



Phone: 03228-291246

PANSKURA BANAMALI COLLEGE

(AUTONOMOUS)

UNDER VIDYASAGAR UNIVERSITY

NAAC Re-accredited 'A' Grade (2016-2021)

DST-FIST(Govt. of India), BOOST-DBT(Govt. of West Bengal) sponsored College

Website : www.panskurabanamalicollege.org

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P.O. - PANSKURA R.S. : PIN – 721152 : DIST. - PURBA MEDINIPUR : WEST BENGAL : INDIA

SEM-I

PAPER CODE-ZOOU MCC101

NON-CHORDATES: PROTISTS TO COELOMATES

Course Learning Objective:

The course would provide an insight to the learner about the existence of different life forms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organisation of the animals based on their evolutionary relationships, structural and functional affinities. The course will also make the students aware about the

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Jyoti
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characteristic morphological and anatomical features of diverse animals; economic, ecological and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

Course Learning Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of systematics, taxonomy and structural organization of animals.
- Appreciate the diversity of non-chordates living in varied habit and habitats.
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyze the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.
- Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem.

THEORY(Credits-4) 60
hours

Unit 1: Protista, Parazoa and Metazoa 13

General characteristics and classification up to classes

Locomotion of *Euglena*, *Amoeba*, *Paramecium*

Reproduction in *Paramecium* (Conjugation)

Unit 2: Porifera 8

General characteristics and classification up to classes

Canal system and spicules in sponges

Unit 3: Cnidaria 8

General characteristics and classification up to classes

Corals and coral reefs

Unit 4: Ctenophora 4

General characteristics and evolutionary significance.

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Jyoti
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Unit 5: Platyhelminthes

8

General characteristics and classification up to classes.

Life cycle and pathogenicity of *Fasciola hepatica* and *Taeniasolium*.

Unit 6: Nematelminthes

5

General characteristics and classification up to classes.

Life cycle and pathogenicity of *Ascaris lumbricoides* and *Wuchereriabancrofti*.

Parasitic adaptation in helminthes.

Unit 7: Introduction to Coelomates 3

Evolution of coelom and metamerism

Unit 8: Annelida4

General characteristics and Classification up to classes

Unit 9: Arthropoda 7

General characteristics and Classification up to classes

Metamorphosis in Insects.

Social life in bees and termites.

Unit 10: Onychophora4

General characteristics and Evolutionary significance.

Unit 11: Mollusca

5

General characteristics and Classification upto classes.

Torsion and detorsion in Gastropoda.

Unit 12: Echinodermata

4

General characteristics and Classification upto classes.

Water-vascular system in Asteroidea.

Larval forms in Echinodermata.

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T.K. 09/08/24

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Recommended Books:

- Barnes, R.D. (2006). Invertebrate Zoology, VII Edition, Cengage Learning, India. · Pechenik, J. A. (2015).
- Biology of the Invertebrates. VII Edition, McGraw-Hill Education *Note: Classification to be followed from “Barnes, R.D. (2006). Invertebrate Zoology, VII Edition, Cengage Learning, India”
- **Note- Classification to be followed for Ruppert & Barnes 1994 (6th edition)**

SEM-II

PAPER CODE– ZOUMCC202(PRACTICALS)

NON-CHORDATES & CHORDATES

1. Study of whole mount of Paramecium
2. Study of Sycon (T.S. and L.S.),
3. Identification (Characteristic Features and Significance) of Amoeba , Euglena, Obelia, Physalia, Aurelia, , Corallium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora, Ctenophora
4. To submit a Project Report on “The Diversity of Pond Protista”.
5. Study of following specimens:
Annelids - Aphrodite, Nereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria.

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Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, termites and honey bees Onychophora–Peripatus.

Molluscs- Chiton, Dentalium, Pila, Lamellidens, Pinctada, Sepia, Octopus, Nautilus.

Echinodermates - Pentaceros/Asterias, Ophiura, Echinus, Cucumaria and Antedon

6. Study of digestive system and septal nephridia of earthworm.

7. Mount of mouth parts and dissection of digestive system, Reproductive System and nervous system of Periplaneta.

8. Study of whole mount of Paramecium

9. Study of Sycon (T.S. and L.S.),

10. Identification (Characteristic Features and Significance) of Amoeba , Euglena,

Obelia, Physalia, Aurelia, , Corallium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora, Ctenophora

11. Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/micro-photographs)

12. Study of adult Ascaris lumbricoides and its life stages (Slides/micro-photographs)

13. To submit a Project Report on “The Diversity of Pond Protista”.

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SEM-III
PAPER CODE – ZOOUMCC303
THE PRINCIPLES OF ECOLOGY

Course Learning Objective: The primary aim of the syllabus is to sensitize the students about the paramount role and importance of nature. The study of Ecology imparts us the knowledge about the judicious use of existing ecological resources for sustainable development. Ecology is the only branch of science which briefs us on the ways and means of living with nature for mutual benefit. Study of ecology will provide students opportunity to understand its practical aspects and helps them to solve many contemporary ecological issues such as global warming, land degradation, habitat loss, desertification and pollution etc. The hands-on experiences of laboratory will also enable students to understand the ecosystem and ecology in a better way.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors.
- Comprehend the population characteristics, dynamics, growth models and interactions.
- Understand the community characteristics, ecosystem development and climax theories.

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J. R. S. RAO
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T. R. S. RAO
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Dr. R. S. RAO
09/08/24

- Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies.
- Apply the basic principles of ecology in wildlife conservation and management.

THEORY(credit-4) 60
hours

Unit 1: Introduction to Ecology 8

The history of ecology, Autecology and Synecology, Levels of organization Laws of limiting factors, Study of physical factors.

Unit 2: Population 18

Unitary and Modular populations, Unique and group attributes of population: density, natality, mortality, Life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent & independent factors. Population interactions, Gause's principle with laboratory and field examples, Lotka-Volterra equation (with problems) for competition and Predation, functional and numerical responses.

Unit 3: Community 13

Community characteristics: species richness, dominance, diversity Abundance, vertical stratification, Ecotone, and edge effect; Ecological succession with one example. Theories of the climax community.

Unit 4: Ecosystem 11

Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow linear and Y-shaped through the ecosystem, Ecological pyramids and Ecological efficiencies.

Unit 5: Toxicology 10

Toxicology: Xenobiotic, Pollutants and Toxins. Acute and Chronic Toxicity, Concept of LC50 and LD50. Bio-magnification and Bio-transformation, Bioindicators.

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Unit6 :Biodiversity and Conservation Ecology

Definition of Biodiversity and types, Biodiversity Hotspots, Megadiversity Countries. Definition of wild life, Wild Life Protection Act (1972), Biodiversity Act (2002), Brief Programs of CITES, WWF and MAB. In situ and Ex situ Conservation, Tiger conservation as a model. Importance of Wetland and Ramsar Sites, Natural Resource management, Human-animal conflict, Arabari Model of Joint Forest Management(JFM).

Recommended Books:

- Odum, E.P. (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole.
- Smith, R. L. (2000). Ecology and field biology. Harper and Row publisher.

SEM-III

PAPER CODE– ZOOUMCC304

CELL BIOLOGY

Course Learning Objective: The objective of the course is to help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Course Learning Outcome: Upon completion of the course, students should to be able to:

- Understand fundamental principles of cell biology.
- Explain structure and functions of cell organelles involved in diverse cellular processes.
- Appreciate how cells grow, divide, survive, die and regulate these important processes.
- Comprehend the process of cell signalling and its role in cellular functions.
- Have an insight of how defects in functioning of cell organelles and regulation of cellular processes can develop into diseases.
- Learn the advances made in the field of cell biology and their applications

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Jyothi
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Shruti
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**THEORY (Credit-4)
hours**

60

Unit 1: Overview of Cells

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, PrionsS

Unit 2: Plasma Membrane

Various models of plasma membrane structure

Transport across membranes: Active and Passive transport, Facilitated transport

Cell junctions: Tight junctions, Desmosomes, Gap junctions

Unit 3: Endomembrane System

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis

Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis

Peroxisomes

Unit 5: Cytoskeleton

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit 6: Nucleus

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus

Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 7: Cell Division

Mitosis, Meiosis, Cell cycle and its regulation

Unit 8: Cell Signaling

GPCR and Role of second messenger (cAMP), Apoptosis , Necrosis.

SEM-IV

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Jeeva 09/08/24

T.R. Nair 09/08/24

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PAPER CODE –ZOOMCC405

DIVERSITY OF CHORDATA & COMPARATIVE ANATOMY OF VERTEBRATES

(GROUP- A: DIVERSITY OF CHORDATA)

Course Learning Objective: The course is designed with an aim to provide scope and historical background of chordates. It will impart knowledge regarding basic concepts of origin of chordates and make the students understand the characteristics and classification of animals with notochord. The exclusive phenomena in chordates like biting mechanism in snakes, flight adaptations in birds etc. will be explained. The adequate explanation to the students regarding various mechanisms involved in thriving survival of the animals within their geographic realms will create interest among students.

Course Learning Outcome: Upon completion of the course, the students will be able to:

- Understand different classes of chordates, level of organization and evolutionary relationship between different subphyla and classes, within and outside the phylum.
- Study about diversity in animals making students understand about their distinguishing features.
- Appreciate similarities and differences in life functions among various groups of animals in Phylum Chordata.
- Comprehend the circulatory, nervous and skeletal system of chordates.
- Know about the habit and habitat of chordates in marine, freshwater and terrestrial ecosystems.

THEORY-(CREDIT-2)

60 hrs

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Unit 1: Introduction to Chordates**1 hrs**

General characteristics and outline classification

Unit 2: Protochordata**4hrs**

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata ; Concept about origin of chordate (Phylogenetic tree) .

Unit 3: Agnatha**1hrs**

General characteristics and classification of cyclostomes up to class.

Unit 4: Pisces**4 hrs**

General characteristics of Chondrichthyes and Osteichthyes, classification up to order, Migration, Osmoregulation and Parental care in fishes.

Unit 5: Amphibia**2 hrs**

General characteristics and classification up to order; Parental care in Amphibians.

Unit 6: Reptilia**4hrs**

General characteristics and classification up to order; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes.

Unit 7: Aves**4 hrs**

General characteristics and classification up to order, Principles and aerodynamics of flight, Flight adaptations and Migration in birds.

Unit 8: Mammals**3 hrs**

General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

Unit 9: Zoogeography**2 hrs**

Zoogeographical realms and distribution of vertebrates in different realms. Plate; Tectonic and Continental drift theory

(GROUP-B: COMPARATIVE ANATOMY OF VERTEBRATES)

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(CREDITS 2)

Unit 1: Integumentary System 4hrs

Structure, functions and derivatives of integument (Fish, Bird and Mammals)

Unit 2: Skeletal System

4hrs

Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral Arches

Unit 3: Digestive System (Carp, Bufo, Pigeon, Cow and Camel) 4hrs

Alimentary canal and associated glands, dentition

Unit 4: Respiratory System 4hrs

skin, gills, lungs, and air sacs; Accessory respiratory organs

Unit 5: Circulatory System 4hrs

General plan of circulation, the evolution of heart and aortic arches.

Unit 6: Urinogenital System 4 hrs

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian Uteri

Unit 7: Nervous System 6 hrs

Comparative account of brain Autonomic nervous system, Spinal cord, and Cranial nerves in mammals

Unit 8: Sense Organs 4 hrs

Classification of receptors Brief account of visual and auditory receptors in man

Recommended Books:

- Young, J. Z. (2004). The Life of Vertebrates. III Edition, Oxford university press.

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Jeeva
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- Parker T.J. and Haswell W.A. (1972). Textbook of Zoology Vertebrates.VII Edition, Volume II .
- Pough H. (2018). Vertebrate life X Edition, Pearson International.

SEM-IV

PAPER CODE –ZOOMCC406

DIVERSITY OF CHORDATA & COMPARATIVE ANATOMY OF VERTEBRATES AND PRINCIPLES OF ECOLOGY

GROUP- A: DIVERSITY OF CHORDATA

PRACTICAL SEC-I

1. Protochordata

Balanoglossus, Ascidia, Branchiostoma.

2. Agnatha

Petromyzon, Myxine.

3. Fishes

Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetradon/ Diodon, Anabas.

4. Amphibia

Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra, Axolotl larva.

5. Reptilia

Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Vipera, Naja, Hydrophis, Crocodylus
Key for Identification of poisonous and non-poisonous snakes.

6. Aves

Study of six common birds from different orders. Types of beaks and claws.

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7. Mammalia

Sorex, Bat (Insectivorous and Frugivorous)

Mount of Weberian ossicles of *Mystus*, pecten from Fowl head

Power point presentation on study of anatomy of any two animals from two different classes by students (may be included if dissections not given permission).

SEC-II

PRACTICAL

CREDITS 2

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Disarticulated skeleton of Frog, Fowl.
3. Carapace and plastron of turtle /tortoise
4. Mammalian skulls: One herbivorous and one carnivorous animal
5. Dissection of fish(Tilapia/Bata) to study arterial and urinogenital system(subject to permission)
6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)
7. Project on skeletal modifications in Amphibia, Reptilia and Mammalia , may be included if dissection not permitted.
- 8.Preparation of permanent slide to show the presence of Barr body in human female blood cells/chick cells.

SUGGESTED READINGS

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.

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2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.

SEM-IV

PAPER CODE-ZOUMCC407

Spryra
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Prasad
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Juelin
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ANIMAL PHYSIOLOGY

course Learning Objective: Physiology is the study of life, specifically, how cells, tissues and organ function. It is a core and fundamental scientific discipline that underpins the health and well-being of living organisms. Besides satisfying a natural curiosity about how our body systems function, it gives us knowledge about the functions of all the parts and systems of the body. It is also of central importance in medicine and related health sciences. The course has been designed to extend the fundamental or coherent understanding of the subject to related disciplinary areas/subjectsthrough understanding of normal body functions, assisting in more effective treatment of abnormal or diseased states. It will equip the students with skill-based knowledge, enabling them to undertake further studies in physiology and related areas as well as in multidisciplinary subjects.

Course Learning Outcome: Upon completion of the course, students will be able to:

- Know the basic fundamentals and understand advanced concepts so as to develop a strong foundation that will help them to acquire skills and knowledge to pursue advanced degree courses.
- Comprehend and analyze problem-based questions.
- Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body and use of feedback loops to control the same
- Learn an integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body. Synthesize ideas to make connection between knowledge of physiology and real world situations, including healthy life style decisions and homeostatic imbalances.

GROUP- A (CONTROLLING AND COORDINATING SYSTEMS)

Unit 1: Tissues 6 hrs

Structure, location, classification and functions of Epithelial tissue, Connective tissue, Muscular tissue and Nervous tissue .

Unit2: Bone and Cartilage 4hrs

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Histology of different types of bones and cartilages.

Unit 3: Nervous System 12 hrs

Structure of neuron, Resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission, Neuromuscular junction; Physiology of hearing and vision.

Unit 4: Muscle 12 hrs

Histology of different types of muscle; Ultrastructure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, Summation and tetanus .

Unit 5: Reproductive System 8 hrs

Histology of testis and ovary; Physiology of male and female reproduction

Unit 6: Endocrine System 18 hrs

Histology of endocrine glands- pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; Hormones secreted by them and their physiological action; Classification of hormones; Regulation of their secretion; Mode of hormone action- Signal transduction pathways for steroidal and non-steroidal hormone

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GROUP- B (LIFE SUSTAINING SYSTEMS)

THEORY(Credits 2)

Unit 1: Physiology of Digestion 7

Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

Unit 2: Physiology of Respiration 8

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration.

Unit 3: Renal Physiology 6

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance.

Unit 4: Blood 7

Components of blood and their functions; Structure and functions of haemoglobin; Haemostasis: Blood clotting system, Kininogen Kinin system, Fibrinolytic system.

Unit 5: Physiology of Heart 8

Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation.

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Recommended Books:

- Ganong, W.F. (2019) Review of Medical Physiology. 26th Edition, Mc Graw-Hill • Guyton, A.C. & Hall, J.E. (2006).
- Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd/W.B. Saunders Company.

SEM-V

PAPER CODE –ZOOUMCC508

FUNDAMENTALS & METABOLIC PROCESSES OF BIOCHEMISTRY

Course Learning Objective: The program is designed to enable a student acquire sound knowledge of biochemistry and its practicable applicability. Effort has been made to make the study relevant, interesting and encouraging to the students to join the industry or to prepare them for higher studies including research. The new and updated syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, chemistry communication skills, team skills as well as ethics.

Course Learning Outcome: Upon completion of the course, students will be able to

- Gain knowledge and skill in the interactions and interdependence of physiological and biomolecules
- Understand essentials of the metabolic pathways along with their regulation.
- Know the principles, instrumentation and applications of bioanalytical techniques.
- Get exposure to various processes used in industries.
- Become aware about classical laboratory techniques, use modern instrumentation, design and conduct scientific experiments and analyze the resulting data.

THEORY (CREDIT-4)

60 hours

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Unit 1: Carbohydrates 4

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates

Unit 2: Lipids 4

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids

Unit 3: Proteins 7

Amino acids: Structure, Classification and General properties of α -amino acids; Physiological importance of essential and non-essential α -amino acids Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins

Unit 4: Nucleic Acids 6

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA, Complementarity of DNA, Hypo-Hyper chromaticity of DNA

Unit 5: Enzymes 10

Nomenclature and classification; Cofactors; Specificity of enzyme action, Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max} , Lineweaver-Burk plot; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

Unit 6: Carbohydrate Metabolism 8

Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

Unit 7: Lipid Metabolism 7

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SEM-V

PAPER CODE –ZOOUMCC509

ANIMALPHYSIOLOGY:(CONTROLLING,CO-ORDINATING&LIFESUSTAINING SYSTEMS)
AND FUNDAMENTALS & METABOLIC PROCESSES OF BIOCHEMISTRY

GROUP-A PRACTICALS Credits-2

SECTION-I

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex).
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells.
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
5. Microtomy: Preparation of permanent slide of any five mammalian (Goat/white rat) tissues.

SECTION-II

1. Determination of ABO Blood group

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2. Enumeration of red blood cells and white blood cells using haemocytometer.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Preparation of haemin and haemochromogen crystals.
5. Recording of blood pressure using a sphygmomanometer.
6. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.

Group-B

FUNDAMENTALS & METABOLIC PROCESSES OF BIOCHEMISTRY

PRACTICAL(CREDITS 2)

SECTION-I

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under different conditions.
4. Demonstration of proteins separation by SDS-PAGE.

SECTION-II

1. Estimation of total protein in given solutions by Lowry's method.
2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue.
3. To study the enzymatic activity of Trypsin and Lipase.
4. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.

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SEM-V

PAPER CODE-ZOOUMCC510

Molecular Biology

Course Learning Objective:

The course aims to provide students with an introduction of the underlying molecular mechanisms of various biological processes in cells and organisms. The study primarily involves learning about structure and synthesis of deoxyribo- and ribo-nucleic acids, formation of proteins, and regulation of gene expression. The course aims to develop basic understanding of structure-function relationships of nucleic acids and proteins.

Course Learning Outcome:

Upon completion of the course, students will be able to:

- Describe the basic structure and chemistry of nucleic acids, DNA and RNA;
- Compare and contrast DNA replication machinery and mechanisms in prokaryotes and eukaryotes.
 - Elucidate the molecular machinery and mechanism of information transfer processes– transcription and translation-in prokaryotes and eukaryotes;
- Explain post-transcriptional modification mechanisms for the processing of eukaryotic RNAs;
- Discuss general principles of transcription regulation in prokaryotes by exploring the structure and function of lactose and tryptophan metabolism operons;
- Give an overview of gene expression regulation in eukaryotes;
- Explain the significance of DNA repair mechanisms in controlling DNA damage;
- Recognise role of RNAs (riboswitches, siRNA and miRNA) in gene expression regulation

Theory [Credits: 4]

60 hrs

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Unit1:Nucleic Acid

6 hrs

Salient features of DNA and types of RNA (mRNA, rRNA and tRNA);
Watson andCrick model of DNA)

Unit 2: DNA Replication 12 hrs

DNA replication in prokaryotes and eukaryotes – replication machinery and mechanisms, semi-conservative, bidirectional and semi-discontinuous replication, Replication of circular and linear double stranded DNA, Replication of telomere.

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Unit 3: Transcription

10 hrs

Machinery and mechanism of transcription in prokaryotes and eukaryotes- RNA polymerases, Transcription unit, Transcription factors, Synthesis of rRNA.

Unit 4: Translation

12 hrs

Genetic code, Degeneracy of the genetic code and Wobble hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure, fidelity of protein synthesis, aminoacyl-tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain, Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation.

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA4
hr
s

Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing.

Unit 6: Gene Regulation

10 hrs

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Overview of transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing and Genetic imprinting.

Unit 7: DNA Repair Mechanisms

2 hrs

Pyrimidine dimerization and mismatch repair.

Unit 8: Regulatory RNAs

4 hrs

Ribo-switches; RNA interference: miRNA and siRNA.

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Recommended Books:

- Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene. VI edition. Cold Spring Harbour Lab. Press, Pearson Pub.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.

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SEM-V

PAPER CODE-ZOUMCC511

Principles of Genetics

Course Learning Objective:

In about a century of its existence, this field has generated tremendous amount of knowledge through observational and experimental research. The information amassed in the last century has laid the foundation for more discoveries in this important field of life science. This course aims to provide an overview of genetics starting from the work of Mendel to the current understanding of various phenomena like recombination, transposition, sex determination and mutations. The course will help in building sound fundamental knowledge of the principles of genetics, to be used as a stepping stone for higher studies and research in this field.

Course Learning Outcome:

Upon completion of the course, students will be able to-

- Have a deeper understanding of the varied branches of the biological sciences like microbiology, evolutionary biology, genomics and metagenomics.
- Gain knowledge of the basic principles of inheritance.
- Analyse pedigree leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner.
- Know the mechanisms of mutations, the causative agents and the harmful impact of various chemicals and drugs being used in day to day life.

Theory [Credits: 4]

60 hrs

Unit 1: Mendelian Genetics and its Extension

10hrs

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, penetrance and expressivity, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters

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inheritance and concept of gene.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping **10 hrs**

Linkage and crossing over, Cytological basis of crossing over, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Linkage map, coefficient of coincidence and Interference, Gene mapping by Somatic cell hybridization.

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Unit-3 : Mutation

10hrs

Types of gene mutations, Detection of mutations in Drosophila: CLB method, attached X method, Mutagens: Physical and Chemical, Molecular basis of spontaneous and induced mutations, Chromosomal aberrations: Variations in number and structure.

Unit 4: Sex Determination

5 hrs

Basis of sex determination: Genetic and environmental; Sex determination in Drosophila and Man; Mechanism of dosage compensation

Unit 5: Extra-chromosomal Inheritance

5hrs

Comparison of nuclear and extra nuclear inheritance; Organelle inheritance: Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces and human disorders, Infective heredity in Paramecium. Maternal effects: Shell coiling in Limnaea, pigmentations in Epephelia.

Unit 6: Polygenic Inheritance

3hrs

Polygenic inheritance with suitable examples and numericals

Unit 7: Recombination in Bacteria and viruses

9 hrs

Conjugation, Transformation, Transduction in bacteria, Complementation test in Bacteriophage

Unit 8: Transposable Genetic Elements

8 hrs

Transposons in bacteria, Ty elements in yeast, Ac-Ds elements in maize and P elements in Drosophila, Transposons in humans, Transposons as mutagens

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SEM-VI

PAPER CODE-ZOOUMCC612

MOLECULAR BIOLOGY & PRINCIPLES GENETICS

GROUP-A PRACTICAL

(CREDITS2)

1. Study of Polytene chromosomes from Chironomous/Drosophila larvae
2. Preparation of liquid culture medium(LB) and raise culture of *E.coli*
3. Preparation of solid culture medium (LB) and growth of *E.coli* by spreading and streaking
4. Demonstration of antibiotic sensitivity/resistance of *E.coli* to antibiotic pressure and interpretation of results
5. Quantitative estimation of DNA using colorimeter (Diphenylaminereagent) or spectrophotometer (A260 measurement)
6. Quantitative estimation of RNA using Orcinol reaction
7. Study and interpretation of electronmicrographs/photographshowing
 - a) DNAreplication
 - b) Transcription
 - c) Splitgenes
8. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
9. 9.Study of various stages of meiosis of Grass hopper.
- 10.Preparation of permanent slide to demonstrate: i) DNA by Feulgen reaction ii) Mucopolysaccharides by PAS reaction.

GROUP-B PRACTICALS

(CREDITS2)

1. TostudytheMendelianlawsandgeneinteractions.
2. Chi-squareanalysesusingseeds/beads/Drosophila.

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Jeeva 09/08/24

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3. Linkage maps based on data from conjugation, transformation and transduction.
4. Linkage maps based on data from Drosophila crosses.
5. Study of human karyotype (normal and abnormal).
6. Pedigree analysis of some human inherited trait

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SEM-VI

PAPER CODE-ZOUMCC613

Developmental Biology

Course Learning Objective: The main aim of the paper on Developmental Biology is to provide the undergraduate students an in-depth knowledge on the embryonic and post embryonic developmental processes. An important aspect of developmental biology is its implication in medicine which is also dealt within this course. The approach of this paper is to make the students realize the most fascinating aspect of developmental biology that a single fertilized egg can give rise to a fully developed complex organism. The course explains the basic principles and concepts underlying the developmental processes at the cellular and molecular level. To understand morphogenesis, the students are introduced to model organisms like *Seaurchin*, *Drosophila*, *Frog* and *Chick* to study different types of eggs, cleavage patterns and various morphogenetic movements during gastrulation leading to formation of germ layers and their fate. By understanding the developmental processes, the students can relate to errors occurring during development leading to congenital disorders and human diseases.

Course Learning Outcome: Upon completion of the course, students should be able to-

- Understand the events that lead to formation of a multicellular organism

From a single fertilized egg, the zygote.

- Acquire basic knowledge of the cellular processes of development and the

Molecular mechanisms underlying these.

- Describe the general patterns and sequential developmental stages during embryogenesis; and understand how the developmental processes lead to establishment of body plan of multicellular organisms.
- Discuss the general mechanisms involved in morphogenesis and to explain how different cells and tissues interact in a coordinated way to form various tissues and organs.
- Understand about the evolutionary development of various animals.

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Theory [Credits: 4]

60 hrs

Unit1:Introduction

4hrs

Historical perspective and basic concepts: Phases of development, cell-cell interaction, pattern formation, differentiation and growth, differential gene expression, cytoplasmic determinants and asymmetric cell division.

Unit 2: Early Embryonic Development

26hrs

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Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Eggmembranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps(including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit3:Late Embryonic Development

10hrs

Fate of Germ Layers; Formation of neural tube, Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Unit4:PostEmbryonicDevelopment

11hrs

Metamorphosis:Changes,hormonalregulationsinamphibiansandinsects;Regeneration:Modesofregeneration,epimorphosis,morphallaxisandcompensatory regeneration (with one example each); Ageing: Concepts andTheories

Unit5:ImplicationsofDevelopmentalBiology

9hrs

Teratogenesis:Teratogenicagentsandtheireffectsonembryonicdevelopment;invitrofertilization,Stemcell(ESC),Amniocentesis.

RecommendedBooks:

- Gilbert,S.F.(2010).DevelopmentalBiology.IXEdition,SinauerAssociates, Inc.Publishers,Sunderland,Massachusetts,USA
- BalinskyB.I.andFabianB.C.(2006).AnIntroductiontoEmbryology.VIII Edition,InternationalThompsonComputerPress.
- Slack, J.M.W. (2013) Essential Developmental Biology. III Edition, Wiley-Blackwell.

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SEM-VI

PAPER CODE-ZOOUMCC614

Evolutionary Biology

Course Learning Objective: The study of evolutionary biology is essential for any one who seeks to obtain an understanding of life and natural world. It is a unifying thread which joins all organisms from prokaryotes to highest of eukaryotes. This course emphasizes on the development of evolutionary thought by dealing in general with the process and pattern of biological evolution. On one hand, it offers a chance to students to learn about deciphering evidences ranging from fossil records to molecular data and arranges them to establish phylogenetic relationships of species, while, on the other.

Course Learning Outcome:

Upon completion of the course, students should be able to-

- Acquire problem solving and high order analytical skills by attempting numerical problems as well as performing simulation studies of various evolutionary forces in action.
- Apply knowledge gained, on populations in real time, while studying speciation, behaviour and susceptibility to diseases.
- Gain knowledge about the relationship of the evolution of various species and the environment they live in.
- Get motivated to work towards mitigating climate changes so that well adapted species do not face extinction as a result of sudden drastic changes in environment.
- Use knowledge gained from study of variations, genetic drift to ensure that conservation efforts for small threatened populations are focused in right direction.

Theory [Credits: 4]

60 hrs

Unit 1: Life's Beginning

7hrs

Chemogeny, RNA World, Biogeny, Origin of photosynthesis, Endo-symbiotic theory.

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Jyoti 09/08/24

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Unit 2: Historical Review of Evolutionary Concepts

4 hrs

Lamarckism, Darwinism, Neo-Darwinism

Unit 3: Evidences of Evolution

12hrs

Fossils (formation, types and dating); Geological timescale; Study of horse phylogeny, neutral theory of molecular evolution, Molecular clock, Example of globin gene family, rRNA/cytc; Phylogenetic trees: types, interpretation and applications.

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Unit 4: Sources of Variation **6 hrs**

Variations: Heritable variations and their role in evolution.

Unit 5: Forces of Evolution: Qualitative studies **8 hrs**

Natural selection, Types of selection, kin selection, adaptive resemblances, sexual selection, frequency dependent selection.

Unit 6: Forces of Evolution: Quantitative studies **6 hrs**

Hardy-Weinberg Equilibrium: statement, assumptions, derivation of the equation; Derivation of equations for change in allelic frequencies in a population by evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient), genetic drift (founder's effect, bottleneck phenomenon), migration and mutation (genetic load).

Unit 7: Product of Evolution **8 hrs**

Speciation: Micro-evolutionary changes (inter-population variations, clines, Ring species, races), Species concept, Isolating mechanisms, Modes of speciation - allopatric, sympatric and parapatric. Adaptive radiation/macroevolution.

Unit 8: Extinctions. **3 hrs**

Background and Mass extinctions (events, causes and effects), Detailed explanation of K-Extinction.

Unit 9: Origin and Evolution of Man **6 hrs**

Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, molecular evidences in human evolution.

Recommended Books:

1. Ridley, M (2004) Evolution III Edition Blackwell publishing
2. Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Bartlett Publishers.
3. Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
4. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates. Snustad. S Principles of Genetics.

Sparna 09/08/24
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Jyoti 09/08/24

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5. Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell.

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SEM-VI

PAPER CODE-ZOOUMCC615P

Developmental & Evolutionary Biology

Practical(GROUP-A)

[Credits:2]

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).
2. Study of whole mounts of developmental stages of chick through permanent slides (Hamburger and Hamilton Stages): Stage 3 (Intermediate Streak)-13 hours, Stage 4 (Definitive Streak)-18 hours, Stage 5 (Head Process)-21 hours, Stage 7-24 hours, Stage 8-28 hours, Stage 10-33 hours, Stage 11-40 hours, Stage 13-48 hours, Stage 19-72 hours and Stage 24-96 hours of incubation.
3. Demonstration of culture of chick embryo from fertilized egg to study various developmental stages.
4. Study of the developmental stages and life cycle of *Drosophila* from stock culture.
5. Study of different sections of placenta (photomicrographs/slides).
6. Project report on *Drosophila* culture/chick embryo development.

Practical(GROUP-B)

[Credits:2]

1. Study of fossils from models/pictures.
2. Study of homology and analogy from suitable specimens.
3. Study and verification of Hardy-Weinberg Law by chi-square analysis.
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies.
5. Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex.
6. Construction of phylogenetic trees with the help of bioinformatics tools (ClustalX).

SEM-VII

PAPER CODE-ZOOUMCC716

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Non-Chordate Biology and Chordate Biology

Course Objective:

The course would provide an insight to the learner about the existence of different life forms on the earth and appreciate the diversity of animal life. It will help the students to understand the features of non-chordates and their systematic organization based on evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals.

Course Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of systematics, taxonomy, and structural organization of non-chordates & chordates.
- Appreciate the diversity of non-chordates & chordates living in varied habits and habitats.
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of non-chordates & chordates.

THEORY (CREDIT-4)

60 hrs

GROUP-A

1. Non-Chordate Biology Origin and evolution of Metazoa-

phylogenetic overview of major invertebrate phyla.; Phylogenetic relationship among Protozoa, Parazoa, Mesozoa, and Metazoa; evolutionary significance; Concepts and evidence about Super Phyla.

2. Foraminifera-

characteristics, origin, distribution, biology, and ecological and economic significance of foraminifera.

3. Comparative account of different larval forms of coelomate non-chordates. 3L

4. Biology of free living nematodes –

Feeding mechanism and roles of nematodes in ecosystem.

5. Lophophorate relationships; Bryozoa (Ectoprocta and Entoprocta) – anatomical peculiarities feeding mechanisms and phylogenetic relationship.

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6. Rotifera – general organization, mastax, reproduction, and cyclomorphosis. 3

7. Foraminifera– characteristics, origin, distribution, biology, and ecological role of foraminifera. 2

8. Conservation strategies of invertebrates: invertebrate diversity, importance, and threats;
alternative approaches to species-focused conservation; conservation status evaluation
for invertebrate species.

GROUP-B

Chordate Biology

1. Origin of Chordates:5

Hemichordata, Cephalochordata, Urochordata, the origin of craniates, the evolution of primates with special reference to *Homo sapiens sapiens*.

2. **Protochordates:** Endostyle and iodine binding capacity in Protochordates. 3

3. Respiratory system & gas bladder: 5

Function and requirements of the respiratory system; ventilation of internal gills; Agnatha, cartilaginous fishes, bony fishes, larval gills; arial respiration in lung fishes; swim bladder and the origin of lungs and other ducts.

4. Excretory System and osmoregulation:5

Evolution of kidneys among vertebrates, kidney structure in relation to osmoregulation; basic pattern and the Archinephros, Pronephros, Mesonephros, Metanephros: External salt excretion, osmoregulation in freshwater and marine fishes, association with the urinary system.

5. Echolocation:

Structure and function of organs of hearing balance and echolocation; morphological adaptation for echolocation; bat echolocation.

6. Integumentary system: Cellular association and glandular System.

RECOMMENDED BOOKS

Spayra, Prasad, G. K. S. 09/08/24 09/08/24

T. K. S. 09/08/24

09/08/24 09/08/24

1. Mayr, E. and P. D. Ashlock (1991). Principles of systematic zoology, McGraw-Hill. Publisher McGraw-Hill, 1991
2. Hickman, C. P., S. L. Keen, et al. (2016). Integrated Principles of Zoology, McGraw-Hill Education. 17th Eds.
3. Biology of the Invertebrates: J A Pechenik.

SEM-VII

PAPER CODE-ZOUMCC717

METHOD IN BIOLOGY & ANIMAL PHYSIOLOGY

Course Learning Objective: Physiology is the study of life, specifically, how cells, tissues and organ function. It is a core and fundamental scientific discipline that defines the health and well-being of living organisms. Besides satisfying a natural curiosity about how our body systems function, it gives us knowledge about the functions of all the parts and systems of the body. It is also of central importance in medicine and health sciences. Upon completing this course, students will be able to address a research problem in biotechnology and provide examples of current applications of biotechnology and advances in different areas like medical, microbial, environmental, and bioremediation. After getting theoretical knowledge, students would be acquainted with some modern instruments and methods indispensable to pursuing advanced research in the biotechnology field.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Have a clear knowledge of basic fundamentals and understanding of advanced concepts so as to develop a strong foundation that will help them to acquire skills and knowledge to pursue advanced degree courses.

- Comprehend and analyse problem-based questions on physiological aspects.
- Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body; and use of feedback loops to control the same.
- Upon completing this course, students will be able to address a research problem in biotechnology and provide examples of current applications of biotechnology and advances in different areas like medical, microbial, environmental, and bioremediation. After getting theoretical knowledge, students would be acquainted with some modern instruments and methods indispensable to pursuing advanced research in the biotechnology field.

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THEORY(CREDIT- 4)

60 hrs

GROUP-A(Methods in Biology)

1. Molecular Biotechnology

- a) Recombinant DNA technology
- b) Restriction & modifying enzymes
- c) Production of recombinant DNA molecule
- d) Cloning Vector
Amplification of DNA by PCR

2. Environmental Biotechnology

- a) Bioremediation
 - i. *In situ* bioremediation
 - ii. *Ex situ* bioremediation
- b) Bioremediation of Xenobiotic components and hydrocarbons
- c) Phytoremediation
Integration of different rural biotechnological tools and Cryopreservation.

3. Environmental Biotechnology

- a) Bioremediation
 - i. *In situ* bioremediation
 - ii. *Ex situ* bioremediation
- b) Bioremediation of Xenobiotic components and hydrocarbons
- c) Phytoremediation
Integration of different rural biotechnological tools and Cryopreservation

GROUP-B

ANIMAL PHYSIOLOGY

1. Blood, Circulation and Respiration:

- i. Haemopoiesis & haemostasis
- ii. Blood volume, blood pressure and their regulation
- iii. Acclimatization to extreme conditions like hypoxia & diving
- iv. Body oxygen stores: Haemoglobin, Oxyhaemoglobin and Myoglobin
- v. Oxygen dissociation curve; Bohr's effect; Haldane effect.

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Jyoti
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2. Cardiovascular System:

- i. Neurogenic hearts
- ii. Myogenic heart, heart as a pump; regulation of heart pumping; specialized junctional tissue
- iii. Cardiac cycle
- iv. Neural and chemical regulation of excitation & conduction in the heart

- v. ECG – principle, measurement and significance.

3. Stress Physiology:

- i. Homeostasis, Comfort zone, feedback control systems
- ii. Oxidative stress; Cellular response; Free radicals and antioxidants

4. Thermoregulation:

- i. Body temperature and determinants of body heat – production and loss
- ii. Physiological events for thermoregulation-physical, chemical, neural; counter current system.

RECOMMENDED BOOKS

1. Textbook of Medical Physiology - Arthur C. Guyton & John Edward Hall. 13th Ed.

2. Ganong's Review of Medical Physiology- Kim E. Barrett, Susan M. Barman, Scott Boitano, Heddwen Brooks. 25th Ed.

3. Biochemistry - Debajyoti Das, 1978.

4. Baker, J. R. (1958). Principles of Biological Micro-technique. Methuen, London.

5. Buchwalow, I. B. and Böcker, W. (2010). Immunohistochemistry: Basics and Methods.

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SEM-VII

PAPER CODE-ZOUMCC718

(PRACTICAL)

Non-Chordate Biology, Chordate Biology, Method in biology and Animal-Physiology

1. Non- Chordate Biology:

i) Identification of common Invertebrate and Vertebrate taxa.

ii) Minor Dissection:

a. Grasshopper - Reproductive system/ Nervous system.

b. Cockroach – Stomatogastric Nervous system.

c. Achatina – Reproductive system & Nervous system.

2. Chordate Biology:

i) Major Dissection: Vth, VIIth cranial nerves of bony fish.

ii) Minor Dissection: Fish scale and pecten of bird.

3. Animal Physiology

i) Demonstration of blood haemoglobin estimation in the animal model

ii) Estimation of pH and its impact on any aquatic animal.

iii) Observation of gut movement in an animal under hypoxia using Dale's apparatus.

iv) Estimation of Blood Pressure and Heart Rate.

v) Determination of Breath-Holding Time (BHT) in humans

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SEM-VIII

PAPER CODE-ZOUMCC819

Cell Biology & Cytogenetics

Course Objective:

The Learning Objectives of this course are as follows: Structure and functions of various cellular compartments and organelles-

- Fundamentals of transport of biomolecules inside the cell and its cytoskeleton
- Cell growth, cell-division and cell-cycle control mechanisms.
- Cell to cell communication and participation of signal transduction pathways, in driving cell response mechanics.
- Students will learn about how the cell has evolved and the basic types of cells present.
- Students will acquire insights into the composition and structure of cell membrane by navigating through various proposed cell models. Students will also learn the functions in detail about the processes of transport across cell membranes.
- Students will learn about the structure and function of various cellular compartments and organelles along with the concept of protein sorting and distribution in unique ways.

Course Outcome:

The Learning Outcomes of this course are as follows:

- Students will learn about how the cell has evolved and the basic types of cells present.
- Students will acquire insights into the composition and structure of cell membrane by navigating through various proposed cell models. Students will also learn the functions in detail about the processes of transport across cell membranes.
- Students will learn about the structure and function of various cellular compartments and organelles along with the concept of protein sorting and distribution in unique ways.
- Demonstrate an understanding of the basic concepts of the subject .
- The course will provide an understanding of genetic analysis at the gene, genome and population levels. Understanding Drosophila genetics. Evaluation of the various aspects of structural, functional and comparative genomics.

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Group-A

1. Bio-membrane Structure

2hrs

The Lipid Bilayer: Composition and Structural Organization; Membrane Proteins: Structure and Basic Functions, Membrane lipids: Phospholipids, Sphingolipids, and Cholesterol and Intracellular Movement.

2. Transmembrane Transport of Ions and Small Molecules

Overview of Transmembrane Transport, ATP-Powered Pumps and the Intracellular Ionic Environment, Overview of Trans-cellular Transport.

3. Moving Proteins into Membranes and Organelles

4hrs

Targeting Proteins to and across the ER Membrane, Insertion of Membrane Proteins into the ER, Targeting of Proteins to Mitochondria and Chloroplasts, Transport Into and Out of the Nucleus.

4. Signal Transduction

6hrs

The basic idea of Cell signaling, G Protein–Coupled Receptors: Structure and Mechanism, G Protein–Coupled Receptors and Regulation of Ion Channels, Signaling through second messengers, Receptor tyrosine kinase signaling, MAP Kinase pathway.

5. Cytoskeleton & Cellular Motility

3hrs

Microtubule Dynamics and regulation, Microtubular motor proteins: Kinesins & Dyneins and Cellular motility.

6. Cell cycle regulation: 5hrs

Phases of Eukaryotic cell cycle, cyclin and cyclin-dependent kinase, Regulation of CDK-cyclin complexes, Protein kinases in cell cycle, Regulation by ubiquitin ligase, Exit from mitosis, DNA replication and DNA damage checkpoints, chromosome–microtubule attachment.

7. Interactions between Cells and Their Environment:

5hrs

Overview of major cell-cell and cell-matrix adhesive interactions, Cell-Cell and Cell–Extracellular Junctions and their adhesion molecules; the extracellular matrix: The basal lamina and connective tissue; Integrin.

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GROUP-B

1. Genetic Fine structure:

5hrs

The CIS-TRANS or complementation test for functional allelism, Fine structure of the phage T4 rII locus, Complementation mapping and deletion mapping.

2. Recombination in Bacteria:5hrs

The CIS-TRANS or complementation test for functional allelism, Fine structure of the phage T4 rII locus, Complementation mapping and deletion mapping.

3. Tumor Inducing Viruses – Viral Oncogenes 8hrs

Life Cycle of Rous Sarcoma Virus, RSV genome organization, mechanism of integration, formation of transducing retroviruses, protein products of proto-oncogene, Onco-proteins, regulation of gene expression and signal transduction Cancer induction by Retroviruses, tumor suppressor gene and their function.

4. Genetic structure of Populations -

7hrs

Genotypic frequencies, Allelic Frequencies, the Hardy-Weinberg Law, calculation of genotypic and allelic frequencies where multiple alleles are present, derivation of the Hardy-Weinberg Law.

Reference Books/ Journal Article:

1. Introduction to Genetic Analysis by J.F.Griffiths.
2. Genes viii by Benjamin Lewin.
3. Genetic: Analysis and Principles by Robert J. Brooker.

SEM-VIII

PAPER CODE-ZOUMCC820

BIOCHEMISTRY & PARASITOLOGY

Course Learning Objective: Biochemistry is to understand the core biological phenomena at the molecular level. The aim of the course is to comprehend the fundamental principles of chemistry that govern complex biological systems. The program is designed to enable a student acquire sound knowledge of biochemistry and its practicable applicability. Parasites are vast menagerie. They can cause diseases without pardon. They can slip into a person's brain wrecking the biological clock turning the day into nights. They can cause livers of cattle useless and roots of plants

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functionless. They may cause a tourist spot an epicenter of epidemic disease. There is an enormous diversity of parasites in nature and knowing and understanding them well becomes very important in the light of controlling and managing the parasites effectively. The economic impact of these organisms is often huge and that makes it even more important to study them. Parasitology will enable us diagnose parasites correctly, understand their life cycle and control them effectively and use some of them as bio control agents. Parasitology; especially the study of life cycles of parasites; has helped in defying the stigmas and religious taboos for many societies making free many of the people from superstition and ill health.

Course Learning Outcome:

Upon completion of the course, students should be able to:

- Gain knowledge and skill in the fundamentals of biochemical sciences, interactions and interdependence of physiological and biochemical processes.
- Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals.
- Understand the variation amongst parasites, parasitic invasion in both plants and animals; applicable to medical and agriculture aspects.
- Help to know the stages of the life cycles of the parasites and the respective infective stages.

THEORY(CREDITS- 4)

GROUP-A

BIOCHEMISTRY

1. **Stabilizing interactions** (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction).2
2. **Protein Conformation:** Primary, secondary, tertiary and quaternary structures; Ramachandran plot; domains; motif and folds.5
3. **Protein Purification:** Salting out, Dialysis, Gel-filtration chromatography, Ion-exchange chromatography, Affinity chromatography, High-pressure liquid chromatography, Gel-electrophoresis, Isoelectric focusing, Twodimensionalelectrophoresis.3

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4. **Enzymes:** Enzyme kinetics, Michaelis-Menten equation, hyperbolic and LineweaverBurke plot; co-enzymes and cofactor; competitive and non-competitive inhibitor and their effects on enzyme kinetics; Active site of an enzyme; Enzyme regulation, allosteric modification, its kinetics, covalently modulated enzymes. 3
5. **Biological Oxidation:** Redox potential, mitochondrial electron carriers, the respiratory chain (electron transport chain); Mitchell's chemiosmotic theory of oxidative phosphorylation; FoF, ATPase, and Q cycle. 4
6. **Lipid Metabolism:** De novo synthesis of fatty acids, microsomal fatty acid elongase, desaturase systems; oxidation of saturated fatty acids and unsaturated fatty acids. 3
7. **Protein metabolism:** Deamination, transamination, formation of urea, formation of specialized products from amino acids: catecholamine, serotonin, melatonin, glutathione, T3, and T4. 2
8. **Carbohydrate metabolism:** Anabolic role of TCA cycle, integration of carbohydrate, fat and protein metabolism. Regulation of Glycolysis and TCA cycle, Gluconeogenesis, Pentose phosphate pathway, Glycogenesis, glycogenolysis with special reference to rate limiting steps. 4

GROUP-B

PARASITOLOGY

1. a) Types of Parasites and hosts. 2
 b) The basic concept of Parasitism, symbiosis, phoresis, commensalisms and mutualism. 2
 Molecular, cellular and physiological basis of host-parasite interactions. 2
3. Life cycle and immunology of *Plasmodium falciparum*. 3
4. Epidemiology and transmission of parasitic diseases. Malaria, Kalaazar. 4
5. a) Zoonosis and Zoonotic diseases with special reference to Balantidiasis, Giardiasis, Filariasis and Paragonimiasis. 4
 b) Life cycle and biology of *Leishmania sp.* *Schistosom sp.* 4
6. Structure and composition of helminth cuticle. 2

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7. Vector biology with special reference to mosquito, sand fly, and ticks. 3

Recommended Books:

1. Biochemistry by Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, 7th Ed. 2012.
2. Biochemistry by Mary K. Campbell, Shawn O. Fa, 6th Ed. 2009.
- Chatterjee, K. D. (1981). *Parasitology (Protozoology and Helminthology)*. 13th ed. CBS.
3. Cheng, T. C. (1986). *General Parasitology*. 2nd ed. Academic Press, Inc. Orlando. U.S.A.
4. Smyth, J. D. (1994). *Animal Parasitology*. 3rd ed. Cambridge University Press.
5. Biochemistry by D Voet and J G. Voet, 4th Ed. 2011.

SEM-VIII

PAPER CODE-ZOUMCC821

CELL BIOLOGY, CYTOGENETICS, BIOCHEMISTRY AND PARASITOLOGY

1. Cell Biology

- a. Identification of different stages of cell division and cell organelle.
- b. Mitochondrial Staining
- c. Cell isolation and cell counting

2. Cytogenetics

- a. The life cycle of *Drosophila*.
- b. Analysis and interpretation of genetic crosses with special reference to *Drosophila*
- c. Study of the polytene chromosome of *Drosophila*.

3. Biochemistry

- a) Quantitative estimation of protein- Lowry method / Bradford method.
- b) Protein denaturation and renaturation assay
- c) Estimation of Glucose, cholesterol, total protein and urea

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- d) Estimation of DNA by Diphenylamine reagent.
- e) Detection of amino acids by Ninhydrin reaction.
- f) Determination of K_m & V_{max} of enzymes Amylase / Alkaline phosphatase.

4. Parasitology

- a) Smear preparation and staining of rectal content of Bufo sp./Cockroach
- b) Preparation and staining of blood parasite from pigeon blood.
- c) Identification:

Plasmodium sp., *Leishmania sp.*, *Ascaris sp.*, *Fasciola sp.*, *Paramphistomum sp.*,
Anopheles sp., *Culex sp.*, *Aedes sp.*, *Columbicola sp.*, *Pediculus sp.*, *Cimex sp.*

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