & II.* Madras: S. Viswanathan Printers and Publishers Pvt. Ltd.
3. Dhami, P.S. and Dhami, J.K. (1979). *Invertebrate Zoology.*Ram Nagar, New Delhi: S. Chand & Co. Ltd.
4. Jan, A. Pechenik (2002). *Biology of Invertebrates* (4th ed.). New Delhi: Tata McGraw-HillPublishing Company Ltd.
5. George Gaylord Simpson (2018). *Principles of Animal Taxonomy*. India: Scientific Publishers.
6. Lal, S.S. (2004). *A Text Book of Practical Invertebrate Zoology*.Meerut: Rastogi Publications.
7. Kapoor, V.C. (2019). *Theory and Practice of Animal Taxonomy and Biodiversity* (8th ed.).New Delhi: Oxford and IBH Publishers.
8. Barrington, E.J.W. (1969). *Invertebrate Structure and Function*. Great Britain. ThomasNelson and Sons Ltd.

Semester I

Core IV - Comparative Anatomy of Chordates

Course Code: PZ2014

No. of hours/ week	No. of credits	Total number of hours	Marks
5	3	75	100

Objectives

1. To provide the knowledge of origin, structure and function of different organ system ofvertebrates.
2. To develop the skills to analyse the anatomy of vertebrates and its significance.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	entify the morphology and anatomy of major groups of ertebrates.	PSO - 1	R
CO - 2	terrelate the development of integuments, circulatory system, spiratory system , skeletal system, sense organs and nervous ystem.	PSO - 1	U
CO - 3	pply the cognitive skills to pursue higher studies and gain mployability in academic and research institutions.	PSO - 3	Ap
CO - 4	halyse the anatomy of different groups of vertebrates.	PSO - 4	An

UNIT I (Ref. 1, 2, 8)

Protochordates: Origin of Chordata. Chordate characters - classification of protochordata- general characteristics, development and affinities of Hemichordata, Urochordata, Chephalochordata.

UNIT II (Ref. 1, 2)

Vertebrate Integument: Origin and classification of vertebrates. Vertebrate integument and its derivatives- development, general structure and functions of skin and its derivatives - glands, scales, horns, claws, nail, hoofs, feathers and hairs.

UNIT III (Ref. 1, 2, 6)

Circulation and Respiration: General plan of circulation in various groups - blood - evolution of heart - evolution of aortic arches and portal systems. Respiratory system - characters of respiratory tissue- internal and external respiration - comparative account of respiratory organs.

UNIT IV (Ref. 1, 2, 6)

Skeletal and Urinogenital system: Skeletal system - form, function, body size and skeletal elements of the body - comparative account of jaw suspensorium, vertebral column - limbs and girdles. Evolution of urinogenital system in vertebrate series.

UNIT V (Ref. 1, 2, 6)

Sensory and Nervous system: Sense organs - simple receptors - organs of olfaction, taste and hearing- lateral line system - electroreception. Nervous system - comparative anatomy of

thebrainin relation to its functions - comparative anatomy of spinal cord - nerves - cranial, peripheraland autonomous nervous system.

Textbook

Jordan, E.L. and Verma, P.S. (2011). *Chordate Zoology*. New Delhi: S. Chand and CompanyLtd.

Reference Books

1. EkambaranathaAyyar, M. and Ananthakrishnan, T.N. (1995).*A Manual of Zoology, Volume II(Part I & II)*.Chennai: S. Viswanathan Pvt. Ltd.
2. Kotpal, R. L. (2014). *Modern text book of Zoology – Vertebrates* **(**3rd ed.). Meerut: RastogiPublications.
3. Kingsley, J.S. (2016). *Outlines of Comparative Anatomy of Vertebrates*. Allahabad: Central BookDepot.
4. Milton Hilderbrand (1998). *Analysis of vertebrate structure*. (5th ed.). New York: John Wiley and SonsInc.
5. Dhami P.S. and Dhami J.K. (1972).*Chordate Zoology*. New Delhi: S. Chand and CompanyLtd.
6. Kardong, K. (2002). *Vertebrates: Comparative Anatomy, Function and Evolution.* Chennai:Tata McGraw Hill Publishing Company Ltd.
7. Young, J. Z. (2004). *The Life of Vertebrates* (3rd ed.). London: Oxford University Press.
8. Verma P.S. (2010).*A manual of Practical Zoology Chordates*.New Delhi: S. Chand & Co.Ltd.

Semester I

Elective I (a) - Animal Husbandry

Course Code: PZ2015

No. of hours/ week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To gain knowledge on livestock management and construction of farms.
2. To develop skills on livestock farming and extend it to the society.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	L
CO - 1	cquire knowledge on Livestock resources, construction and anagement of Livestock farms.	PSO - 1	
CO - 2	entify the breeds and stages of livestock.	PSO - 1	
CO - 3	nalyse the ethical laws formulated by the Animal Welfare oard.	PSO - 4	n
CO - 4	evelop entrepreneurial skills and gain employability in animal rms and research laboratories.	PSO - 3	p

UNIT I (Ref: 1, 2, 5, 7)

Livestock farming (Ruminants I): Prospects of livestock industry in India. Introduction and scope of cattle farming.Housing systems- selection of site, layout and design.Selectionof cattle - important exotic and indigenous breeds and their characteristics. Fodder production and preservation of green fodder.Management and feeding practices of calves, heifers, pregnant, lactating and dry animals, bulls and working animals.Cattle Diseases. Parasites – ecto and endo parasites.

UNIT II (Ref: 1, 2, 3, 4, 5, 6, 7)

Livestock farming (Ruminants II): Breeds of sheep and goat. Important economic traits for meat, milk and fibre. Management and feeding practices during different stages of growth and production (milk, meat and wool). Breeding schedule and management of ram and buck. Weaning and fattening of lambs and kids. Methods of milking and precautions.Factors affecting quality and quantity of milk production and milk products.

UNIT III (Ref: 1, 2, 5, 7)

Livestock (Non ruminants): Scope of swine farming. Importantexotic and indigenous breeds and their characteristics.Housing and feeding of swine. Management of different categories of swine: pregnant sows, pig-lets, growing stock, lactating sows. Horses, donkeys and mules: feeding, Foaling and care of newborn.Care of race horses and preparing horses for show.

UNIT IV (Ref: 1, 2, 5)

Laboratory and Pet animal management: Handling, weighing, sexing and weaning of laboratory animals (rat and rabbit). Marking for identification, Feeding schedule. Prophylactic measures and Hygienic care. Handling of dogs and pet birds - Feeding practices and care of young ones. Grooming and bathing of dogs. Marketing.

Unit V (Ref: 1, 8, 9, 10, 11, 12)

Animal welfare: Animal welfare and ethics - role and current status of Animal Welfare Board of India and other welfare organizations. Common offences against animals - Prevention of Cruelty to Animals (PCA) Act, 1960.Functions of Animal ethics committee (CPCSEA). Livestock Importation Act - Evidence, liability and insurance.

Textbook

Mathialagan, P. (2007).*Textbook of Animal Husbandry and Livestock Extension*. (3rd ed.). Lucknow: International Book Distributing Co.

Reference Books / Web link

1. Tarit Kumar Banrjee (2016). *Applied Zoology*. London: New Central Agency (P) Ltd.
2. SupritiSarkar, GautamKundu, KorakKantiChaki. (2016). Introduction to Economic ZoologyLondon: New Central Agency (P) Ltd.
3. Nagendra S. Pawar. (2008). *Applied Zoology*.New Delhi: Adhyayan Publishers.
4. Sukumar De. (2005). *Outlines of Dairy Technology*.New Delhi: Oxford University Press. 5.Williamson. G and Payne. J. A. (1978). *An introduction to Animal Husbandry in the Trophics*.London: Longman Group Limited.
5. Whyte. R. O. (1968). *Land, Livestock and Human Nutrition in India*. Delhi: UBS Publishers.
6. Cole. H. H. (1966). *Introduction to Livestock Production*. London: Freeman and Company.
7. https://www.oxfordscholarship.com.
8. http://www.awbi.in/about.html
9. https://indiacode.nic.in
10. https://www.nacenkanpur.gov.in
11. https://nacenkanpur.gov.in

Semester I

Elective I (b) - Health Care

Course Code: PZ2016

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To make the students realize the importance of the health of the body, developa healthy personality so as to live a healthy and successful life.
2. To acquire independent employable skills in voluntary organizations or in health sectors.

Course Outcomes

CO	pon completion of this course the students will be able :	PSO addressed	L
CO - 1	ɒell quality life and factors that determine health.	SO - 4	R

CO - 2	utline the concept of health and well-being, personal ealth care, maternal and child health, environmental and ental health, alternative medicine and first aid.	SO - 3	
CO - 3	ake use of the different aspects of health and well-beingin ay to day life.	SO - 3	p
CO - 4	xamine personal health problems and its remedies.	SO - 1	n

UNIT I(Ref.4)

Concept of health and well-being: Definition - Physical, mental, social and positivehealth - Quality of life. Determinants of health: Heredity - Environment - Lifestyle - Socio-economic conditions - Health services. Nutrition and Health: Nutrients that provide energy - Carbohydrates - Lipids - Proteins. Nutrients that regulate: Vitamins - Minerals - Water. Healthy diet - Food guide Pyramid - Snacking - Vegetarian diet - Fast food.

UNIT II(Ref.2)

Personal Health Care: Protecting skin - common skin problems - Dry Skin, Acne, Dermatitis, Psoriasis, skin infections – skin cancer - caring for the skin. Hair - General care, cleaning tips, preventing hair loss, Anti dandruff strategies. Teeth - Common dental problems - General care of teeth - Dental checkup. Eye - Common eye problems - Eye diseases - General care of eyes - Vision checkup. Ear - general care - do's and don'ts.

UNIT III(Ref. 2)

Maternal and Child Health: Motherhood - pregnancy confirmation test - Prenatal care - Intra natal care - problems during pregnancy - Miscarriage and stillbirth - premature birth -labor and delivery - Family planning. Child health: Care of the newborn - Feeding - Nutritional guidelines - Care of the under-five (Toddler and Preschool).

UNIT IV(Ref.2)

Environmental and Mental Health: Mental health: Characteristics - Types: Schizophrenia - Manic depressive psychoses - Paranoia - Neurosis - Personality and character disorders. Environmental health: health in the home environment - pollution at home - diseases. Safety at home: Fall - Fires - Poisoning - Electrical hazards - Safety in road (Auto mobile - Pedestrian) - Disaster management (Severe weather condition - Flood- Lightning - Cyclone - Earthquake – Landslides- Tsunami).

UNIT V(Ref. 1, 3, 5)

Alternative medicine and First aid: Naturopathy - Homeopathy- Ayurveda - Unani - Siddha. First aid: First aid procedures for dehydration - heart attack - fractures and dislocation, burns - bleeding - poisoning - electric shocks - drowning.

Reference Books

1. Park, K. (1995). *Park's Textbook of preventive and social medicine*. Jabalpur: M/S BanarsidasBhanot Publishers.
2. Getchell, Pippin and Varnes (2006). *Perspectives on Health*. USA: D C Heath & Co.
3. LakshmanaSarma and Swami Nathan. S. (1960). *Speaking of nature cure – Regain,retain and improve health the drugless way*. New Delhi: Sterling Publications Pvt. Ltd.
4. Tom Sanders and Peter (2004). *Emery Molecular basis of human nutrition*. London:Taylor and Francis Publishers.
5. Eva Roman (2008). *First aid*. New Delhi: Indiana Publishing House.

Semester II

Core V - Biostatistics, Computer Applications and Bioinformatics

Course Code: PZ2021

No. of hours/ week	No. of credits	Total number of hours	Marks
6	4	90	100

Objectives

1. To enable the students to collect and use the data to derive inferences in various biologicalexperiments.
2. To develop analytical skills of statistics and draw valid conclusions in research.

Course Outcomes

CO	Upon completion of this course the students will be able to :	PSO addressed	L
CO - 1	call different biological data, methods of collection, processing nd retrieval tools in sequence analysis.	PSO - 1	
CO - 2	xplainmeasures of dispersion,significance of data and soft wares pplied in biostatistics and biological databases.	PSO - 2	
CO - 3	nalyze the data and interpret the results manually or by using oftware.	PSO - 2	n
CO - 4	pply statistical and bioinformatics tools in research and gain mployability in Research and Development organizations.	PSO - 3	p
CO - 5	evaluate biological data and critically analyse the research findings.	PSO - 4	
CO - 6	rmulate hypothesis, solve problems and present data to the cientific community.	PSO - 4	

UNIT I (Ref. 1, 2, 7, 9)

Data collection and presentation: Population and sample in biological studies - variables - sampling methods. Types of biological data. Measurement scales - ratio scale, interval scale, ordinal scale, nominal scale - parameters and statistics. Accuracy and precision.Data collection and presentation: Tabulation - graphs - diagrams. Frequencydistribution - histogram - frequency curves and Ogives. Measures of central tendency: types of mean, median, mode.

UNIT II (Ref. 1, 2, 7, 8, 9)

Measures of dispersion: Range - quartile and percentile - mean deviation - standard deviation - coefficient of variation -skewness and kurtosis - standard error. Distribution: Binomial, Poisson and Normal. Parametric and non-parametric tests. Hypothesis testing - single and two population mean - types of error (Type I and Type II) - Chi-square analysis-test for goodness of fit and homogenecity.

UNIT III (Ref. 1, 2, 7, 8, 9)

Analysis of Data: Student's *t*-distribution - Analysis of variance (ANOVA): one way classification and two way classification (Factorial design). Probability: Addition theorem, multiplication theorem and conditional theorem. Permutation and combination.Correlation -

types, methods of study and testing the significance. Regression: equations –regression lines - simple linear regression and testing its significance. Mathematical modeling in biology: types and applications.

UNIT IV

Computer applications: Micrtosoft office - M.S. Power point. MS Excel. Statisticalfunction: Descriptive statistics -*t*-test, ANOVA, correlation, regression, Chi-square test, table and charts. Viruses and worms.Statistical Packages: SPSS, Minitab, Sigmaplot, Originpro (Brief account).

UNIT V (Ref. 10)

Bioinformatics: Scope - Biological data bases - Data base retrieval tools (Locus link, ENTREZ, Pubmed and SRS) - Nucleotide sequence data base (NCBI, EMBL) - Protein data base (Protein data bank-PDB). Data base similarity research tools (BLAST, MSA). Biological sequence analysis: sequence alignment, pair-wise alignment and multiple sequence alignment.Protein structure visualizing tools (RasMol, Swiss PDB Viewer).Applications of bioinformatics tools.

Textbooks

Gurumani, N. (2005). *An Introduction to Biostatistics.* Chennai: MJP Publishers.

Attwood, T.K and Parry Smith, D.J. (2005).*Introduction to bioinformatics.*Delhi: Pearson Education Pvt. Ltd.

Reference books

1. Pillai, R.S.N. and V.Bagavathi (2016).S*tatistics Theory and Practice* (8th ed.).NewDelhi: S. Chand PublishingCompany Ltd.
2. Khan, I. andKhanum, A. (2014). *Fundamentals of Biostatistics* (3rd ed.): Hyderabad. UkaazPublications.
3. Zar, J.H. (1984). *BiostatisticalAnalysis*(2nd ed.). London: Prentice-Hall InternationalInc.
4. Bailey, N.T.J. (1997). *Statistical methods in Biology* **(**3rd ed.). New York: Cam.University Press.
5. Sokal, R. and James, F. (1973). *Introduction to Biostatistics.* Tokyo, Japan: W.H.Freeman and Company Ltd.
6. Daniel, W.W. (1987). *Biostatistics: A foundations for Analysis in the Health Sciences*.New York: John Wiley &Sons.
7. Gupta, S.P. (1998). *Statistical Methods.* New Delhi: S. Chand and Company Ltd.
8. Banerjee, P.K. (2005). *Introduction to Biostatistics.*New Delhi: S. Chand and Company Ltd.
9. Pranab Kumar Banerjee (2009).*Introduction to Biostatistics*, New Delhi: S. Chandand Company Ltd.
10. Ignacimuthu, S. (2013) *Basic Bioinformatics* (2nd ed.)New Delhi: Narosa PublishingHouse.

Semester II

Core VI - Cell and Molecular Biology

Course Code: PZ2022

No. of Hours/ week	No. of Credits	Total Number of Hours	Marks
6	4	90	100

Objectives

1. To provide knowledge on the structure and functions of bio-membranes, cell organelles and signaling pathways.
2. To avail employment in educational institutions and research laboratories.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	L
CO - 1	cognize the structural and functional organization of plasma embrane, cell organelles, cell receptors, protein synthesis and bnormal cell growth.	SO - 1	
CO - 2	lustrate cellular organization and changes occurring in cells.	SO - 1	
CO - 3	nalyse the prokaryotic and eukaryotic cells, flow of genetic formation from DNA to protein, cell signaling and regulation of ell cycle.	SO - 2	n
CO - 4	valuate the changes in the cells, cell cycle and proteins involved the regulation and apoptosis.	SO - 4	
CO - 5	pply the principles and techniques of molecular biology for search and employment.	SO - 3	p

UNIT I (Ref. 1, 4)

Cell Structure and Functions of cell organelles: prokaryotic and eukaryotic cells - structure. Plasma membrane: Structure and function. Active transport and pumps- transport by transporter proteins - membrane potential.Tight junction, Gap junction. Cytoskeleton - Microfilaments, intermediate filaments and microtubules. Extracellularmatrix - Collagen and non-collagen components.

UNIT II (Ref. 4, 5)

Cell organelles and Nucleic acids: Structure and functions of Nucleus: Nuclear pores, Nucleolus. Mitochondria, Ribosomes, Endoplasmic reticulum (ER): Rough and SmoothER - Golgi complex - lysosomes. DNA and RNA: Types, structure and functions.

UNIT III (Ref. 1, 2, 3).

Signaling pathways: Cell adhesion molecules - Extra cellular signaling – signaling molecules and their receptors - Pathways of intracellular signal transduction: G protein coupled receptors - Cyclic AMP pathways - Receptor Tyrosine Kinases (RTKs): Ras, Raf and MAP kinase pathway - second messengers - signaling from plasma membrane to nucleus.

UNIT IV (Ref. 1, 6)

Protein synthesis and transport: Transcription and Translation in Prokaryotes and Eukaryotes. Gene regulation - positive and negative, Protein trafficking - sorting - transport from endoplasmic reticulum to Golgi, transport to lysosome - exocytosis - endocytosis. Membrane protein and secretory proteins.

UNIT V (Ref. 1, 3)

Normal and abnormal cell growth: Cell cycle - Mitosis - Meiosis. Regulation of cell cycle: Cyclin and Cyclin dependent kinases. Apoptosis - mechanism and significance. Molecular aspects of cancer, proto-oncogenes - oncogenes, tumour suppressor genes.

Textbook

Lodish, H. and Berk, A. (2016).*Molecular Cell Biology* (8th ed.). New York: W.H.Freeman and Company Limited Publication.

Reference Books

1. Gupta, P.K. (2014). *Cell and Molecular Biology* (4th ed.). New Delhi: Rastogi Publication.
2. Geoffrey M. Cooper and Robert E. Hausman (2013). *The cell: A Molecular Approach*
3. (6thed.). Massachusetts, USA: Sinauer Associates Publication.
4. Pranav Kumar and Usha Mina (2018). *Life Sciences – Fundamentals and Practice I.*
5. (4th ed.). New Delhi: Pathfinder Publication.
6. Powar C.B. (2010). *Cell Biology*. Hyderabad: Himalaya Publisher.
7. Alberts B., Johnson. A., Lewis, J., Raff, M., Roberts, K. and Watter, P. (2008).
8. *Molecular Biology of the Cell* (5th ed.). New York: Garland Science Publication.
9. De Robertis, E.D.P. (2011). *Cell and Molecular Biology* (8th ed.). New York: Lippincott Williams & Wilkins Publication.

Semester II

Core VII - Developmental Biology

Course Code: PZ2023

No. of hours/ week	No. of credits	Total number of hours	Marks
5	4	75	100

Objectives

1. To enable the students to gain knowledge on the process by which a zygote, multiplies,differentiates and develops into an adult.
2. To gain employment in fertility centers, hospitals and health centers.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	L
CO - 1	iscuss basic concepts and developmental processes of different rgan systems and techniques in reproductive biology.	PSO - 1	
CO - 2	istinguish the embryonic structures, origin and development of rgan systems.	PSO - 1	
CO - 3	nalyse the regulating mechanisms of developmental processes nd identify deformities.	PSO - 2	n
CO - 4	pply knowledge to pursue higher studies and gain mployability in biological research laboratories.	PSO - 3	p

UNIT I (Ref. 1, 2, 5)

Reproductive system: Historical perspectives and theories of embryology. Sexual and asexual reproduction - Parthenogenesis and types.Male reproductive system of a mammal, spermatogenesis, structure and function of sperm, semen and seminal fluid**.**Female reproductive system of a mammal, oogenesis, ovulation, vitellogenesis, types of eggs.

UNIT II(Ref. 1, 2, 3)

Fertilization and molecular aspects: Mechanism of fertilization, theories of fertilization. Cleavage: Laws - planes - patterns - chemical changes during cleavage. Cleavage and blastulation in chick and mammal.Cell lineage, fate map of chick and mammal.

UNIT III(Ref. 1, 2, 4)

Morphogenetic movements and Organogenesis in chick and mammals: Gastrulation - germinal layers and their derivatives, neurogenesis, notogenesis, development of mesoderm and coelom. Organogenesis: eye, skin and its derivatives, heart, kidney, limbs, alimentary canal and its derivatives.

UNIT IV(Ref. 1, 3, 6)

Development of reproductive organs in man: development and differentiation of testis, development of male genital ducts and accessory glands. Development and differentiation of ovary, development of female genital ducts and accessory glands.Teratogenesis and teratogens.Infertility - causes and treatment, development of extra embryonic membranes.Placentation in mammals.

UNIT V (Ref. 1, 3, 5)

Embryonic induction, Metamorphosis and Regeneration: Embryonic induction in vertebrates - types - exogenous and endogenous. Theories of organizer or inductor, competence. Differentiation - characteristics and types, selective action of genes in differentiation. Metamorphosis in insects and amphibians.Neoteny. Regeneration - regenerative ability in animals and mechanism.

Text Book

Balinsky, B. I. (2012). *An Introduction to Embryology* (5th ed.). Philadelphia: CengageLearning Publishers.

Reference books

1. Jain, P.C. (2017). *Elements of Developmental Biology (Chordate Embryology).* NewDelhi: Vishal publishing Co.
2. Wolpert, L. (2010). *Principles of Development* **(**4th ed.). United Kingdom: OxfordUniversity Press.
3. Ronald W. Dudek and James D. Fix (2005). *Embryology* **(**3rd ed.). Philadelphia, USA: Lippincott Williams and Wilkins Publication.
4. Chattopadhyay, S. (2017). *An Introduction toDevelopmental Biology* (2nd ed.). Kolkata: ArnbhaSen, Books and allied (P) Ltd.
5. Twyman, R. M. (2004). *Developmental Biology*. New Delhi: BIOS ScientificPublishers.
6. Verma, P. S. and Agarwal, V. K. (2014). *Chordate Embryology: Developmental Biology*. New Delhi: S. Chand and Company Ltd.
7. Gayatri Prakash (2007). *Reproductive Biology*. United Kingdom: Alpha Science International Ltd.
8. Sastry, K.V. and Shukla, V. (2003). *Developmental Biology* (1st ed.). New Delhi: Rastogi publications.

Semester II

Core VIII - Research Methodology

Course Code: PZ2024

o. of hours/ week	**No. of credits**	**otal number of hours**	**arks**
5	4	75	00

Objectives

1. To enable the students to understand the working principles of bio-instruments andmethodologies used in biological investigations.
2. To enhance report writing skills and create self-employment opportunities.

Course Outcomes

CO	**pon completion of this course the students will be able :**	**PSO addressed**	**L**
CO - 1	utline the principles and working mechanism of laboratory quipments and research techniques.	PSO - 1	
CO - 2	xplain laboratory or field procedures, methods, and strumentation for biological studies.	PSO - 1	
CO - 3	nalyze scientific methods to develop hypotheses, design and xecute experiments by selecting the appropriate research chniques.	PSO - 2	n
CO - 4	onceptualize research processes, data presentation, report riting and publication in journals.	PSO - 3	p
CO - 5	valuate scientific ideas and design experiments to address edical, social and environmental problems.	PSO - 4	

UNIT I (Ref. 1, 2)

Microscope: Principle - types - interference, fluorescence, confocal, electron microscopes scanning tunneling microscope, atomic force microscope, near field scanning optical microscope, magnetic force microscope. Photomicrography.

UNIT II (Ref. 1, 2, 5)

Centrifugation: Principle - factors affecting sedimentation rate - Types and applications of centrifuges. Cryotechniques- cryopreservation. **Cytotechnique**: Whole mounts. Microtome: Rotary and Freezing microtome. Microtomy: Fixation - dehydration - clearing- embedding - sectioning - staining - mounting.

UNIT III (Ref. 3, 4, 5)

Chromatography: Principle, types - gas and liquid chromatography - High Performance Liquid Chromatography - Ion exchange - Affinity chromatography. **Electrophoresis**:Principles, types - gel - Polyacrylamide gel, agarose gel, Blotting techniques,Iso electric focusing - Immunoelectrophoresis. Protein sequencing methods.

UNIT IV (Ref. 3, 4, 5)

Spectroscopy: principle, types - UV-Visible Spectroscopy, Atomic Absorption Spectroscopy, flame photometer, chemiluminometer, Nuclear Magnetic Resonance spectroscopy, FTIR spectrometry - Electron Spin Resonance, Magnetic Resonance Imaging - applications. Radio activity counters.

UNIT V (Ref. 6, 7)

Experimental design and Report writing: Essential steps in research - Literature collection - Review of literature - Bibliography - Literature citation - Research report - Tables - Figures - Formatting and typing - Online literature collection - open access journals - Predatory journals - Impact factor - Citation index- H-index- Plagiarism - Copy Right - Patent.

Textbooks

Veerakumari, L. (2006). *Bioinstrumentation.*Chennai: MJP Publishers.

Gurumani, N. (2006).*Research Methodology for Biological Sciences*.
Chennai: MJPPublishers.

Reference Books

1. Marimuthu, R. (2008). *Microscopy and Microtechnique*. Chennai: MJP Publishers.
2. Prakash, M. and C.K. Arora (1998). *Microscopical Methods*. New Delhi: AnmolPublications Pvt. Ltd.
3. Keith Wilson and John Walker (2018). *Principles and Techniques of Practical Biochemistry* (8th ed.). United Kingdom: Cambridge University Press.
4. Pranav Kumar (2018). *Fundamentals and Techniques of Biophysics and MolecularBiology*. New Delhi: Pathfinder publication.
5. RamnikSood (2006). *Medical Laboratory Technology*. New Delhi: Jaypee BrothersMedical Publishers Pvt. Ltd.
6. R. Paneerselvam. (2016). *Research Methodology.* New Delhi: PHI Learning Pvt. Ltd.
7. Gurumani. N. (2010).*Scientific thesis writing and paper presentation*. Chennai: MJPPublishers.

Semester II

Elective II (a) - Animal Behaviour and Chronobiology

Course Code: PZ2025

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To acquaint students with deep understanding of Animal behaviour and Chronobiology.
2. To develop skills of animal watching and procure jobs in sanctuaries.

Course Outcomes

CO	pon completion of this course the students will be able :	PSO addressed	L
CO - 1	escribe animal behaviour, reflexes, biological rhythms and hronobiology.	PSO - 1	
CO - 2	ummarize the history of ethology, social behaviour in nimals, organization of circadian system in multicellular nimals.	PSO - 1	
CO - 3	lustrate the developing compassion towards animals, group election, altruism, predict biological clock system, circadian acemaker system in vertebrates.	PSO - 1	p
CO - 4	nalyse the patterns of animal behaviour and complexity of iological clock system in vertebrates.	PSO - 3	n
CO - 5	ssess the relevance of biological clocks for human welfare nd taking decisions.	PSO - 4	

UNIT I(Ref. 1, 3, 4, 5, 6)

Introduction to Animal Behaviour: Principles of Animal Behaviour, Historicalperspectives of ethology, Approaches to animal behaviour. Ethogram - Methods and recording of a behaviour. Innate behavior, Neurological basis of animal behaviour, hormonal control of behaviour.

UNIT II(Ref. 1, 4, 5, 7)

Patterns of Behaviour: Reflexes - types, reflex path, characteristics of reflexes. Orientation: Primary and secondary orientation, kinesis - orthokinesis, klinokinesis; taxis - tropotaxis, klinotaxis, menotaxis, mnemotaxis. Learning: Associative learning, classical and operant conditioning, Habituation and Imprinting. Memory - types of memory.

UNIT III(Ref. 1, 4, 5)

Social and Sexual Behaviour: Social Behaviour: Concept of Society; various modes of animal communication. Altruism; Insect's society with Honey bee as example; Foraging in honey bee and bee communication.Nesting behavior in birds.Sexual Behaviour: Matechoice,

intra-sexual selection (male rivalry), inter-sexual selection (female choice), sexual conflict in parental care.

UNIT IV(Ref. 1, 6, 8, 9, 10)

Introduction to Chronobiology: Historical developments in chronobiology; Biological oscillation: the concept of average, amplitude, phase and period. Biological clocks: centraland peripheral biological clock, adaptive significance of biological clocks, Chronopharmacology, Chronomedicine, Chronotherapy.

UNIT V(Ref. 1, 2)

Biological Rhythm: types of biological rhythms: short- and long- term rhythms, Circadian rhythms - molecular biology of the circadian pacemaker system, Tidal rhythms and Lunar rhythms. Circannual rhythms, Photoperiod and regulation of seasonal reproduction of vertebrates, Role of melatonin.

Textbook

Agarwal, V.K. (2009). *Animal Behaviour* (*Ethology*). New Delhi: S. Chand and Company Ltd.

Reference Books / web link

1. Sanjib Chattopadhyay (2012). *LIFE: Evolution, Adaptation and Ethology*. Kolkata: Books and Allied (P) Ltd.
2. Chandrashekaran, M.K. (1985). *Biological Rhythms*.Madras Science Foundation.
3. Mohan P. Arora. (2016). *Animal Behavior*. Chennai: Himalaya Publishing House.
4. Auprey Manning and Mariam Stamp Dowkins (2012).*An Introduction to Animal behavior*. UK: Cambridge University Press.
5. Slatter P. J. B. (1985). *An Introduction to Ethology*. UK: Cambridge University Press.
6. Saha T. K. (2009). *An Introduction to Animal behaviour*. Delhi: Emkay Publications.
7. Machve K. K. (2016). *Evolution of Animal Behaviour*. Thiruvananthapuram: ManglamPublications.
8. http://www.apiindia.org/pdf/progress_in_medicine_2017/mu_75.pdf
9. https://www.pharmatutor.org/articles/chronopharmacology-overview
10. https://www.sciencedirect.com/topics/medicine-and-dentistry/chronotherapy

Semester II

Elective II (b) - Bioinformatics

Course Code: PZ2026

No. of hours/week	No. of credits	Total number of hours	Marks
4	3	60	100

Objectives

1. To understand the application of computer technology, to study and process biological data.
2. To develop skills to use bioinformatics tools.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	L
CO - 1	escribe the basics of bioinformatics.	PSO - 1	
CO - 2	hoose bioinformatics tools and data bases.	PSO - 1	
CO - 3	terpret sequence alignment and alignment programs.	PSO - 2	
CO - 4	entify the tools for drug discovery, docking and molecular hylogeny.	PSO - 3	n
CO - 5	se bioinformatics tools for molecular data analysis and ubmission.	PSO - 4	p

UNIT I (Ref. 1)

Introduction to Bioinformatics and databases: Introduction and definition, applications, Databases: Types of databases. Biological databases: nucleotide sequence databases - GenBank, DDBJ, EMBL, NCBI; Protein sequence databases - PDB, Uniprot, TrEMBL; NDB. Chemical databases; PubChem,ChemBank, CSD; Bibliographic databases- MEDLINE, PUBMED.

UNIT II (Ref. 1)

Sequence Analysis: Sequence alignment and alignment programs; Comparison of two sequences - Dot Matrix analysis; Scoring schemes - PAM Matrices and BLOSUM Matrices; Dynamic programming- Needleman-Wunch algorithm, Smith-Waterman algorithm, BLAST and FASTA; Multiple Sequence Alignment, ClustalW; Storing alignments.

UNIT III (Ref. 6, 7)

Drug Designing: Drug discovery process - drug target identification, target validation, Lead compound identification, Lead optimization, Docking (importance, mechanics of docking, docking sites), Quantitative structure-activity relationship. Preclinicaland clinical development.

UNIT IV (Ref. 1)

Phylogenetic analysis: Molecular phylogenetic analysis; methods of phylogenetic analysis - phenetic and cladistic; phylogenetic trees, methods for determining evolutionary trees - maximum parsimony, distance and maximum likelihood; phylogenetic software resources.

UNIT V (Ref. 1)

Genomics and Proteomics: Central dogma of molecular biology. Genomics - structural, comparative and functional. Proteomics - expression, structural and functional. Types of sequences used in Bioinformatics – DNA sequences, RNA sequences, Protein sequences.

Textbook

Rastogi, S. C. Mendiratta, N. and Rastogi, P. (2011).*Bioinformatics*. PHI Learning PrivateLimited, New Delhi.

Reference Books

1. Attwood, T.K. and Parry-Smith, D.J. (2006). *Introduction toBioinformatics*. DorlingKindersley Publication: Delhi.
2. Gladis Helen Hepsyba, S. and Hemalatha, C.R. (2009). *Basic Bioinformatics.* Chennai:MJP Publishers.
3. John De Britto, A. (2011). *Bioinformatics.* Sivakasi; Anto Art Craft Printers.
4. Sundaralingam, R. and Kumaresan, V. (2008). *Bioinformatics.* Nagercoil: SarasPublication.
5. Jin Xiong (2006). *Essential Bioinformatics.* UK: Cambridge University Press.
6. Hooman H. Rashidi and Lukas K. Buehler (2000). *Bioinformatics Basics: Application in Biological Science and Medicine.* New York: CRC Press.
7. Mohan Bansal, A.S. (2003). *Medical Informatics – A primer.* New Delhi: TataMcGraw- Hill Publishing Company Ltd.

Semester I

Practical I - Biochemistry and Ecobiology

Course Code: PZ20P1

No. of hours/week	No of credits	Total number of hours	Marks
4	4	60	100

Objectives

1. To design and perform biochemical experiments.
2. To understand the interaction between abiotic and biotic environment.

Course Outcomes

CO	pon completion of this course the students will be able :	PSO addressed	L
CO - 1	escribe the knowledge necessary for professional or cademic work in the field of biochemistry and ecology.	PSO - 1	
CO - 2	nalyse the biomolecules and physico-chemical parameters samples.	PSO - 2	n
CO - 3	evelop drawing and writing skills and design experiments.	PSO - 4	p
CO - 4	stimate the components of an ecosystem.	PSO - 2	

Biochemistry

1. Colorimetry- verification of Beer-Lambert's law.
2. Preparation of Acid & Alkali solutions and acid-base titration applying Henderson-HasselBalch' equation.
3. Preparation buffers of known pH and solutions of known molarity, normality,percentage, ppt, ppm.
4. Chromatographic separation of amino acids.
5. Quantitative estimation of glucose (Blood/ Tissue).
6. Quantitative estimation of protein (standard graph).
7. Quantitative estimation of total lipid (Blood/ Tissue).
8. Quantitative estimation of ascorbic acid.
9. Quantitative estimation of blood urea.
10. Determination of salivary amylase activity in relation to substrate applying Michaelis -Menten equation.

Instruments/ Charts/Models

Colorimeter, pH Meter, Centrifuge, Chromatogram, Electrophoretic unit

Ecobiology

1. Measurement of primary productivity (O_2 measurement method).
2. Sampling of animal population using quadrat method.
3. Observation of life table in an insect.
4. Collection and identification of freshwater planktons.
5. Measurement of turbidity using Secchi disc.
6. Estimation of LC50 of a pesticide.
7. Estimation of H_2S in water sample.
8. Estimation of salinity in water sample.
9. Estimation of CO_2 in water sample.
10. Study report of a pond ecosystem.

Specimen/ Chart/ Models

Commensalism (Shark and *Echeneis*), Mutualism (Sea anemone and Hermit crab),Food chain, Food web, Conventional energy source (coal) and non-conventional energy source (wind mill).

Semester II

Practical II - Biostatistics, Computer applications and Bioinformatics&Cell and Molecular Biology

Course code: PZ20P2

No. of hours/week	No of credits	Total number of hours	Marks
4	4	60	100

Objectives

1. To design an experimental problem and evaluate critically with inferential biostatisticsand necessary computer skills.
2. To develop the skills involved in cell biology, histology and biomolecules separationtechniques.

Course Outcomes

CO	pon completion of this course the students will be able to:	PSO addressed	L
CO - 1	nalyze and interpret the collected data using statistical ethods manually and soft wares.	PSO - 1	n
CO - 2	valuate the biological samples applying research techniques.	PSO - 2	
CO - 3	evelop drawing and writing skills through record and design xperiments.	PSO - 2	p
CO - 4	esign biological experiments.	PSO - 2	

Biostatistics, Computer applications and Bioinformatics

1. Collection of biological data (Primary and Secondary).
2. Classification and representation (Graphical and Diagrammatic) of collected data.
3. Measures of dispersion- standard deviation and standard error.

4. Estimation of population by Mark and Recapture method using beads.
5. Correlation co-efficient – length and width of molluscan shells.
6. Study of probability using coin tossing with 2 and 3 coins and chi square test.
7. Regression Analysis.
8. Test of significance (student's *t*-test).
9. Preparation of graph using M.S. Excel.
10. Retrieval of DNA and protein sequence from NCBI.
11. Visualizing protein structure using RasMol.

Charts/ Models

NCBI, SWISS-PROT and PubMed

Cell and Molecular Biology

1. Isolation and observation of sub cellular organelles.
2. Observation of mitosis - onion root tip.
3. Observation of meiosis - grasshopper testis.
4. Observation of polytene chromosome - salivary gland of Chironomus larva.
5. Barr-body identification.
6. Observation of striated muscle fibre - coxal muscle of cockroach.
7. Observation of adipocytes - fat body of cockroach.
8. Haemolymph smear (Cockroach).
9. Whole mount preparation of a specimen.
10. Sectioning and staining of a tissue.

Spotters/ Slides

Fluid mosaic model, Golgi complex, Cancer cell, Cadherins, Karyotype, Haemocytometer

Semester III
Core IX - Physiology
Course Code: PZ2031

Hours/ Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To impart knowledge on the structure and functions of various organs, organ systems and associated disorders.
2. To develop skills relevant for pursuing higher education and apply the knowledge in their life.

Course Outcomes

CO	pon completion of this course the students will be ble to:	PSO addressed	CL
CO - 1	call the structure and functions of organ systems.	SO - 1	R
CO - 2	escribe the anatomy of different physiological systemsat e tissue and cellular levels.	SO - 1	U
CO - 3	arry out physiological studies in the laboratory, terpret data and graphs and write a report.	SO - 2	Ap
CO - 4	nalyze the physiological changes in relation to nvironmental conditions.	SO - 3	An
CO – 5	valuate the physiological functioning of different rgans.	SO - 4	E

UNIT I

Nutrition: types of nutrition and feeding mechanisms in animals. Digestion - Functional anatomy of the digestive system (human), Movements of gastrointestinal tract, Secretory functions of the alimentary tract and glands, Digestion and absorption. Metabolism of protein, carbohydrate and lipid. Balanced diet – Malnutrition - Energy balance – BMR. Gastrointestinal disorders: Gall stones, liver cirrhosis, gastritis, peptic ulcer and appendicitis.

UNIT II

Respiration and Homeostasis: Respiratory organs and respiratory pigment in animals, Physiological anatomy of the respiratory system (human), Transport of respiratory gases, Regulation of respiration, Respiratory problems - bronchial asthma, pneumonia and pulmonary tuberculosis. Homeostasis: Osmoregulation - types and mechanism. Thermoregulation – classification, thermoregulatory mechanism in animals, aestivation and hibernation, Deep sea physiology, High altitude and space physiology, Effects of exposure to cold and heat. Bioluminescence – physiology and functions.

UNIT III

Circulation: Components and functions of blood, Blood clotting. Haemopoiesis. Myogenic and neurogenic heart. Functional anatomy of human heart, Cardiac cycle, pacemaker, heart rate, Bradycardia and tachycardia, Regulation of cardio- vascular system. Blood pressure, sphygmomanometer, Electrocardiogram (ECG), Heart diseases (Atherosclerosis, coronary thrombosis and angina pectoris). Lymphatic system - organization, composition of lymph and functions.

UNIT IV

Neuro-muscular system: Structure of the brain and neuron, Neurotransmitters, Synapse, Nerve impulse conduction, Reflex activity, Inborn and conditioned reflex actions, Electroencephalogram. Neural disorders - Meningitis and epilepsy. Types of muscle, structure and properties of skeletal muscle, Mechanism of muscle contraction, Neuromuscular junction. Sense organs - Structure and functions of skin, eye and ear.

UNIT V

Excretion and Reproduction: Excretory organs in different groups of animals, Patterns of excretion, Structure and function of kidney (human), Nephron, Formation of urine, Micturition, Renal disorders – nephritis, renal calculi, Dialysis. Structure of testis and ovary (human), oestrus and menstrual cycle, ovulation, pregnancy, parturition and lactation, hormonal regulation of reproduction.

Reference Books

1. Sembulingam, K. & Prema Sembulingam (2013). *Essentials of Medical Physiology* 6th ed.). Bangalore: Jaypee Brothers Medical Publishers Pvt. Ltd.
2. Guyton & Hall (2010). *Textbook of Medical Physiology* (12th ed.). Philadelphia:John E. Hall, Saunders Elsevier.
3. Elaine N. Marieb (2003). *Human Anatomy and Physiology* (6th ed.). San Francisco: Daryl Fox publisher.
4. Sawant, K.C. (2011).*Human Physiology*. New Delhi: Wisdom Press/ Dominant

Publishers and Distributors Pvt Ltd.
5. SaradaSubrahmanyam&Madhavankutty, K. (2001). *Textbook of Human Physiology* (6th ed.). New Delhi: S. Chand and Company Ltd.
6. William. S. Hoar (1984). *General and Comparative Animal Physiology* (2thed.).Prentice Hall of India.
7. Prosser, C. L. (1991). *Comparative Animal Physiology* (4th ed.). United States: JohnWiley and Sons Ltd.
8. Nielsen Knut Schmid (2007). *Animal Physiology, Adaptation and Environment*
9. (5th ed.). New Delhi: Cambridge University Press.
10. Nagabushanam, R., Kadarkar, M.S. &Sarojini, R. (2002). *Textbook of Animal Physiology.* New Delhi: Oxford and IBH Publishing Company.
11. Sobti, R.C. (2008). *Animal Physiology.* New Delhi: Narosa Publishing HousePvt. Ltd.
12. Rastogi, S.C. (2007). *Essentials of Animal Physiology* (6th ed.). New Delhi: JBA Publishers.

Semester III

Core X - Genetics and Evolution

Course Code: PZ2032

Hours/ Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To enrich the knowledge on the principles of heredity at molecular level and to discern the evolutionary significance.
2. To develop skills for assessing heritability, identifying genetic disorders and constructing phylogenetic trees.

Course Outcomes

O	**pon completion of this course the students will be able :**	**PSO addressed**	**L**
O - 1	call the principles of inheritance, mutation, genetic is orders, genetic equilibrium and patterns of evolution.	SO - 1	
O - 2	escribe Linkage and crossing over, Gene concept, Hardy einberg law and gene frequency, principles and methods of olecular evolutionary studies.	SO - 1	U
O - 3	terpret the heritability and its measurements, molecular and io chemical basis of genetic diseases, gene frequencies of o pulation, Universal Tree of Life, cultural evolution of man.	SO - 2	p
O - 4	halyse the expressivity of genes, chromosome mapping, heritance of particular character through Pedigree chart, actors affecting Hardy Weinberg equilibrium and hylogenetic relationship.	SO - 3	n

O - 5	valuate allelic and non-allelic interactions, effects of utation, selection, migration, adaptation on Mendelian opulation.	SO - 4	

UNIT I

Mendelian Genetics: Mendelian principles (Dominance, segregation, independent assortment). Allelic and non-allelic interactions. Penetrance, expressivity and pleiotropism. Linkage and crossing over – types – mechanism – theories. Chromosome mapping - linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids. LOD score linkage test. Polygenic inheritance. Heritability and its measurements. QTL mapping.

UNIT II

Molecular and Human Genetics: Gene concept. Mutation – types and effects of gene mutation – mutagens – insertional mutagens. DNA damage and repair. Inter and Intra chromosomal aberrations. Ploidy - kinds – mechanism – significance. Human chromosomes, Karyotyping, Chromosomal banding and painting. Pedigree analysis. Inborn errors of metabolism: Disorders of amino acid metabolism (phenylketonuria, alkaptonuria, albinism), Disorders of nucleic acid metabolism (Gout, ADA deficiency), Disorders of carbohydrate metabolism (Pompe's, G_6PD deficiency), Disorders of lipid metabolism (Tay Sach's disease, Gaucher's disease), Hemoglobin disorders (sickle cell anemia, thalassemia).

UNIT III

Population Genetics and Evolution: Mendelian populations - gene pool and gene frequencies - Hardy Weinberg law and genetic equilibrium. Calculation of gene frequencies for autosomal (dominant and recessive alleles, codominant alleles and multiple alleles) and sex-linked genes. Factors affecting Hardy Weinberg equilibrium – selection - heterozygous advantage – mutation – migration – random genetic drift – Founder's effect. Genetic load and death - neutralist hypothesis - genetic polymorphism.

UNIT IV

Molecular evolution: Principle – methods of molecular evolution – nucleotide substitution (types and rates). Interpretation of variation in DNA sequence. Molecular clock. Origin of new gene functions – evolution of novel genes and proteins. Molecular phylogeny – phylogenetic tree – reconstruction of phylogenetic relationship – Distance Matrix approach and Parsimony based approach - kinds of molecular phylogenies – Universal Tree of Life. Phylogenetic and biological concept of species. Adaptive radiation. Isolating mechanisms. Modes of speciation (allopatry and sympatry).

UNIT V

Origin of higher categories: Major trends in the origin of higher categories. Microevolution, macroevolution, megaevolution and co-evolution. Evolution rates, phyletic gradualism and punctuated equilibrium. Origin and Evolution of Primates: Evolution of Anthropoid Primates - The first hominids and origin of modern man - Bipedalism – communication – speech – language - altruism and morality. Evolution of culture.

Reference Books

1. Verma, P.S. &Agarwal, V.K. (2010).*Genetics* (9th ed.). New Delhi: S. Chand Publishing.
2. Verma, P.S. &Agarwal, V.K. (2004).*Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.* New Delhi: S. Chand Publishing.

3. Peter Snustad, D. & Michael J. Simmons (2009).*Principles of Genetics* (5th ed.).USA: John Wiley & Sons, Inc.
4. Eldon John Gardner, Michael J. Simmons & D. Peter Snustad (2005). *Principles of Genetics*(8th ed.). New Delhi: Wiley (India) Pvt. Ltd.
5. Monroe W. Strickberger (2015). *Genetics* (3rd ed.). India: Pearson Education.
6. Robert F. Weaver and Philip W. Hedrick (1989).*Genetics*.New York: W. M. C.Brown Publishers.
7. Emmanuel. C., Rev. Fr. Ignacimuthu, S. & Vincent, S. (2006). *Applied Genetics*. Chennai: MJP Publishers.
8. Hickey, G. I., Fletcher, H. L. &Winter, P. (2010). *Genetics.* New York: Taylor and Francis Group Publications.
9. Sanjib Chattopadhyay (2008). *Evolution, Adaptation and Ethology.*Kolkata:Books and Allied Pvt. Ltd.
10. Maynard Smith, J. (1999).*Evolutionary Genetics.* England: Oxford UniversityPress.
11. Monroe W. Strickberger (2000). Evolution (3rd ed.). Sudbery, Massachusetts: Jones and Bartlett Publishers.
12. Ledyard Stebbins (1971). *Processes of organic evolution.*
13. Mark Ridley (1996). *Evolution.* England: Blackwell Science Ltd.
14. Arora, M. P. (2000). *Organic Evolution.*Mumbai: Himalaya Publish House.
15. Tomar, B.S. & Singh, S.P. (2000). *Evolutionary Biology.* Meerut: Rastogi Publications.
16. Ahuja, N. (2008). *Evolution and Population Genetics.* New Delhi: Pearl Books.
17. Savage, J.M. (1969). *Evolution.* New Delhi: Amerind Publishing Co. Pvt. Ltd.

Semester III

Core XI - Culture and Capture Fisheries

Course Code: PZ2033

Hours/ Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To impart knowledge on the construction, maintenance and management of cultivableorganisms in aqua farms.
2. To practice aqua farming and extend it to the society.

Course outcomes

O	pon completion of this course the students will be ableto	PSOs addressed	L
O - 1	call the culture of finfish, shellfish and their management.	SO - 1	
O - 2	escribe different types of aquatic organisms, construction of onds, nutrition and breeding in aquaculture.	SO - 1	
O - 3	late culture practices, breeding techniques, fish pathology, shery genetics.	SO - 2	p
O - 4	nalyse physico-chemical and nutritional factors for ptimizing aquaculture, fish marketing and preservation.	SO - 3	n
O - 5	ssess profitability of an established aqua farm.	SO - 4	

UNIT I

Purpose and importance of aquaculture - basic qualification of candidate species - cultivable freshwater and marine fishes - global and Indian scenario of aquaculture. Construction and maintenance of fish farm: selection of site - lay-out and types of ponds - aquatic plants and their control - control of fish predators - liming - fertilization of ponds. Kinds of aquaculture - Integrated fish farming - Sewage fed fish culture - Pen and cage culture.

UNIT II

Nutrition and Breeding: Nutritional requirements - Culture of fish feed organisms - phytoplankton (diatom), zooplankton (rotifers, cladocerans), Artemia, Tubifex. Artificial feed and feed formulation. Seed collection: Sex identification – collection, rearing and selection of brooders - induced breeding by hypophysation - ovaprim - transportation of fish seed.

UNIT III

Finfish culture: Culture of Indian major carps, Tilapia and murrel. Ornamental fish culture and its prospectus. **Shell fish culture**: Culture of freshwater and marine prawns, lobsters, crabs, edible and pearl oysters. **Fish pathology**: Ectoparasites, Endoparasites, Bacterial, Viral and Fungal diseases, nutritional deficiency diseases.

UNIT IV

Fishery Genetics: Chromosomes in fishes - chromosome set manipulation - gynogenesis and androgenesis - induced polyploidy. Chromosomal abnormalities - Sex determination in fishes - sex patterns - intrinsic and extrinsic factors in sex control and sex reversal. Transgenic fishes.

UNIT V

Capture Fisheries: Inland fisheries (riverine, lakesterine and cold water fisheries) - Estuarine fisheries - Marine fisheries. Crafts and fishing gears - Common fishes of Kanyakumari - Fish spoilage and methods of fish preservation – Fish Marketing and co-operative societies in aquaculture. **Economic importance of fishes**: Food value and fish by-products.

Reference Books

1. Pandey, K. &Shukla, J.P. (2005). *Fish and Fisheries*. Meerut: RastogiPublications.
2. Pillay, T.V.R. (1990). *Aquaculture: Principles and Practices.* England: Fishing News Books Ltd.
3. Jhingran, V.G. (1997). *Fish and Fisheries of India*. New Delhi: Hindustan PublishingCompany.
4. Santhanam, R. (1990). *Fisheries Science.* New Delhi: Daya Publishing House.
5. Khanna, S. S. & Singh, H. R. (2014). *A Text Book of Fish Biology andFisheries*.Delhi: Narendra Publishing House.
6. Ghosh, R. (2007). *Fish Genetics and Endocrinology*. New Delhi: SwastikPublishers.
7. Reddy, P.V., Ayyappan, G.K., Thampy, S., &Gopal Krishna, D.M. (2005). *Textbookof Fish genetics and Biotechnology*. New Delhi: Indian Council of Agricultural Research.
8. Jai Singh, P. (2008).*Fishes of Kanyakumari – A Hand Book on the Study ofFishes* (2nd ed.). Nagercoil: Tower Graphics Printer.
9. Schaperclaus, W. (2001). *Fish Diseases, Vol.I and II.* New Delhi: OxonianPrivate Ltd.

10 Santhanam, R., (2008). *A manual of Freshwater Aquaculture.* New Delhi: OxfordandIBH Publishing Company, South Asia Books.

11 Khanna, S. S. (2005).*An Introduction to fishes*. Allahabad: Silver linePublications.

12 Santhanam, R. (2008). *A manual of Freshwater Aquaculture.* New Delhi:Oxford andIBH Publishing Company, South Asia Books.

13 Khanna, S.S. (2005). *An Introduction to fishes.* Allahabad: Silver linePublications.

Semester III

Elective III (a) - General Endocrinology

Course Code: PZ2034

Hours/ Week	Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on the function and the pathology of the endocrine system.
2. To develop skills for analysing clinical problems of the endocrine system and pursueresearch.

Course Outcomes

O	pon completion of this course the students will be ble to:	SO ddressed	L
O - 1	efine the concepts of endocrine system, hormones, iosynthesis and pathology.	PSO - 1	
O - 2	ssociate the role of the endocrine system in relation to omeostasis, growth, development, behaviour and nvironmental factors.	SO - 2	
O - 3	pply the knowledge of endocrine pathology to hormone- lated disorders.	PSO - 4	p
O - 4	nvisage women related physiological processes related endocrine glands and hormones.	PSO - 3	n
O - 5	orrelate endocrine regulation of growth, reproduction nd metamorphosis in various invertebrates and ertebrates.	PSO - 4	

UNIT I

Introduction: Historical perspective and scope of endocrinology. Endocrine methodologies - assay of hormones, surgical methods, radioisotope studies, pharmacological methods, and replacement therapy and animal models for research. Chemical messengers - neurocrine, paracrine, autocrine, endocrine, pheromones and chalones.

UNIT II

Neurosecretion and Neuroendocrine mechanisms: Neuroendocrine integration- evolution of regulatory mechanisms and endocrine control of neural function. Neuroendocrine mechanisms and functions in insects, crustaceans and non-arthropod invertebrates. Analogous neurosecretory systems of invertebrates and vertebrates.

UNIT III

Endocrine glands and hormones: Organization of the endocrine system - classification of hormones - structure, functions and patho-physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas, gonads. Gastro-intestinal hormones.

UNIT IV

Hormone synthesis and mechanism of Hormone action: Biosynthesis, storage and release of amine (catecholamines and thyroxine), protein (growth hormone and insulin) and steroid hormones (sex hormones). Mechanism of hormone action - receptors (membrane and cytosolic) - second messengers, signal transduction, termination of hormone activity. Pathophysiological correlates of hormone action. Endocrine disorders due to receptor number and function. Hormonal therapy.

UNIT V

Endocrine Integration: Diffuse effect of hormones - Hormonal regulation of growth, development and metabolism, reproductive cycle and pregnancy, parturition and lactation, migration (birds and fishes), behavior and hibernation, neoplastic growth, colour change in vertebrates.

Reference Books

1. Mac E. Hadley and Jonathan Levine (2009). Endocrinology. India: Pearson Education (Singapore) Pvt. Ltd.
2. Aubrey Gorbman and Howard A. Bern (1974). A textbook of Comparative Endocrinology. Bombay: John Wiley and Sons, Inc. Wiley Eastern Pvt. Ltd.
3. Barrington, E.J.W (1975). An Introduction to General and Comparative Endocrinology, 5th Ed. London: Oxford University Press.
4. Donnell Turner, C. and Joseph T. Bagnara, W.B. (1976). General Endocrinology (6th ed.). Philadelphia: Saunders Company.
5. James Griffin and Sergio R. Ojeda (1988). Textbook of Endocrine Physiology. London: Oxford University Press.
6. Prakash S. Lohar (2005). Endocrinology: Hormones and Human Health. Chennai: MJP Publishers.

Semester III

Elective III (b) – Forensic Biology

Course Code: PZ2035

Hours/ Week	Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To emphasize the importance of scientific methods in crime detection.
2. To develop skills for disseminating information on the advancements in the field offorensic science.

Course Outcomes

CO	pon completion of this course the students will be ble to:	PSO addressed	L
CO - 1	call the fundamentals of forensic biology, psychology nd criminal profiling.	PSO - 1	
CO - 2	utline the use of scientific evidence in a legal context sing basic facts, fundamental principles and functionsof rensic science.	PSO - 2	
CO - 3	pply the knowledge gained on forensic, dermatoglyphic, erological and odontological techniques to render rensic service during real-time crime scenes.	PSO - 3	p
CO - 4	nalysefingerprints, personal identification evidence, bite arks and pug marks.	PSO - 3	n
CO - 5	valuate information to find strategies to resolve roblems in forensic biology.	PSO - 4	

UNIT I (Ref. 1, 2, 3)**(12 hrs.)**

Introduction to Forensic Biology: Concepts and scope, functions and historical aspects of forensic science. Importance, nature, location, collection and preservation of biological exhibits and crime scene investigation of biological evidence. Forensic dermatoglyphics - biological basis of fingerprints,formation of ridges, fundamental principles of fingerprinting, types offingerprints, fingerprint patterns, automated fingerprint identification system.

UNIT II (Ref: 4, 5, 9, 10)**(12 hrs.)**

Forensic examinations: Forensic examination of hair - importance, nature, location, structure, growth phases of hair, collection, evaluation and tests for their identification. Forensic Serology - identification of body fluids, collection and preservation of blood evidence, distinction between human and non-human blood, semen - forensic significance of semen, composition and morphology of spermatozoa, collection, evaluation and tests for identification of semen. Composition and forensic significance of saliva, sweat, milk and urine.

UNIT III (Ref. 6, 7, 8) **(12 hrs.)**

Forensic Odontology: Structural variation, types of teeth - human and non- human teeth, determination of age from teeth, eruption sequence, dental anomalies, their significance in personal identification. Bite marks - forensic significance, collection and preservation of bite marks, photography and evaluation of bite marks, lip prints in forensic investigations.

UNIT IV (Ref. 1, 2, 6) **(12 hrs.)**

Forensic Entomology and Forensic Microbiology: Forensic Entomology - insects of forensic importance, collection of entomological evidence during death investigations. The role of aquatic insects in forensic investigations, insect succession on carrion and its relationship to determine time since death, factors influencing insect succession on carrion, its application to forensicentomology. Forensic Microbiology - types and identification of microbialorganisms of forensic significance.

UNIT V (Ref. 2, 6, 10) **(12 hrs.)**

Wildlife Forensics: Importance of Wildlife Protection Act-1972- Schedules in the protection of endangered species of flora and fauna. Identification of wildlife materials such as skin, fur, bones, nails, horn, teeth, plants, plant parts and products by conventional and modern

methods. Identification of pug marks of various animals, DNA techniques in wildlife investigations.

Reference Books

1. S. Chowdhuri (1971). *Forensic Biology*. New Delhi: BPRD.
2. R. Saferstein (1993). *Forensic Science Handbook* (Vol. 3). New Jersey: Prentice Hall.
3. R.S. Ramotowski (2013). *Lee and Gaensleen's, Advances in Fingerprint Technology*
4. (3rd ed.). Boca Raton: CRC Press.
5. L. Stryer, (1988). *Biochemistry* (3rded.). New York: W.H. Freeman and Company.
6. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, (1993).*Harper's Biochemistry.* Norwalk: APPLETON and Lange.
7. M. Bernstein (1997). *Forensic odontology in, Introduction to Forensic Sciences* (2nd ed.), W.G. Eckert (Editor). Boca Raton: CRC Press,
8. J. Dix (1999). *Handbook for Death Scene Investigations*. Boca Raton: CRC Press.
9. V.J. Geberth, (2006). *Practical Homicide Investigation.* Boca Raton CRC Press,
10. W.G. Eckert and S.H. James (1989).*Interpretation of Bloodstain Evidence at Crime Scenes*. Boca Raton: CRC Press.
11. G.T. Duncan and M.I. Tracey (1997). *Serology and DNA typing in, Introduction to Forensic Sciences* (2nd ed.), W.G. Eckert (Editor.). Boca Raton: CRC Press.

Semester III
PG Self-Learning Course

Life Science for Competitive ExaminationsCourse Code: PZ20S1

No of credits	Marks
2	100

Learning Objectives

1. To enable the students to gain knowledge on various fields of life sciences.
2. To face competitive examinations like UGC-CSIR, NET and other similar examinations.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	recall the terms inMolecular Cell Biology, Developmental Biology, Taxonomy, Physiology, Inheritance, Ecology and Evolution.	PSO - 1	R
CO - 2	summarise related concepts of biology.	PSO - 4	U
CO - 3	apply the acquired knowledge in entry level services.	PSO - 2	Ap
CO - 4	analyse and interpret the concepts for research and higher education.	PSO - 3	An

UNIT I

Molecular Cell Biology: Membrane structure and function:Structure of cell membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electricalproperties of membranes. Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure and function of cytoskeleton and its role in motility. Organization of genes and chromosomes: Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Cell division and cell cycle:Mitosis and meiosis, steps in cell cycle, regulation and control of cell cycle. DNA replication, repair and recombination: Unit of replication, enzymes involved replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination. RNA synthesis and processing: transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport. Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins. Control of gene expression at transcription and translation level: regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

UNIT II

Developmental Biology and Taxonomy: Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. Morphogenesis and organogenesisin animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons. Post embryonic development - larval formation, metamorphosis; regeneration, environmental regulation of normal development; sex determination. Programmed cell death, aging and senescence. Principles & methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals and microorganisms. Levels of structural

organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems.Comparative anatomy, adaptive radiation, adaptive modifications.Outline classification of animals and microorganisms: Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms.Evolutionary relationships among taxa.

Unit III

System Physiology – Animal: Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation. Respiratory system:Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Excretory system:Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. Digestive system: Digestion, absorption, energy balance, BMR. Thermoregulation: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization. Stress and adaptation.Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation,neuroendocrine regulation.

UNIT IV

Inheritance Biology: Mendelian principles: Dominance, segregation, independent assortment. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, finestructure analysis of genes. Human genetics: Pedigree analysis, Lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination including transposition.

UNIT V

Ecology and Evolution: The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growthcurves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation- demes and dispersal, interdemic extinctions, age structured populations. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).Emergence of evolutionary thoughts: Lamarck; Darwin - concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

Reference Books

1. Vijay N. Waghmare (2004). *Life sciences for NET/SLET exams of UGC-CSIR.*Maharashtra:Mudra Publication.
2. Dr. A P Singh and Kumar Pushkar (2010). *CSIR-UGC NET/JRF/SLET Life Sciences(Paper I & II).* New Delhi: Upkar Publishers.
3. ArunChaudhary, B. L., Chaudhary and KailashChoudhary (2007). *CSIR/NET Life Sciences*. New Delhi: New Age Publishers.
4. Kumar Pranav Mina Usha (2011). *CSIR-JRF-NET: Life Sciences Fundamentals andPractice (Part - I).* New Delhi: Pathfinder Academy.
5. AshishNagesh, Quaisher J. Hossain, Prashant Kumar (2012). *UGC-CSIR NET (JRF &LS) Life Science*. Chennai: Arihant Publishers.
6. Rupendra Singh (2014). *CSIR NET/JRF Life Sciences* (4th ed.). Lucknow: Catalyst Center of Excellence Pvt. Ltd.
7. Pramod Singh (2014). *Trueman's UGC CSIR-NET Life Sciences.*NewDelhi:Danika Publishing Company.
8. RPH (2014). *CSIR-UGC NET Life Science (Popular Master Guide): Life Sciences,* RPH Editorial Board.

Semester IV

Core XII – Microbiology

Course Code: PZ2041

Hours/ Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To facilitate the students to understand the microbes and their significance.
2. To develop skills in microbial techniques relevant to industries, environment anddisease management.

Course Outcomes

CO	pon completion of this course the students willbe ble to:	SO ddressed	CL
CO - 1	escribe the structure, distribution and life cycle of icroorganisms and their role in human welfare.	PSO - 1	R
CO - 2	xplain culture techniques, growth, fermentation and icrobial products.	PSO - 2	U
CO - 3	pply the microbiological laboratory skills in clinical search, food industries and environmental anagement.	PSO - 3	Ap
CO - 4	nalyze beneficial and harmful microbes	PSO - 3	An
CO - 5	valuate the microbial importance and applications in arious fields.	PSO - 4	E

UNIT I

Introduction: History and scope, classification of microorganisms, Whittaker's five kingdom classification, three domain classification. Virus - General properties, structure of viruses, viral taxonomy, bacteriophages, reproduction of DNA and RNA phages, temperate bacteriophages and lysogeny, cytocidal infections and cell damage, persistent, latent and slow virus infections. Cultivation of viruses and purification assays. Viruses and cancer. Viroids and prions.

UNIT II

Bacteria: Classification, Bergey's system of bacterial classification, Bacterial morphology and fine structure of Escherichia coli. Bacterial nutrition - Common nutrient requirements, Nutritional classes, Uptake of nutrients. Bacterial growth and measurement of growth - Influence of environmental factors on growth, Synchronous growth, Continuous culture, Chemostat and turbidostat. Types of culture media - Pure culture and methods of isolating pure cultures (streak plate technique and pour-plate technique).

UNIT III

Industrial Microbiology: Fermentation and microbes - fermenter and types of fermenters (air-lift fermenter and stirred tank fermenter). Production of microbial products - alcohol (ethanol), antibiotics (penicillin), vitamin B_2 and Vitamin B_{12}. Biofertilizers - steps for preparing bacterial biofertilizers, mass cultivation of Cyanobacteria and Azolla, production of

mycorrhizal fungi and VAM fungi. Bacterial insecticides – Pseudomonas species and Bacillus species. Food spoilage and food preservation.

UNIT IV

Environmental Microbiology: Drinking water and microbiological analysis of water purity - Coliform test, Most Probable Number (MPN) test, and Membrane Filter (MF) test. Purification of water. Sewage treatment – small scale, large scale (primary, secondary and tertiary) treatment. Biogas production – solubilization, acetogenesis and methanogenesis. Microbial leaching – copper and uranium leaching. Biodegradation of petroleum and xenobiotics.

UNIT V

Antimicrobial agents: classification, Drug administration, determination of antimicrobial activity, mechanism of antimicrobial agents, effectiveness of antimicrobial drugs, drug resistance, drug dosage, antibacterial drug (penicillin), antifungal drug (nystatin), antiviral drug (amantadine). Current problems of antibiotic resistance in man. Microbes and diseases - Gnotobiotic animals, distribution of normal micro biota of the human body, Mechanism of microbial pathogenesis, Nosocomial infections. Protozoan diseases - Malaria and Amoebiasis. Fungal diseases - Mycotoxicosis and Aspergillosis. Bacterial diseases - Air borne diseases – Meningitis and Streptococcal pneumonia. Food and water borne diseases - Cholera and Typhoid. Soil borne diseases - Tetanus and Anthrax. Sexually transmitted and contact diseases – Gonorrhea and Syphilis. Viral diseases - Ebola, Hepatitis-B, Rabies and AIDS.

Reference Books

1. Dubey R.C. &Maheswari, D.K. (2010).*A textbook of Microbiology* (3rd ed.).New Delhi: S. Chand and Co.
2. Joanne, M., Wiley Linda M., Sherwood Christopher J. &Woolverton. (2013).Prescott's Microbiology. America: McGraw-Hill International.
3. ArtiKapil. (2013). Anandanarayan&Paniker's textbook of Microbiology. Hyderabad:Universal Press.
4. John L. Ingraham & Catherine A. (2004).*Introduction to Microbiology*. UK:Ingraham Thomson Brooks /Cole.
5. Alcamo E. (2001). Fundamentals of Microbiology.6th Ed. New Delhi: Jones andBartlett Publishers.Pelzar, Chan and Krieg (2006). *Microbiology*.New Delhi: Tata McGraw HillPublishing Company. Ltd.
6. Vijaya Ramesh, K. (2004).*Environmental Microbiology*. Chennai: MJP Publishers.
7. Powar, C.B. and Daginawala, H.F. (2008). *General Microbiology*, Vol. 2. Chennai:Himalaya Publishing House.
8. Singh, R.P. (2007). *General Microbiology.* New Delhi: Kalyani Publishers.
9. Johri R.M., Snehlatha, Sandhya Sharma (2010). *A Textbook of Algae.* New Delhi:Wisdom Press.

Semester IV
Major Core XIII - Biotechnology and Nanobiology
Course Code: PZ2042

Hours/ Week	Credits	Total Hours	Marks
6	4	90	100

Objectives

1. To enable the students to understand the essence of biotechnology and become aware of the advances in Nanobiology.
2. To develop skills to apply biotechnological principles in research related to geneticmanipulations, industrial and environmental biotechnology.

Course Outcomes

O	pon completion of this course the students will be ble to:	PSO addressed	L
O - 1	xplain the various techniques used in modern iotechnology.	SO - 1	
O - 2	utline the basic concepts of Biotechnology and anobiology, its application and threat to the society.	SO - 2	
O - 3	pply the biotechnological principles in research and dicial use of bio- and nanotechnology to solve societal roblems.	SO - 2	p
O - 4	nalyze the impact of biotechnological products and enetically modified organisms in bioremediation.	SO - 3	n
O - 5	valuate the function, gene modulation and their effectson nprovement of crops and animals after the applications f cloned genes.	SO - 4	
O - 6	esign simple experiments on biotechnology and ommunicate the results through publication.	SO - 3	

UNIT I

Gene cloning: Basic steps of gene cloning, restriction and modifying enzymes, linkers and adaptors, cloning and expression vectors, construction of chimeric DNA, nucleic acid probes, DNA libraries, polymerase chain reaction, molecular markers, DNA sequencing, synthesis of oligonucleotides. Human Genome Project.

UNIT II

Animal Biotechnology: Primary culture and cell lines, pleuripotent stem cell lines, tissue engineering. In vitro fertilization and embryo transfer in animals; gene transfer methods. Primary explantation techniques – organ and embryo culture – transgenic animals and the knockouts. Biotechnology and aquaculture - ploidy induction, gynogenesis and androgenesis.

UNIT III

Medical Biotechnology: Hybridoma technology and Monoclonal antibodies – Applications of biotechnology in medicine, Vaccines, diagnostics and forensics. Gene therapy – Pharmacogenomics. **Enzyme biotechnology**: Isolation and purification of enzymes, uses of enzymes in industries, immobilization of enzymes and their uses, Biosensors. Terminator and traitor technology. Intellectual Property Rights.

UNIT IV

Industrial and Environmental Biotechnology: Production of metabolites - Downstream processing and in situ recovery of products, microbial biotransformation, microbial biomass

production (SCP). Bioremediation and phytoremediation - Genetically engineered microorganisms (GEMs) - treating oil spills, detection of pesticide in soil and their degradation, sequestering heavy metals. Biomining and Biofuels.

Unit V

Nanomaterials: Types and properties, DNA and protein nanoarrays, biosystems (microbes) as nanofactories. Application of nanotechnology - medical diagnostics, imaging and drug delivery, agro-practices and food related nanoproducts, cosmetics, contact lenses and dental implants. Nanotechnological approaches for environmental remediation, prevention of contamination, environment maintenance and quality enhancement. Risks and threats of nanoparticles in environment.

Reference Books

1. Gupta P.K. (2009). *Elements of Biotechnology.* Meerut: Rastogi Publications.
2. Singh B.D. (2003). *Biotechnology - Expanding Horizons.* Chennai: Kalyani Publishers.
3. Satyanarayana V. (2004).*Biotechnology.* Kolkata: Books and Allied (P) Ltd.
4. Dubey R.C. (2006). *A Textbook of Biotechnology* (4th ed.). New Delhi: S. Chand andCo. Ltd.
5. Rema L.P. (2006). *Applied Biotechnology.* Chennai: MJP publishers.
6. Prakash S. Lohar, (2012). *Biotechnology.*Chennai: MJP publishers.
7. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey& Goldie Oza (2012). *BioNanotechnology: Concepts and Applications.* New Delhi: Ane Books Pvt.Ltd
8. VinodLabhasetwar&Diandra. L. Leslie-Pelecky (2007). *Biomedical applications of Nanotechnology.* New Jersey: Wiley Publications. Jo Anne Shatkins (2008). *Nanotechnology: Health and Environmental Risks.*New York: CRC Press.
9. Y.S. Raghavan (2010). *Nanostructures and Nanomaterials: Synthesis properties andapplications.* New Delhi: Arise Publishers and distributors.
10. Parthasarathy, B.K. (2007). *Nanotechnology in Life Science.* New Delhi: IshaBooks.
11. Rakesh K. Yadav (2009). *Investing in Nanotechnology.* New Delhi: Mangalam Publications.

Semester IV

Core IVX - Immunology

Course Code: PZ2043

Hours/ Week	Credits	Total Hours	Marks
5	4	75	100

Objectives

1. To facilitate the students to appreciate the defense functions of the immune system.
2. To develop the skill to determine the immunomodulatory strategies used to enhance orsuppress the immune response.

Course Outcomes

O	**pon completion of this course the students will be able :**	**PSO addressed**	**L**
O - 1	call the importance of immunity, immune response, MHC, CR and TCR, antigen –antibody interaction.	SO - 1	
O - 2	late the evolution of immune molecules in different groupsof nimals, immunodeficiency diseases and immunotechniques.	SO - 1	
O - 3	ake use of immunization schedules, differentiate the typesof ypersensitive allergic reactions and symptoms.	SO - 2	p
O - 4	nalyse the immune response in relation to toxicants, accines, tumour, and infectious diseases.	SO - 3	n
O - 5	valuate the role of immune cells and humoral factors in mmune response	SO - 3	
O – 6	redictimmuno-nano materials for immunodiagnostic, erapeutic techniques and research.	SO - 4	

UNIT I

Immune system in invertebrates and vertebrates: Immunity - Innate and acquired, II, III and IV line of defense. Types – natural and artificial - active and passive immunity; Lymphoid organs and cells involved in immune response. Antigens and Immunoglobulins – characteristics, haptens, types. Immune Response: Humoral and Cell mediated immune response - primary and secondary immune response, importance of B cells in humoral immune response (antibody formation), factors influencing antibody formation. Immunological memory (Anamnesis). Immunization: immunization schedule and vaccines.

UNIT II

Major and minor histocompatibility complex: MHC class I and II molecules, cellular distribution and regulation of MHC expression, MHC in immune responsiveness, MHC and susceptibility to infectious diseases. Minor histocompatibility (H) antigens. Immune effector mechanisms: Cytokines and their functions, Complement system – classical and alternate pathways, biological functions.

UNIT III

B and T cell: B cells - Maturation, activation and differentiation - B cell receptor (BCR) - B cell co-receptor complex - signal transduction from B cell antigen receptor, major pathways of BCR signaling. T cells - maturation, activation and differentiation, T cell receptor (TCR), T cell co-receptor complex - formation of T and B cell conjugates, Co-stimulation in T cell response and signal transduction. Clonal anergy. Antigen processing and presentation – role of antigen presenting cells – cytosolic pathway and endocytic pathway.

UNIT IV

Immune system in health and diseases: Tumour immunology - properties of tumour cells, causes of tumours, tumour antigens, immune response to tumour, immune surveillance, immunodiagnosis of tumour antigens, immuno therapy of tumour. Hypersensitivity: factors causing hypersensitivity, Type I, II, III, and IV reactions. Immunodeficiency - primary and secondary. Autoimmune diseases - characteristics, causes, classification, localized (Diabetes mellitus, Addison’s disease) and systemic (systemic lupus erythematosus, rheumatoid arthritis). Immune response to infectious diseases and treatment - Protozoan disease (Malaria), Bacterial disease (Tuberculosis), Viral disease (AIDS).

UNIT V

Antigen-antibody interaction: strength, affinity, avidity and cross reactivity. Complement fixation test - precipitation reaction in fluids and precipitin curve. Radial immunodiffusion and double immunodiffusion. Immunoelectrophoresis – counter and rocket electrophoresis. Agglutination reaction - hemagglutination, bacterial agglutination, coated particle agglutination, agglutination inhibition. Radio immuno assay - ELISA – Western blotting - Immunofluorescence - Flow cytometry. Transplantation: classification of grafts, mechanism of graft rejection, graft versus host reaction, immuno suppressive therapy during transplantationReference Books

1. Goldsby, R.A., Kindt, T.J. & Osborne, B.A. (2007). *Kuby's Immunology* (6thed.).New York: W.H. Freeman and Company.
2. Deves, P., Martin, S., Burton, D. &Roitt I.M. (2017). *Roitt's Essential Immunology* (13thed.). Oxford: Wiley-Blackwell Scientific Publication.
3. Ashim, K., Chakravarthy (2007). *Immunology and Immunotechnology* (2th ed.). Delhi: Saurabh Printers Pvt. Ltd.
4. Dasgupta, A. (1992). *Modern Immunology* (2th ed.). New Delhi: Jaypee Brothers Medical Publications Pvt. Ltd.
5. Gupta, S.K. (1991). *Immunology perspectives in Reproduction and Infection.*New Delhi: Oxford and IBH publication Co. Pvt. Ltd.
6. Hannigan, B.M., Moore, C.B.T. & Quinn, D.G. (2010). *Immunology* (2th ed.). India: Viva Book Pvt. Ltd.
7. Rao, C.V. (2006). *Immunology* (2th ed.). Chennai: Narosa Publishing House.
8. Murphy, K., Travers, P. and Walport, M. Garland (2008). *Janeway's Immunobiology* (7th ed.). New York: Science Publishers.
9. Dulsy Fathima and Arumugam, N. (2020). Immunology. Nagercoil: Saras Publications.

Semester IV

Core XV - Medical Laboratory Technology

Course Code: PZ2044

Hours/ Week	Credits	Total Hours	Marks
5	4	75	100

Objectives

1. To impart knowledge on laboratory principles, clinical analysis and safety measures in handling samples.
2. To develop skills on laboratory investigations adopted in medical diagnosticlaboratories.

Course Outcomes

CO	pon completion of this course the students will be ble to:	PSO addressed	CL
CO - 1	utline the laboratory principles applied in diagnosis of isease and methods of biomedical waste disposal.	PSO - 1	R
CO - 2	xplain the type of specimens, collection and use of ppropriate diagnostic techniques.	PSO - 2	U

CO - 3	repare reagents, handle instruments and perform clinical nalysis.	PSO - 3	Ap
CO - 4	terpret and validate the results.	PSO - 4	An

UNIT I (Ref.1, 5)**(15 hrs.)**

Laboratory instruments and safety measures: Scope of Medical laboratory technology. Laboratory principles - Organization of clinical laboratory - Role of medical laboratory technician. Laboratory instruments: Common glass wares in clinical laboratory - Centrifuges - Water bath – Refrigerator – Autoclave - Hot air oven – Mixer – Laminar air flow – Microscope – Analyser –Spectrometer – Cell counter - Blood bank. Safety measures - Cleaning and sterilization methods -antiseptics and disinfectants - hospital and clinic borne infection and personnel hygiene.

UNIT II (Ref. 1, 2, 3, 5, 6)**(15 hrs.)**

Clinical sample collection, processing and storage: Specimen collection and processing of blood, urine and cerebrospinal fluid, separation of serum and plasma, Handling of specimens for testing, preservation and transport of specimen, factors affecting the clinical results, effect of storage on sample. Anticoagulants: EDTA, Di- potassium salts of EDTA, oxalate, sodium citrate and sodium fluoride. Techniques of sample processing: Throat Swab, Sputum, blood, urine, stool, pus, CSF, other body fluids, other swabs like from wounds, skin clipping, spore strips.

UNIT III (Ref.1, 2, 3, 5, 6, 7, 8)**(15 hrs.)**

Body fluid analysis: Physical, chemical and microscopical examination of cerebrospinal fluid, pleural fluid, synovial fluid. Haematological techniques - Haemoglobin estimation, Erythrocyte Sedimentation Rate, Differential count, Total Red Blood cell count, Total White blood cell count, Platelet count. Blood banking technology - Blood typing, collection and storage and plasma separation.Diagnosis of Covid-19.

UNIT IV (Ref. 1, 3, 5) **(15 hrs.)**

Histopathology: Introduction of histopathology, labelling and transportation of tissue specimens, tissue processing- fixation, sectioning, staining and mounting, manual and automated method. Cryostat, frozen sections of fresh, fixed and unfixed tissue, freeze drying, rapid frozen sections and staining for emergency diagnosis.

UNIT V (Ref. 1, 2, 3, 7, 8)**(15 hrs.)**

Clinical sample analysis and biomedical waste management: Physical, chemical and microscopical examination of sputum, urine and stool. Routine examination of urine and their clinical significance. Pregnancy test. Semen: Sample collection and microscopic examination for count and morphology. Bio-medical waste – waste generation, segregation ,disposal. Management of Bio-medical Waste, Technologies for Treatment for BMW, Legal Aspects and Environment Concern. COVID

Reference Books

1. Mukerjee, K. L. & S. Ghosh, (2010). *Medical Laboratory Technology*, Volume I, II,III. New Delhi: McGraw Hill.
2. Sood. R. (2006).*Textbook of Medical Laboratory Technology*. New Delhi: Jaypee.
3. Rajan, S. (2012). *Manual for Medical Laboratory and Technology* (1st ed.). Chennai:Anjanaa Book House.
4. John Bernard Henry (2001). *Clinical diagnosis and management by laboratoryMethods* (20th ed.). Philadelphia: Saunders & Co.
5. Mary Vijaya, T., Mini, M.L., SunithaKumari, K. &Asha, K.R.T. (2003).*Practical Clinical Biochemistry Manual.*Kaliakkavilai: Rishi Publications.
6. Himadri Panda (2019). *Biomedical Waste Management, Recycling and Applications*(1st ed.). India: Discovery Publishing house Pvt. Ltd.
7. Najih A. Naser&Saleh A. Naser (1998).*Clinical Chemistry Laboratory Manual*.USA: Moshby Inc.
8. SabtiriSanyal (2000). *Clinical Pathology*. Delhi: Reed Elsevier India Pvt. Ltd.

Semester IV

Elective IV (a) - Parasitology

Course Code: PZ2045

Hours/ Week	Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To enable the students to be aware of the cosmopolitan distribution ofparasites, vectors and their control measures.
2. To develop skills for employment in clinical laboratories and healthdepartments.

Course Outcomes

O	**pon completion of this course the students will be ble to:**	**PSO addressed**	**L**
O - 1	efine the basic biology and life cycle of parasites cluding epidemiology, diagnosis and treatment.	SO - 1	
O - 2	xplain morphological characters of parasites, evelopmental stages and their infestation.	SO - 1	
O - 3	entify appropriate techniques and develop basic skills for etection of parasites.	SO - 3	p
O - 4	nalyse the medical and public health aspects of human arasitic infections.	SO - 2	n
O - 5	ompare the diagnostic methods of parasitic infestation in eterinary hospitals, clinics and research laboratories.	SO - 4	

UNIT I

Introduction: Historical perspectives - taxonomy and classification of parasites – origin and evolution of parasitism - host parasite relationship, classification of parasites and hosts– transmission of parasites – Parasitic zoonoses – pathogenesis - clinical manifestations of parasitic diseases.

UNIT II

Protozoan parasites: Introduction and classification. Intestinal Amoeba - Pathogenic free living amoeba – Intestinal flagellates – Trypanosomiasis, Leishmaniasis, Balantoidiasis, Malaria, Isosporiasis, Toxoplasmosis, Cryptosporidiosis, Pneumocytosis. Protozoans of minor medical importance.

UNIT III

Helminth parasites: Trichiuriasis, Trichinellosis, Strongyloidiosis, Ascariasis, Enterobiosis, Filariasis, hook worm diseases, Dracunculiasis, Onchocerciasis, Loiosis – Larva migrants. Nematodes of lesser medical importance - Diphyllobothriasis, Taeniasis, Echinococcosis, Sparganosis, Schistosomiasis, Fascioliosis, Fasciolopsiasis, Paragonimiasis, Clonorchiasis, Trematodes of minor medical importance.

UNIT IV

Parasitic Insects: Prevalence, transmission and control of parasitic infections. Parasitic infection in compromised host. Applied Parasitology: Eosinophilia in parasitic infections, Nosocomial parasitic infections. Evasion and parasitic mode of life – morphological, biochemical and ethological adaptations. Quality assurance and laboratory safety.

UNIT V

Diagnostic methods in parasitology: Microscopical examination of blood, stool, urine, sputum and biopsy material for parasites – general rules for microscopical examination. Cultural examination - preparation of media – techniques for cultivation of E. histolytica, Leishmania, Plasmodium. Immunodiagnostic methods – ELISA, AGD, IHA, IFAT, CFT, DAT, IB, WB, BF, DFAT. Molecular characterization of stage specific antigen nucleotide probes for diagnosis of protozoan diseases.

Reference Books

1. Cheng, C.T. (1964). *The Biology of Animal Parasites.* Tokyo: Toppan Company Ltd.
2. Chatterjee, K.D. (1981). *Parasitology*. Calcutta: Chatterjee Medical Publishers.
3. Rajesh Karyakarte&AjitDamle (2008).*Medical Parasitology* (2nd ed.). Kolkata: Books and Allied (P) Ltd.
4. Ichhpujani R.L. & Rajesh Bhatia (2002).*Medical Parasitology.* New Delhi: Jaypee printers.
5. Patvaik, B.D. (2001). *Parasitic Insects.* Delhi: Dominant Publishers and Distributors.
6. Jones, A.W. (1976). *Introduction to Parasitology.* Boston, USA: Addison-Wesley Publishing Company.
7. Subah, C.P. (2001). *Textbook of Medical Parasitology.* Chennai: All Indiapublishers and Distributors.

Semester IV

Elective IV (b) - Applied Entomology

Course code: PZ2046

Hours/ Week	Credits	Total Hours	Marks
4	3	60	100

Objectives

1. To impart knowledge on insect diversity and economically important insects.
2. To develop skill to collect, identify and differentiate pests from productive insects and their management.

Course Outcomes

O	**pon completion of this course the students will be ble to :**	**PSO addressed**	**L**
O - 1	entify locally available insects, the pests of agriculture, omestic animals and public health, types of infestations nd their control measures.	SO - 1	
O - 2	istinguish the salient features of insects, beneficial sects, pests and their control measures.	SO - 1	
O - 3	emonstrate research and effective communication skills,to commend the application of safer pest control easures.	SO - 4	p
O - 4	nalyze the types, damages and loss caused by pests andtheir ffective control measures.	SO - 2	n
O - 5	esign an experiment to evaluate the effectiveness of ethods of pest control.	SO - 3	

UNIT I (Ref.1, 3, 5, 8, 9)**(12 hrs.)**

Insecta: Salient features of Class Insecta and orders - Orthoptera, Isoptera, Hemiptera, Diptera, Coleoptera, Lepidoptera, Dermaptera, Odonata, Neuroptera and Hymenoptera. Categories of pests (major and minor) – based on occurrence, types and level of infestation.Types of damage caused by insect pests to crops.Causes of pest outbreak.

UNIT II (Ref. 3, 4, 5, 6, 7)**(12 hrs.)**

Agricultural Entomology: Life history and control measures of agriculture crop pest – Cereal - Paddy(*Scirpophagaincertulas),* Oil seeds - Coconut (*Oryctes rhinoceros*), Maize (*Chilopartellus*), Vegetables – Brinjal (*Leucinodes orbonalis),* Okra(*Eariasvitella*), Pulses (*Helicoverpaarmigera*), Fruits – Banana(*Odoiporuslongicollis),* Mango (*Ste Sitophilus oryzae*).

UNIT III (Ref. 2, 3, 4, 6)**(12 hrs.)**

Pests of Domestic Animals: Stable fly and cattle fly; Fowl - shaft louse and chicken flea; sheep and goat - head maggot and sheep ked. Insects associated with medical importance and management - head louse*Pediculushumanuscapitis*, mosquitoes - *Anopheles*, *Culex*, *Aedes*, flea - *Xenopsyllacheopis*, eye fly, sand fly, ticks, mites and bed bug. Insects associated with household insects - cockroaches, termites and silverfish.

UNIT IV (Ref. 2, 3, 4, 5)**(12 hrs.)**

Productive and beneficial insects: Types**,** Life cycle and economic importance - honey bees and Silkworms. Lac insects – lac cultivation, shellac.Biological control agents- Lacewings, ladybird beetles, *Trichogramma*.Pollinators, Weed killers, Scavengers, Insect as food and feed.Insects as biological indicators and experimental models. Cochineals - *Dactylopiuscoccus*. Medicinally important insects.

UNIT V (Ref. 6, 7, 8, 9)**(12 hrs.)**

Pest management: Assessment of pest status. Economic Injury Level, Pest Control - Chemical control - pesticides. Biological control - predator, parasites, biocides and microbial

control. Recent trends in pest control - Pheromones, Attractants, Repellents, Antifeedants, Chemosterilants and chitin inhibitors. Host - plant resistance to insects, *Bt* cotton - concepts and application. Concepts of Biointensive Integrated Pest Management (BIPM) and biopesticides.

Reference Books

1. Ambrose, D.P (2017). *The Insects: Structure, Function and Biodiversity* (2nd ed.). Ludhiana: Kalyani Publishers.
2. Ambrose, D.P. (2017. *The Insects: Beneficial Harmful Aspects* (2nd ed.). Ludhiana: Kalyani Publishers.
3. David, B &Ananthakrishnan, T.N. (2016). *General and Applied Entomology* (2nd ed.).New Delhi: Tata McGraw hill publishing company Ltd., India.
4. Vasantharaj David, B. & Ramamurthy, VV. (2012). *Elements of Economic Entomology* (7thed.). Chennai: Namratha publications.
5. Awasthi, V.B. (2012). *Introduction to General and Applied Entomology* (3rd ed.). India: Scientific publishers,
6. AbishekShukla, D. (2009).*A Handbook of Economic Entomology*. New Delhi:
7. edams eBooks.
8. Ministry of Agriculture, Government of India (1995). *Manual on Integrated Pest Management in Rice & Cotton*.
9. Chapman RF. (1998). *The Insects: Structure and Function*. Cambridge: CambridgeUniv. Press.
10. Romoser, W.S &Stoffolano, J.G. (1998). *The Science of Entomology*. New York:McGraw-Hill Company.

Semester III

Practical III - Physiology & Genetics and EvolutionCourse code: PZ20P3

(Conducted during III Semester)

Hours/ Week	Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To equip the students to analyse the physiological processes and inheritance.
2. To develop the skill to trace the phylogenetic relationship of living organisms.

Course Outcomes

O	**pon completion of this course the students will be ble to:**	**SO ddressed**	**L**
O - 1	call the functioning of organ and organ systems and endelian inheritance, population genetics, adaptive diation and evidence of evolution.	SO - 1	
O - 2	terpret the importance of factors in physiological ctivities and genes in inheritance, changes in gene and ene frequencies in a population.	SO - 3	
O - 3	entify the sex and mutant forms in *Drosophila*, inical features of disorders, gene frequencies in naturalopulation.	SO - 2	p
O - 4	esign experiments based on Hardy-Weinberg Law, nzyme activity and effect of physical factors on hysiological activities.	SO - 4	n

Physiology

1. Effect of temperature on heartbeat of Freshwater Mussel and calculation of Q10.
2. Effect of temperature on salivary amylase activity and calculation of Q10.
3. Effect of pH on salivary amylase activity.
4. Salt loss and salt gain in a freshwater fish.
5. Examination of excretory products of fish, bird and mammals.
6. Survey of digestive enzymes in Cockroach.
7. Counting of blood cells using a hemocytometer.
8. Haemolysis of blood – Demonstration.
9. Observation of haemin crystals in blood.
10. Estimation of haemoglobin.

Charts/ Slides/ Models/ Bookplates/ Instruments

EEG, ECG, Conditional reflex, Skeletal muscle, Kymograph,Sphygmomanometer, Intestine, Nervous tissue, Liver, Lungs, Heart, Kidney.

Genetics and Evolution

1. Demonstration of monohybrid and dihybrid cross using beads.
2. Identification of sex and mutant forms of *Drosophila*.
3. Observation of Simple Mendelian Traits in man.
4. Calculation of gene frequencies using Hardy-Weinberg equilibrium - ABO bloodgroup.
5. Demonstration of natural selection using beads.
6. Demonstration of genetic drift using beads.
7. Analysis of dermatoglyphic data (fingerprint patterns) of the class population.
8. Study of homologous organs (fore limbs and hind limbs of vertebrates).
9. Study of analogous organs (wings of animals).
10. Adaptive radiation - beaks in Birds.

Specimens / Charts / Models / Photographs

Karyotype of syndromes (Down's syndrome, Klinefelter's syndrome and Turner's syndrome), Chromosomal banding Pedigree chart, Fossils **(**Ammonite, Trilobite, Nautiloid fossil), Geographical isolation (Indian and African Elephants), Seasonal Isolation (Sea Urchin), Phylogram, Universal Tree ofLife, Coevolution.

Semester IV

Practical IV – Microbiology & Biotechnology and Nanobiology

Course Code: PZ20P4

Hours/ Week	Credits	Total Hours	Marks
4	4	60	100

Objectives

1. To demonstrate competency in routine microbiological and biotechnologicaltechniques.
2. To develop skills in cell culture and analytical techniques for procuring employabilityin research laboratories.

Course Outcomes

O	**pon completion of this course the students will be ble to:**	**SO ddressed**	**L**
O - 1	call microbiological and biotechnological experiment rotocols.	SO - 1	
O - 2	entify tools and techniques relevant to microbiology nd bio-nanotechnology.	SO - 2	
O - 3	erform microbiological and biotechnological xperiments pertinent for the welfare of the nvironment and society.	SO - 4	p
O - 4	halyse the impact of microbiological, biotechnological roducts and genetically modified organisms in ioremediation.	SO - 3	n

Microbiology

1. Preparation of culture media.
2. Isolation of bacteria from soil and water (Streak plate method).
3. Serial dilution technique.
4. Measurement of growth of bacteria (turbidimetric method).
5. Bacterial count by plate count method.
6. Observation of bacterial motility by Hanging Drop method.
7. Gram staining of bacteria.
8. Negative staining of bacteria.
9. Methylene blue reduction test to assess the quality of milk.
10. Antibiotic susceptibility test by disc-diffusion method.

Specimen/ Models/ Charts

Salmonella, *Clostridium*, Rabies virus, hepatitis – B, *Entamoeba*, *Azolla*, ocular and stage micrometer, inoculation loop, autoclave, laminar airflow chamber.

Biotechnology and Nanobiology

1. Extraction and estimation of genomic DNA from goat liver.
2. Separation of DNA using Agarose gel electrophoresis.
3. Polymerase chain reaction (Demonstration).
4. Culture of animal cells (Demonstration).
5. Immobilization of yeast cells using sodium alginate method.
6. Alcohol fermentation from fruit juice (wine).
7. Estimation of ethanol content in wine.
8. Production of amylase by bacteria.
9. Preparation of nanosolution (silver).
10. Biofabrication of nanomaterials by using plant materials.

Flow charts/ Instruments/ Figures

Plasmid DNA isolation, Insulin production by rDNA Technology, Hybridoma production, Synthesis of DNA nanoarray, Southern blotting, Biosensor (glucometer), Air-lift bioreactor, Superbug, Buckyballs, Dendrimers.

Semester IV

PG Self-Learning Course Environmental Impact Assessment and Audit

Course Code: PZ20S2

No of credits	Marks
2	100

Learning Objectives

1. To demonstrate the students the importance of EIA and environmental audits.
2. To develop the skill to assess and audit the impact of environmental pollution.

Course Outcomes

CO	Upon completion of this course the students will be able to:	PSO addressed	CL
CO - 1	define activities involved in Environmental Auditing, Environmental protection and project proposals.	PSO - 1	R
CO - 2	describethe impact of proposed developments on natural and man-made environment.	PSO - 4	U
CO - 3	develop cognitive, technical and creative skills which enable students for life-long learning and participate in environmental protection and conservation activities for sustainable environment and gain employability.	PSO - 2	Ap
CO - 4	formulate hypotheses and test them by designing appropriate experiments, analyze, interpret the data and communicate the results through effective written and oral communication.	PSO - 3	An

UNIT I

Introduction to Environmental Impact Assessment(EIA) and Audit: Environment and Industries, Input information, Plant operation, Environmental Management planning, Waste Streams impact on water bodies.

UNIT II

Environmental Impact Assessment planning: Activities, Methodologyfor Environmental Impact Assessment, Role of Environmental Engineering firm, Role of Regulatory agencies andcontrol boards, Role of the Public.

UNIT III

Environmental Audit: Introduction, Environmental information Purpose and advantage of studies, General approach of environmental Auditing Environmental Audit, Audit programs in India, Auditing program in major polluting Industries, Reports of the Environmental auditstudies.

UNIT IVsssss

Pollution prevention and control laws and acts: Constitution of India andenvironment, Environment laws, Administrative and legislative arrangement for Environmental protection, Indian Standards, Pollution control acts in India, criticalappraisal,fiscal incentives for environmental protection.

UNIT V

Environmental Projects: Guidelines of preparation of project report and its evaluation, methods of clearance fromthe concern authorities at various labels.

Reference Books

1. Prabu, PC.,Udayasoorian and G. Balasuramanian (2009). *An Introduction to Ecology andEnvironmental Science*. Delhi: Avinash Paperbacks.
2. Biswarup Mukherjee (2011). *Environmental Biology and Toxicology*. Faridabad: Silver LinePublications.
3. Santosh Kumar Garg, RajeshwariGarg and RanjniGarg (2007). Delhi: Khanna Publishers.
4. Hunt D. Johnson C (1995).*Environmental Management Systems*.London: McGraw Hill.
5. International Chamber of Commerce (1991).ICC Guide to Effective Environmental Auditing.Paris: ICC Publication No 483.

	Content addressed with Local Needs
	Content addressed with NationalNeeds
	Content addressed with Regional Needs
	Content addressed with Global Needs