



List of New Course(s) Introduced

Department : Zoology

Programme Name : B.Sc.

Academic Year : 2021-22

List of New Course(s) Introduced

Sr. No.	Course Code	Name of the Course
01.	ZOUATT1	Systematics and Diversity of Life- Protists to Chordates
02.	ZOUATT2	Developmental Biology and Evolution
03.	ZOUATG1	Exploring the Brain: Structure and Function
04.	ZOUBTT1	Comparative Anatomy and Physiology of Non-chordates
05.	ZOUBTT2	Cell Biology and Histology
06.	ZOUBTG1	Vectors, Diseases and Management
07.	SEC-L1	Aquaculture
08.	SEC-L2	Sericulture
09.	AEC-A1	Human Health and Sex Education

A. V. Bhatnagar

विद्यानायक
HEAD
जन्तु विज्ञान विभाग
Department of Zoology
गुरु घासीदास वि.वि., बिलासपुर
Guru Ghasidas Vishwavidyalaya, Bilaspur



Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2021-22

School : School of Studies of Life Sciences

Department : Zoology

Date and Time : 24 Dec, 2021 - 11:30 AM

Venue : Department of Zoology

The scheduled meeting of member of Board of Studies (BoS) of Department of Zoology, School of Studies of Life Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur was held to design and discuss the B. Sc. scheme and syllabi.

The following members were present in the meeting:

1. Prof. Shivkant Kumar Prasad (External Expert Member BoS, Dept. of Biosciences., Pandit Ravishankar Shukla University).
3. Prof. LVKS Bhaskar (HOD, Dept. of Zoology.-cum Chairman, BOS)
4. Dr. Rohit Seth (Member BoS, Associate Professor, Dept. of Zoology)
5. Dr. Sushant Kumar Verma (Member, Assistant Professor, Dept. of Zoology)

The committee discussed and approved the scheme and syllabi.

1. As per UGC LOCF guidelines, University/ department have liberty to offer GEC, AEC and SEC courses offered by any department to students of other departments.
2. The No. of GEC course is four. One GEC course is compulsory in first 4 semesters each. Pool for GEC will be given by Dean.
3. The No. of AEC course is five. One AEC course is compulsory in first 5 semester each.
4. The No. of SEC course is two. One SEC course is compulsory in first 2 semesters each.
5. Pool for AEC and SEC will be given by University.

The following new courses were introduced in B. Sc. Zoology (I to II semester):

Sr. No.	Course Code	Name of the Course
01.	ZOUATT1	Systematics and Diversity of Life- Protists to Chordates
02.	ZOUATT2	Developmental Biology and Evolution
03.	ZOUATG1	Exploring the Brain: Structure and Function
04.	ZOUBTT1	Comparative Anatomy and Physiology of Non-chordates
05.	ZOUBTT2	Cell Biology and Histology
06.	ZOUBTG1	Vectors, Diseases and Management
07.	SEC-L1	Aquaculture
08.	SEC-L2	Sericulture
09.	AEC-A1	Human Health and Sex Education


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Signature & Seal of HoD



Scheme and Syllabus

REVISED SCHEME AND SYLLABUS

FOR

Learning Outcomes based Curriculum Framework

(LOCF)

For

ZOOLOGY HONOURS

DEPARTMENT OF ZOOLOGY

SCHOOL OF LIFE SCIENCES

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (CG)

2021

Dr. K. Khanna

S.K. Singh

Neeraj



B.Sc. Hon's (Zoology): LOCF 2021-2022
Department of Zoology, School of Life Sciences

Course Opted	Course Code	Name of the course	Credit	Hour/week	Internal Assess	End Sem Exam
Semester I						
CC-1 Theory	ZOUAT11	Systematics and Diversity of Life- Protists to Chordates	3	3	30	70
CC-1 Practical	ZOUATL1	Lab Course	2	4	30	70
CC-2 Theory	ZOUAT12	Developmental Biology and Evolution	3	3	30	70
CC-2 Practical	ZOUALT2	Lab Course	2	4	30	70
GEC-1 Theory	ZOUATG1	Exploring the Brain: Structure and Function	3	3	30	70
GEC-1 Practical	ZOUALG1	Lab Course	2	4	30	70
AEC-1 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-1 Practical		To be drawn from the pool of AEC	1	2	30	70
SEC-1 Theory		To be drawn from the pool of SEC	1	1	30	70
SEC-1 Practical		To be drawn from the pool of SEC	1	2	30	70
		Additional Credit Course				
TOTAL			19	27	300	700
Semester II						
CC-3 Theory	ZOUBT11	Comparative Anatomy and Physiology of Non Chordates	3	3	30	70
CC-3 Practical	ZOUBLT1	Lab Course	2	4	30	70
CC-4 Theory	ZOUBT12	Cell Biology and Histology	3	3	30	70
CC-4 Practical	ZOUBLT2	Lab Course	2	4	30	70
GEC-2 Theory	ZOUBTG1	Vectors, Diseases and Management	3	3	30	70
GEC-2 Practical	ZOUBLG1	Lab Course	2	4	30	70
AEC-2 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-2 Practical		To be drawn from the pool of AEC	1	2	30	70
SEC-2 Theory		To be drawn from the pool of SEC	1	1	30	70
SEC-2 Practical		To be drawn from the pool of SEC	1	2	30	70
		Additional Credit Course				
Total			19	27	300	700
Semester III						
CC-5 Theory	ZOUCTT1	Comparative Anatomy and Physiology of Chordates	3	3	30	70
CC-5 Practical	ZOUCTL1	Lab Course	2	4	30	70
CC-6 Theory	ZOUCTT2	Genetics	3	3	30	70
CC-6 Practical	ZOUCTL2	Lab Course	2	4	30	70
CC-7 Theory	ZOUCTT3	Biochemistry	3	3	30	70
CC-7 Practical	ZOUCTL3	Lab Course	2	4	30	70
GEC-3 Theory	ZOUCTG1	Food, Nutrition and Health	3	3	30	70
GEC-3 Practical	ZOUCTL1	Lab Course	2	4	30	70
AEC-3 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-3 Practical		To be drawn from the pool of AEC	1	2	30	70
		Additional Credit Course				
Total			22	31	300	700
Semester IV						
CC-8 Theory	ZOUBTT1	Behaviour and Chronobiology	3	3	30	70
CC-8 Practical	ZOUBLT1	Lab Course	2	4	30	70
CC-9 Theory	ZOUBTT2	Ecology	3	3	30	70
CC-9 Practical	ZOUBLT2	Lab Course	2	4	30	70
CC-10 Theory	ZOUBTT3	Molecular Biology	3	3	30	70
CC-10 Practical	ZOUBLT3	Lab Course	2	4	30	70
GEC-4 Theory	ZOUBTG1	Global Environmental Issues	3	3	30	70
GEC-4 Practical	ZOUBLG1	Lab Course	2	4	30	70
AEC-4 Theory		To be drawn from the pool of AEC	1	1	30	70
AEC-4 Practical		To be drawn from the pool of AEC	1	2	30	70
		Additional Credit Course				
TOTAL			22	31	300	700
		Summer Internship*	6	90*	30	70

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Core Courses (CC): ZOUATTI and ZOUALTI

Semester	Core Course	Course Title	Credits
I	CC-I	Systematic and Diversity of Life- Protists to Chordates	Theory: 03 Practical: 02

About the course

The course is a walk for the Bachelor's entrant through the amazing diversity of living forms from simple to complex one. It enlightens how each group of organisms arose and how did they establish themselves in the environment with their special characteristics. It also deals with the differences and similarities between organisms on the basis of their morphology and anatomy which led to their grouping into taxa and clades.

Learning outcomes

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to protists, non chordates and chordates.
- Group animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

Theory

UNIT I: Origin of Life on Earth, Products of evolutionary process

13 Lectures

Origin of life on Earth: Arrival of simple form from primordial chemicals. Multicellularity: from simple collections of poorly differentiated cells to complex body plans. Biological diversity. Systematics and taxonomy. Species concept, clades. Nomenclature and utility of scientific names. Classification: morphological and evolutionary (molecular). Relationship of taxa: phylogenetics and cladistics.

UNIT II: Diversity in Protists and acoelomate Metazoa

13 Lectures

Structure and diversity in Protists. Origin of Metazoans: Diploblastic and triploblastic organization; symmetries; body cavities; protostomes and deuterostomes. Special features and structural diversity in sponges. Cnidarians: Special features; transition of third germ layer; polymorphism and division of labour; coral reef forming Cnidarians. The Bilateria: Basic characteristics. The acoelomates: Basic organization and adaptive radiations in flatworms.

UNIT III: Diversity in pseudocoelomate and coelomate Non chordates

13 Lectures

The Ecdysozoa: characteristics of the representative taxa. Pseudo coelomates; Basic organization and adaptive radiations in roundworms. The coelomates: Basic organization and adaptive radiations in Arthropods- Ancestors/ fossil arthropods. Adaptive radiations in Crustaceans, Insects, etc. Basic organization and diversity in Annelids. Basic organization and diversity in Molluscs. Disruption of bilateral symmetry and its significance. Basic organization of Echinoderms; their affinity to Chordates.

UNIT IV: Diversity in Protochordates and Chordates

13 Lectures

Chordates- Primitive Chordates and their affinities. Hemichordates, Urochordates and Cephalochordates. Advent of vertebrates: Cyclostomes, their evolutionary status and affinities. Basic organization and diversity of fishes, their evolutionary transitions. From Water to Land invasion - Early Tetrapodes. Amphibians diversity and adaptability to dual mode of life. Amniotes: the amniotic egg, adaptive

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radiations in reptiles; the avian ancestors. Birds: Adaptation from terrestrial to aerial mode of life. Origin of Mammals- Special features of Monotremes and Marsupials. Characteristics of other mammalian groups with special reference to primates

Recommended readings

1. Barnes, R. S. K.; Calow, P.; Olive, P. J. W.; Golding, D. W.; Spicer, J. I. (2002) The Invertebrates: a Synthesis, Blackwell Publishing.
2. Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
3. Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
4. Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw- Hill.
5. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
6. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
7. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

Practical

1. Study of animals through slides and museum specimens in the laboratory with details on their classification, biogeography and diagnostic features (record book).
2. Study of animals in nature during a survey of a National Park or Forest area.
3. Collection of five species (preferably invertebrates, insects) belonging to a clade. A project work on their generic identification, description and illustration with a note on their locality. Also the assessment of their relationship by constructing a cladogram using characters and character states.
4. Comparison of two species of birds belonging to same genus (Interspecific difference).
5. Comparison and weighting of characters of two birds belonging to same family but dissimilar genera.

Group discussion or Seminar presentation on one or two related topics from the list.

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Core Courses (CC): ZOUATT2 and ZOUALT2

Semester	Core Course	Course Title	Credits
I	CC-II	Developmental Biology and Evolution	Theory: 03 Practical: 02

About the course

The course explains the sequence of events starting with a single cell to the production of a very complex organism. The course not only describes how embryos develop (embryology), but also highlights how the processes of development are brought about by changing individual cells into specialized cells with specific functions (the cellular level), and how genes within the genome of the organism drive and guide these changes (the molecular level). It also deals with a comparative account of development in some select groups of animals.

Learning outcomes

After successfully completing the course, the students will be able to

- Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
- Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
- Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
- Examine the evolutionary history of the taxa based on developmental affinities.
- Understand the relevance of developmental biology in medicine or its role in development of diseases.

Theory

- UNIT I: How does reproduction start, commence and modify in living system? 13 Lectures**
Reproduction: a basis of species sustenance. Asexual and sexual reproduction and their relevance in corresponding environments. How are germ cells "special"? Gamete formation, types, external and internal fertilization; causes of Infertility. Structural and biochemical changes in gametes during and after fertilization, block to polyspermy. Establishment of the major embryonic axes, polarity, morphogen gradients and their interpretation. Fate maps, their relevance. In vitro fertilization; Amniocentesis; Artificial insemination (AI); Test tube baby.
- UNIT II: How does development affect organization of phenotypes & their variation? 12 Lectures**
Developmental commitment. Mosaic and regulative development. Direct and indirect development. Cleavage: types and patterns. Body plan and symmetries. Germ layer differentiation. Tubulation. Morphogenesis: Epiboly, emboly/ invagination, involution and ingression. Induction and recruitment. Organogenesis: formation of heart and kidney. Concept of competence, determination and differentiation and growth, molecular mechanism involved. Pluripotency. Stem cell biology and tissue repair
- UNIT III: Tracing the evolutionary biology of development 12 Lectures**
Role of extra embryonic membranes in development. Placenta: types, structure and functions. Metamorphosis in insect and frog. Regeneration: epimorphosis, morphallaxis and compensatory regeneration. Development, ageing and apoptosis. Developmental mechanisms of evolutionary change (Evo-devo). Developmental biology in understanding of disorders. Teratogenesis; wound healing, birth defects, developmental brain disorders. Neurodegeneration. Endocrine Disruptors & Cancer.

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UNIT IV: Understanding evolution through natural selection, adaptation and optimal models tradeoffs
15 Lectures

Early life on Earth and its indirect evidences, direct evidence of early life; great oxygenation and its relationship with life. Evolution and radiation of metazoans, major evolutionary transitions, Mass extinctions, Anthropocene and its uniqueness. Evidences of evolution: Hardy-Weinberg Equilibrium, Selection, Migration. Nonrandom mating, Cost/ benefit of sex, Sexual conflict, Evolution in asexual systems Life-history adaptations, Number and size of offspring; Parent-offspring conflict. Genetic drift, Neutral evolution; Theories of evolution. Sources of variation: mutation, recombination, epigenetic variation. Evolution of mutation rates. Phenotypic plasticity, Genome evolution: Mobile genetic elements; gene duplication. Evolution and Health: Evolution of antibiotic Resistance, Virulence, Evolutionary medicine.

Recommended readings

1. Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
2. Gilbert, S.F. (2010) Developmental Biology (9th edition). Sinauer
3. Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press
4. Campbell, N. and Reece, J. (2014) Biology (10th edition). Benjamin Cummings
5. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing.
6. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007) Evolution. Cold Spring, Harbour Laboratory Press.
7. Hall, B. K. and Hallgrímsson, B. (2008). Evolution. IV Edition. Jones and Bartlett

Practical

1. Types of eggs based on quantity and distribution of yolk: sea urchin, insect, frog, Chick.
2. Comparative study of cleavage patterns in Frog and Amphioxus models.
3. How do cells move, change shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick?
4. Study of development of chick embryo through incubated chick eggs up to 96 h.
5. Extra embryonic membranes of chick through permanent slides.
6. Some videos to develop understanding on the process of development.
7. Study of adaptive radiations in feet of birds and mouth parts of insects.
8. Understanding embryological evidence of evolution (through charts and videos).
9. Study of types of fossils.
10. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit).
11. Serial homology in appendages of Palaemon.

Group discussion or Seminar presentation on one or two related topics from the list.

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Core Courses (CC): ZOUBTT1 and ZOUBLT1

Semester	Core Course	Course Title	Credits
II	CC-III	Comparative Anatomy and Physiology of Non Chordates	Theory: 03 Practical: 02

About the course

The course makes a detailed comparison of the anatomy of the different taxa of non chordates. It also highlights how in the taxonomic hierarchy, there is an increase in the complexity of structure and function. The course thus gives an overview of the intricate life processes and adaptive radiations in non chordates.

Learning outcomes

After successfully completing this course, the students will be able to

- Develop an understanding of the characters used to classify besides being able to differentiate the organisms belonging to different taxa.
- Acquire knowledge of the coordinated functioning of complex human body machine.
- Have hands on experience of materials demonstrating the diversity of protists and non-chordates.
- Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
- Realize that very similar physiological mechanisms are used in very diverse organisms.
- Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.
- Undertake research in any aspect of animal physiology in future.

Theory

UNIT I: Diversity of Tegument and Digestive system 13 Lectures

Basic affinities and differences between prokaryotes and eukaryotes; protists and the non-chordate animals. Symmetry, Coelom development and diversity. Cell membrane in protists and its derivatives. Tegument in non-chordates and its derivatives. Nutrition and feeding modes in protists. Digestive system & feeding mechanism in non-chordates; Process of digestion from food vacuoles to complex digestive organs.

UNIT II: Diversity of Locomotory, Respiratory, Circulatory and Excretory systems 13 Lectures

Locomotion and diversity of locomotory organs in protists and non-chordates, muscle and locomotion, Structure and diversity of skeletal elements in protists and non-chordates. Respiration: diversity of respiratory organs, modes of respiration. Respiratory pigments and oxygen consumption rates of different organisms. Circulation and the diversity of circulatory system. Excretion (protists): endocytosis, exocytosis; Excretion and diversity of excretory organs in non chordates.

UNIT III: Diversity of Nervous and Reproductive systems 13 Lectures

Nervous system with special reference to diversity in brain and nerve chord. Neuroendocrine systems, pheromones. Sense organs: Mechanoreceptors and their diversity in different taxa. Sense organs: photoreceptors, chemoreceptors, thigmoreceptors, rheoreceptors and proprioceptors in different taxa. Diversity of the reproductive organs and accessory sex organs; modes of reproduction- asexual and sexual reproduction. Metamorphosis. Diversity of larval forms in non-chordates

UNIT IV: Evolution and characteristics of important Non Chordate taxa 13 Lectures

Organization and affinities in fossils (such as trilobites). Affinities of living fossils, Limulus and Peripatus. Polymorphism and colony formation. Parasite adaptations and life cycle patterns in parasites belonging to different taxa. The parasites listed by World Health Organization under preventive programmes. Structure and diversity of the pest organisms. Invertebrate model organisms and their

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importance. Taxa with special characteristics: Types of canal systems in sponges and their significance. Torsion and detorsion in Mollusca. Components of water vascular system in echinoderms.

Recommended readings

1. Barrington, E J W. (1967) Invertebrate structure and function, Nelson, London.
2. Barnes, R. D. (1968) Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.
3. Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.
4. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
5. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Marshall, A.J and Williams, W.D. (1995) Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers.
7. <http://abacus.bates.edu/acad/depts/biobook/AnimPhyl.pdf>

Practical

1. Study of models, permanent slides and museum specimens representing different protists and non-chordate taxa.
2. Some additional slides/specimens of Protozoans of agricultural importance. Coral-reef forming Cnidarians Plant parasitic nematodes Nematodes used as models in experimental biological research
3. Dissection of Pheretima to expose circumpharyngeal ganglia
4. Dissection of Periplaneta to expose the digestive system and salivary glands
5. Dissection of Palaemon to expose appendages and statocyst
6. Dissection of Pila
7. Study of larval forms: Ephyra, Planula, Trochophore, Pluteus, Veliger, Zoea, Metazoea, Bipinnaria
8. Some videos to develop understanding on the animals of different taxa.

Group discussion or Seminar presentation on one or two related topics from the list.

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Core Courses (CC): ZOUBTT2 and ZOUBLT2

Semester	Core Course	Course Title	Credits
II	CC-IV	Cell Biology and Histology	Theory: 03 Practical: 02

About the course

The course provides a detailed insight into basic concepts of cellular structure and function. It also gives an account of the complex regulatory mechanisms that control cell function.

Learning outcomes

After successfully completing this course, the students will be able to

Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.

Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.

Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.

Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.

Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

Theory

UNIT-I: The structure and organelles of prokaryotic and eukaryotic cells.

13 Lectures

Cell biology, its scope in modern perspective. Cell theory and its modern version and interpretation. General structure of prokaryotes, bacteria, archaea and eukaryotes. Extra nuclear cell organelles: Ultrastructure and functions of endoplasmic reticulum, ribosome, Golgi apparatus, lysosome, peroxisomes. Mitochondria: Origin, structure, composition, genome organization and function. Cytoskeleton: composition and functions; microtubules and microfilaments. MT vs Actin - their organization, association with membrane. Nucleus: size, shape, structure and functions of interphase nucleus. Ultrastructure of nuclear membrane and pore complex. Nucleolus: general organization, chemical composition and functions, nuclear sap/ nuclear matrix, nucleo-cytoplasmic interactions.

UNIT-II: Cell membrane and transport mechanism

12 Lectures

Cell membrane organization: cell membrane: structure, composition, models and function. Fluid mosaic model. Lipid Composition, inner and outer leaflets. Structure and functions of membrane proteins: Integral, peripheral and lipid-anchored membrane proteins. Junctional complexes, membrane receptor modifications: microvilli, desmosomes and plasmodesmata. Receptor mobility and clustering in the lipid bilayer. Cell receptor function - cellular trafficking. Transport across membrane: diffusion and osmosis. Active and passive transport, endocytosis and exocytosis

UNIT-III: Cell cycle, cell signaling and cell culturing

14 Lectures

Cell cycle, cell division- mitosis and meiosis. Cell division check points and their regulation. Role of growth factors. Mutations in the genes that regulate cell cycle and division and their role in causing cancer. Programmed cell death (Apoptosis). Cell regulation and Cell signaling: Signaling molecules and their receptors. Functions of cell surface receptors. Regulation of signaling pathways. Cell culture: Types of cell culture- monolayer and suspension culture. Types of culture media. Sterilization methods for culture wares and culture media. Maintenance of a cell line and storage of cells. Subcellular fractionation by differential centrifugation.

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UNIT-IV: Structural and functional significance of animal tissues - 13 Lectures

Introduction to tissues. Epithelial tissue: types, structure and characteristics. surface modifications. Basement membrane: structure and characteristics. Cell junctions. Exocrine and endocrine glands: types and structure. Connective tissue cells. Structure and function of loose, dense and adipose tissue. Cartilage and bone: classification, and fine structure. Structure and function of spleen. Membranes of the brain and spinal cord.

Recommended readings

1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons, Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & 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. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.

Practical

1. Study of prokaryotic and eukaryotic cell types with the help of chart, slide and video.
2. Separation and isolation of cells by sedimentation velocity in unit gravity.
3. Disruption of cells, isolation and identification of subcellular components; isolation of nuclei.
4. Isolation of mitochondria by differential centrifugation and identification of succinic dehydrogenase in the mitochondrial pellet.
5. Chromosome segregation in mitosis and meiosis.
6. Preparation of chromosome squashes from grasshopper/cockroach testes for the observation of stages of meiosis.
7. Study of types of tissue through permanent slides: epithelial, connective, muscular, nervous etc.
8. Study of histology of tissues by preparing permanent stained slides through microtomy.
9. Isolation and estimation of DNA.

Group discussion or Seminar presentation on one or two related topics from the list.

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Generic Elective Courses (GEC): ZOUATGI and ZOUALGI

Semester	Core Course	Course Title	Credits
I	GEC-I	Exploring the Brain: Structure and Function	Theory: 03 Practical: 02

About the course

The course provides an insight into the structure of brain, its associated functions, its gradual evolution with increased cranial capacity, mechanism of neurotransmission and the associated neurodegenerative disorders.

Learning outcomes

After successfully completing this course, the students will be able to understand:

- The early and current status of neuroscience.
- The structure of brain cells and their circuit.
- Evolution and adaptation of brain.
- Brain development, aging and imaging.
- Neurotransmitters and their action.
- The process of learning and memory.
- Different type of brain disorders.

Theory

UNIT I: Scope of Neuroscience, Brain structure

11 Lectures

Introduction to Neuroscience and its scope. Classical views and latest advances in Neuroscience. Brain cells, types: Neurons – types and structure; Glia- types and structure; Neuronal circuit.

UNIT II: Evolution and development of brain

12 Lectures

Evolution and Adaptation of Brain: Theories of brain evolution. Evolution of brain in vertebrates and associated behavioral adaptation. Organization and development of brain in human. Divisions of the brain. Structure-function relationship. Neuroimaging- CT and MRI.

UNIT III: Neurotransmitters and mechanism of neurotransmission

13 Lectures

Neurotransmitters and neurotransmission: Noradrenergic, serotonergic, dopaminergic and cholinergic system. Mechanism of neurotransmission and drug action. Learning and memory. Types, mechanism, disorders.

UNIT IV: Managing brain health

16 Lectures

Brain aging: Structural and chemical changes. Functional changes. Maintenance of healthy brain. Brain disorders: Neurodegenerative diseases- Epilepsy, Stroke, Alzheimer's, Parkinsons. Neuropsychiatric disorders- Anxiety, Depression, Mood disorders, Schizophrenia.

Recommended readings

1. Squire, L. et al. (2003) Fundamental Neuroscience, Academic Press.
2. Kandel, E. (2000) Principles of Neural Science, McGraw Hill

Practical

1. Dissection and study of chicken brain.
2. Observation and quantization of Drosophila behavior in response to food.
3. Experiments based on the course contents.

Group discussion or Seminar presentation on one or two related topics from the list.

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Generic Elective Courses (GEC): ZOUBTGI and ZOUBLGI

Semester	Core Course	Course Title	Credits
II	GEC-II	Vectors, Diseases and Management	Theory: 03 Practical: 02

About the course

The course provides an insight into the common vector-borne diseases, their etiology, role of vectors in their spread, host-parasite relationship and finally the strategies to manage these vectors.

Learning outcomes

After successfully completing this course, the students will be able to:

- Develop awareness about the causative agents and control measures of many commonly occurring diseases.
- Develop understanding about the favourable breeding conditions for the vectors.
- Devise strategies to manage the vectors population below threshold levels, public health importance.
- Undertake measures or start awareness programmes for maintenance of hygienic conditions, avoidance of contact from vector, destruction of breeding spots in the vicinity of houses and cattle shed by public health education campaign.

Theory

Unit I: Vector and vector bionomics

13 Lectures

Brief introduction, types and morphological peculiarities of vectors such as mosquitoes, flies, fleas, lice, bugs, ticks and mites. Host-vector relationship. Primary and secondary vector concept. Vectorial capacity. Vector bionomics-larval habitats and host biting preferences, human and animal biting indices. Evolution of vector bionomics and its effect on disease transmission. Vector incrimination. Human practices and the occurrence of pests

Unit II: Disease vectors and the causes of disease outbreaks

13 Lectures

Salient features of the vectors belonging to Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina (families Ixodidae and Argasidae) etc. Role of non-blood sucking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fevers, Vagabond's disease and Phthiriasis; of bugs in transmission of Chaga's disease of. Brief account of mites and the associated diseases. Population biology, Factors affecting abundance, Density dependence and independence, How do people cause outbreak?

Unit III: Vector management strategies

13 Lectures

Control of vector flies by screening, fly traps, electrocution, poison baits and outdoor residual sprays; biological control by natural parasites and predators. Chemical control. Efficacy of synthetic pyrethroids, residual spray of insecticides, treated bed nets/curtains and fumigations. Biological control of mosquitoes by the use of viruses, bacteria, fungi, parasites, nematodes and larvivorous fishes. Sterile insect technique, Eradication, Other genetic approaches, Pheromones/allelochemicals, Attract-and-kill, Mating disruptors, alarm pheromones and oviposition disruptors

Unit IV: Emerging concepts and approaches to vector management

13 Lectures

Legislation and regulation, Methods of sampling and monitoring, sampling plan, Allocation of sampling units. Exclusion and routes of entry. Controlled atmosphere. Risk assessment, The integrated control/IPM approach. Damage thresholds estimation, Forecasting, Increasing agroecosystem resistance, Pesticide selection, Eradication versus control, Up to what limits IPM should be adopted. Decision support



Ability Enhancement Course (AEC): AI

Semester	Core Course	Course Title	Credits
I-V	AEC-I	Human Health and Sex Education	Theory: 01, Practical: 01

About the course

The course is designed to address problems associated with health and sex thereby, promoting fitness and well being.

Learning outcomes

After the completion of this course, the students will be able to:

- understand the importance of good health.
- observe clean sexual habits thereby warding off sexually transmitted diseases.

Theory

Unit I: Health: Physical and spiritual

Health as a state of wellbeing, health awareness, Physical health, immunization and vaccination, healthy food, balanced diet, food supplements, proper sleep, exercise and keeping away from stress, pathogens and pollution. Reproductive health, adolescence, senescence. Prevention from mental illness and disabilities, alcoholism, tobacco addiction, de-addiction, lifestyle diseases. Spiritual health, yoga and meditation.

Unit II: Human reproductive and developmental cycle

Human reproductive system: structural details of male reproductive system, semen, hormonal control. Female reproductive system- structure of ovary, puberty, reproductive cycles and hormonal control, gestation period, hysterectomy, menopause. Events of human reproduction: Gametogenesis- spermatogenesis and oogenesis, ovulation, fertilization, embryonic development, parturition.

Unit III: Infertility and assisted reproductive techniques

Human intervention in reproduction: Contraception and birth control-barrier method, hormonal methods, natural methods, sterilization, termination of pregnancy. Infertility-male and female infertility, causes and treatment for infertility. Advanced Reproductive Technologies- IVF, GIFT, ZIFT, Donor Insemination (DI). Sperm transfer techniques. Surrogacy.

Unit IV: Sex education and prevention from Sexually transmitted diseases

Sexually transmitted diseases: Syphilis, chlamydia, trichomoniasis, gonorrhoea, AIDS, Sex education: Adolescent sexual activity, teenage pregnancy, sexual harassment, sexual awareness and policies (legal aspects), lesbian and gay sex, bisexual, transgender youth, adolescent stress management

Recommended readings

- Kothari P. (1994) Common sexual problems and solutions by, LBS Publishers and Distributors Ltd.
- Hadley, Mac. E. (2004) Endocrinology. (5th edition) Pearson Education, Singapore.
- Taylor, D.J., Green, N.P.O., Stout G. W. (2005) Biological Science. (Editor R. Soper) 3rd Edition, Cambridge University Press.
- The Complete Manual of Fitness and Well-being. The Reader's Digest Association, Inc. Pleasantville, New York / Montreal.
- Guyton, A.C. and Hall, J.E..Textbook of Medical Physiology.

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Skill Enhancement Course (SEC): L1

Semester	Core Course	Course Title	Credits
I-II	SEC-I	Aquaculture	Theory: 01, Practical: 01

About the course

This course will give the students an understanding of the principles of aquaculture, including production systems, water quality, nutrition, spawning, larval culture and culture methodologies with special reference to fish, and prawn. The course will include an opportunity to conduct hands-on activities related to culture and husbandry of animals

Learning outcomes

- After completing this course the learners will be able to
- understand the aquaculture systems
 - Understand conditioning factors and how they can be manipulated
 - Describe water deputation mechanisms
 - Understand the environmental impacts of aquaculture

Theory

Unit I: Freshwater aquaculture systems

Aquaculture concept, Culture systems: Freshwater prawn culture, fish culture in paddy fields, Brackish water culture, Mariculture: Oyster culture, Crab culture, Lobster culture, mussel culture, culture of Eels, Culture of aquatic weeds. Composite fish culture: Definition and various patterns. Mixed fish farming in India. Techniques of composite culture. Culture of buffalo fish .Culture of Catfishes. Culture of miscellaneous fishes. Cray fish culture.

Unit II: Preparation and management of fish culture ponds

Nursery ponds. Predatory and Weed fishes and their control. Fish toxicants. Fertilization. Aquatic insects and their control. Fish food organisms and their production. Supplementary feeding. Transport of fish seed and Brood fish. Causes of mortality in transport. Methods for packaging and transport. Open systems. Closed systems. Use of chemicals in live fish transport. Anesthetic drugs. Antiseptics and Antibiotics.

Unit III: Fish pathology

Parasitic infections. Fungus infections. Protozoan diseases.suryodata; Worm diseases. Non parasitic diseases. Rearing ponds, Stocking ponds. Fish breeding: Natural and artificial. Harvesting: Fishing techniques, preservation & processing of fish. Fresh water prawn culture. Introduction. Brooding characteristics. Juvenile prawn migration. Seasonal & regional distribution of seeds. Identification of juveniles. Controlled breeding. Culture: Ponds, Monoculture. Mixed culture.

Unit IV: Technologies in Fisheries development

Role of hard water in culture of Macrobrachium species. Fertilization & feeds. Pearl culture: Introduction, Pearl producing mollusks, pearl formation, collection of oysters, Rearing of oysters, insertion of nucleus, harvesting of pearls, composition & quality of pearl. Recirculation technology. Geographic Information System (GIS) technology, passive Acoustics in fisheries, Use of Information Communication Technology (ICT) in fishes: production aspects, marketing aspects.

Recommended readings

1. Jingran, V. G. (1983) Fish and fisheries of India , Hindustan pub. corp. New Delhi.
2. Hute, M. and Kahn, H. (2000) Textbook of fish culture, Blackwell Scientific Publication, Australia.
3. Srinivasulu, M., Reddy, K.R.S., Rao, S. (1999) Text book of Aquaculture, Discovery Publishing House New Delhi.
4. Yawn Mehta, Fisheries & Aquaculture Biotechnology (2011) Campus Books International, Prashad street, Ansari Road, Durga Ganj, New Delhi.

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Skill Enhancement Course (SEC): L2

Semester	Core Course	Course Title	Credits
I-II	SEC-II	Sericulture	Theory: 01, Practical: 01

About the course

The course gives insight into the principles of sustainable sericulture and how these principles can guide your silkworm rearing into an enduring practice. The students will know about the laws and by laws governing keeping silkworm.

Learning outcomes

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

- Generation of skilled man power in the field of sericulture,
- To impart training in extension management and transfer of technology,
- To impart training in Post Cocoon Technology, and
- To provide field exposure

Theory

Unit I: Silkworm distribution and races

The silkworms. Its morphological characteristics. Distribution and types of races. Exotic and indigenous races of silkworm. World silk production World map and silk road, spread of Sericulture to Europe, South Korea, Japan, India and other countries. Sericultural practices in tropical and temperate climate.

Unit II: Biology of silkworm

Mulberry and non-mulberry Sericulture. Biology of silkworm. Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances. Silkworm rearing technology: Early age and Late age rearing Selection of silkworm races/breeds for rearing. Incubation- definition, requirement of environmental conditions, incubation devices; identification of stages of development; black boxing and its importance.

Unit III: Diseases of silk worm and prevention and control

Diseases of silkworm, Disinfectants: Formalin, bleaching powder RKO. Types of moutages, Spinning, harvesting and storage of cocoons. Introduction; classification of silkworm diseases. Protozoan disease: symptomatology due to Nosema bombycis infection, source, mode of infection and transmission, cross infectivity, prevention and control. Bacterial, Viral, Fungal diseases: causative agents, symptoms, transmission prevention and control.

Unit IV: Prospects of Sericulture in India

Sericulture Types- natural and synthetic fibres- types of silk produced in India; Importance of mulberry silk. Silk industry in different states, employment, potential in mulberry and nonmulberry sericulture. Employment generation in sericulture: Role of women in sericulture. Sericultural practices in rain-fed and irrigated conditions; traditional and non-traditional areas. Sericulture organization in India; role of state departments of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development .

Recommended readings

1. Manual on sericulture (1976). Rome : Food and Agriculture Organization of the United Nations, Agricultural Services Division.
2. Ullal, S.R. and . Narasimhan, M.N. (1987) Handbook of Practical Sericulture: CSB, Bangalore
3. Silkworm Rearing and Disease of Silkworm (1956) Ptd. By Director of Ptg., Sm. & Pub. Govt. Press, Bangalore
4. Jolly, M. S. (1986) Appropriate Sericultural Techniques; Ed., Director, CSR & TI, Mysore.
5. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1 (1972) Fuzi Pub. Co. Ltd., Tokyo, Japan.
6. Narasimhan, M. N. (1988) Manual of Silkworm Egg Production; CSB, Bangalore.
7. Sengupta, K. (1989) A Guide for Bivoltine Sericulture. CSR & TI, Mysore.

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