



Central University of Himachal Pradesh

(Established under Central Universities Act 2009)

PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL PRADESH

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SEMESTER- III

Course Code: ZOOL 525A

Credit: 02

Course Name: Entomology

Course Content

UNIT- I

General Introduction of Class Insecta: Characteristic and adaptive features for diversity, Basis of classification and classification up to orders.

General Anatomical description of Insect body: Segmentation and Tagmosis; Integument-structure and function of cuticle, Moulting, Sclerotization and Colouration; Head-Structure of head, Appendages and Antennae, types of antennae; Thorax- Generalized thoracic structure, Appendages of thorax, Types of legs, Development of wings, Types of wing, Flight mechanism, Abdomen- Structure, Appendages; External genitalia.

UNIT-II

Digestive system: Mouth parts, types and feeding mechanism, Structure of alimentary tract and accessory glands, mechanism of digestion and absorption; Respiratory system: Aerial respiration- spiracles, trachea and tracheoles; Aquatic respiration, mechanism of gas exchange; Circulatory system: organs and mechanism of circulation, haemolymph and haemocytes.

UNIT-III.

Excretory system: Organs and physiology of excretion, Osmoregulation; Reproductive system: Female & Male reproductive systems; Modes of reproduction; Endocrine system: Insect hormones, Metamorphosis; Nervous system- vision (Structure of compound eye, Formation of image) and acoustics (Sound production organs, structure and Mechanism of sound production).

UNIT-IV

Social Insects: Evolution of Sociality, Life cycle and Social organization of termites, honeybees and ants.

Beneficial and Harmful Insects: Pollinator and Edible insects, Agricultural insect pest and Medical Insect Vectors.

UNIT-V

Chemical Communication in Insects: Pheromones and allomones-chemistry and functions; Bioluminescence : Structure of organs and mechanism of light production; Insect development: Types of larvae and pupae.

Books:

1. Imms , A. D., A general text book of entomology, Chapman & Hall, UK
2. Borror, D. J., Triplehorn, C. A., and Johnson, Introduction to the study of insects, N. F.,M Saunders College Publication, USA
3. Gullan, P. J., and Cranston, P. S.,The Insects, An outline of Entomology, Wiley Blackwell, UK
4. Snodgrass, R. E., Principles of Insect Morphology, Cornell Univ. Press, USA
5. Chapman, R. F., The Insects: Structure and function, Cambridge University Press, UK
6. Wilson, E. O., The Insect Societies, Harvard Univ. Press, UK .
7. Wigglesworth, Vincent B, The Principles of Insect Physiology, Chapman & Hall Ltd. USA.
8. Klowden, M. J., Physiological system in Insects, Academic Press, USA



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SEMESTER- III

Course Code: ZOOL 526A

Credit: 02

Course Name: Animal Behaviour

Course Contents:

UNIT- I

Introduction -Definition, Ethology, History of the study of animal behavior and contribution of scientists; significance of Animal behaviour, objectives of behaviour; Approaches and methods in study of behaviour.

UNIT- II

Patterns of behaviour: Reflexes- reflex action, types of reflexes, reflex arch, characteristics of reflexes; Orientation and Navigation, Migration in fishes and birds; Individual behavioural patterns; Fixed action pattern, Instinct and Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting; Learning and memory.

UNIT- III

Role of brain, hormones and pheromones in regulation of behaviour; Motivation; Mimicry, mimetic releaser and code breakers; Biological rhythms- Types and characteristics.

UNIT- IV

Social Behaviour: An over view of Sociality in animal systems, Aggregations- Schooling in fishes, Flocking in birds, Herding in mammals, Social organization in honey bee, Various type of communications

Altruism: Reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call and Parental care.

UNIT- V

Ecological aspects of behaviour: Habitat selection, Homing, Territoriality, Dispersal, Foraging; Reproductive behaviour: Asymmetry and Sexual Dimorphism, Mate choice, Sexual selection and sexual conflicts.

Suggested Books:

1. Peter Marler and J. Hamilton, Mechanism of Animal Behaviour, John Wiley & Sons, USA
2. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK
3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA
4. Goodenough, McGuire and Wallace, Perspective on Animal Behaviour, John Wiley & Sons, USA
5. Sherman P. W. and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA
6. Manning A. and Dawkins M.S., An Introduction to Animal Behaviour, Cambridge University Press, UK
7. Richard Dawkins, The Selfish Gene, Oxford University Press, 2016.



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SEMESTER- III

Course Code: ZOOL 527

Credit: 02

Course Name: Immunology and Biotechnology

Course Contents:

UNIT - I

Innate and acquired immunity, characteristics of immune response, humoral and cellular immunity, benefits and damaging effects of immunology. Cell and tissues of immune system. Cells of immune system, primary and secondary lymphoid organs.

UNIT - II

Immunogenes, major classes of antigens, physical and chemical properties of antigens. Immunoglobulins: Structure and functions of immunoglobulins, classes and subclasses of human immunoglobulins, polymorphism, primary and secondary immune response. MHC, Complement system: Complement proteins, pathways of complement activation

UNIT - III

Precipitation, agglutination immune fluorescence, RIA, ELISA, Hybridoma, isolation and characterization of monoclonal antibodies. Hypersensitivity, Anaphylaxis, antibody-mediated cytotoxic and immune complex reactions.

UNIT - IV

Biotechnology: scope significance, microbes and microbial systems and their improvement for biotechnological use, Principles and techniques of plant and animal cell culture.

UNIT – V

Principles and applications of DNA recombinant technology to agricultural and human diseases. Intellectual property rights, PCR and DNA finger printing. Fermentation technology, bioremediation, biopesticides and biosensors, single cell protein.

Suggested Reading:

1. Immunology by Janis Kuby
2. Immunology by J.P. Bellanti.
3. Fundamentals of Immunology by W.E. Paul
4. Essential Immunology by J.M. Roitt
5. Immunology by E.S. Golub
6. Immunology by E. Benjamini, R. Coico and G. Sunshine
7. Walker, J.M. and Gungold, E.B. (eds) Molecular biology and Biotechnology, Royal Society of Chemistry, Cambridge, 1990.
8. Maniaties. T.N. Fritsch, E.F. and Sambrook, t. Molecular Cloning. A Laboratory Manual, cold spring Herber, New York. 1990
9. Kumar H.D. A text book on Biotechnology, affiliated East West Press Pvt. Ltd., New Delhi, 1993.



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SEMESTER- III

Course Code: ZOOL 528

Credit: 02

Course Name: Ichthyology

Course Content

UNIT- I

Introduction and History of Ichthyology Classification and diagnostic characters (up to orders) of extant Cyclostomata, Chondrichthyes and Osteichthyes (9 major orders of fishes) ,Extinct fish group Origin, Evolution and Phylogeny of fishes External morphology, body form, appendages, pigmentation, Principles of morphometry, Locomotion

UNIT-II

Exo Skeleton: Structure and development of Placoid and Non placoid scales Food and feeding habits, Digestive system and its anatomical modifications Respiration: Structure and functions of gills; adaptations for air breathing; role of air bladder. Mechanism of gas exchange

UNIT-III

Excretion and Osmoregulation; Glomerular and aglomerular kidneys; Nitrogen(ammonia,urea, TMAO) excretions; Mechanism of water and salt balance in fresh water, marine, estuarine fishes. Role of skin and gills Reproduction: Structure of gonads, gametogenic cycles; spawning, Parental care Fish migration – types and regulation

UNIT-IV

Brief introduction to Thermoregulation of Fishes Nervous system and Sense organs: Organization of the central and peripheral nervous systems. Eye, lateral line organs and chemoreceptors, Electric Organ Endocrine organs: Functions of the pituitary, thyroid, inter-renal and chromaffin tissues, ultimobranchial and corpuscles of Stannius

UNIT-V

Buoyancy mechanisms: Role of fat and swim bladder Applied Ichthyology: Integrated fish farming, Carp farming, Snow trout farming Construction and Maintenance of Aquaria, ornamental fishes, indigenous and exotic fishes Economic importance of fish and fish products



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SEMESTER- III

Course Code: ZOOL 571 A

Credit: 02

Course Name: Pesticides Hazards and Environment

UNIT- I

Definition, classification, brief history, pesticides registration, pesticide industries and markets in world and India;

Chemical nature of pesticide; Group characteristics and function of pesticides (organochlorides, organophosphates, carbamates, pyrethroids, insect growth regulator, botanical) and persistence in environment; Routes and site of exposure: Inhalation, injection through food and intestine; Problems of pesticide hazards and environmental pollution.

UNIT-II

Principles of toxicology: toxicants, toxicity, LD₅₀ and LC₅₀, dose-response relationship; Effects of pesticides: carcinogenic, mutagenic, teratogenic and other health hazards (ecological effect, immunotoxicity, synergetic and antagonistic action); Evaluation of toxicity.

UNIT-III

Mode of action: Central Nervous system, Acetylcholinesterase and unknown modes of action; Metabolism of insecticides: Phase I and Phase II reactions and metabolism of other pesticides; Nano-pesticides: Use of nano-pesticides in plant protection, delivery technology and their behaviour in different ecosystem. Therapy and Antidot procedure and precaution.

UNIT-IV

Insects and its environment :Inter relations with living and non-living environment; Fluctuation in insect population and insect dispersal; Extreme environment and insect adaptation in Desert, cave, high altitude and terrestrial stream; Entomophagous insects.

UNIT-V

Impact of global climatic changes on insect behaviour, physiology and reproduction; Insect biodiversity and their functioning in Terrestrial and aquatic ecosystem and their restoration.

Suggested Books

1. Greim H., and Snyder, R., Toxicology and Risk Assessment: A Comprehensive Introduction, (ed), John Wiley and Sons, UK
2. Whitford, F., The Complete Book of pesticide management, Wiley Interscience, John Wiley and Sons, UK
3. Hodgson, E., and Kuhr, R. J., (ed), Safer Insecticides, Marcel Dekker Inc., New York, USA
4. Matthews, G. A., Pesticide Application Methods, Blackwell Science, London, UK
5. Wilkinson, C. F., Pesticide Biochemistry and Physiology, Plenum Press, New York, UK
6. Roberts, T. R., and Hutson, D. H. Metabolic pathways of agrochemicals Part II, The Royal Society of Chemistry, UK
7. Carde, R. T., and Bell, W. J., Chemical Ecology of Insects, Chapman & Hall, New York, USA



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SEMESTER- III

Course Code: ZOOL 572 A

Credit: 02

Course Name: Insect Control and IPM

Course Content:

Unit-I

Causes of success of insects, Origin of insect pests, Factors affecting the abundance of insects; History of insect pest control; Basic principles and components of insect pest management;

Mechanical control: Handpicking and crushing, use of sticky barriers, electrical grid, low and high temperature, destruction of crop residues, weeds and trash;

Unit-II

Cultural control: Crop rotation, tilling the soil, destruction of places of breeding or overwintering refuge, destruction or provision of alternate hosts, time of planting and harvesting, trap crops, nutrient management;

Physical control: Chemosterilants, Radiation, Sterile insect release method (SIRM), Pheromones and hormones: use in insect pest management.

Unit-III

Chemical control: classification of insecticides, properties of insecticides and their mode of action, synergists, formulations, application and appliances, repellents, attractants, botanicals, Synthetic organic insecticides, IGR, Pest resurgence and physiology of insecticidal resistance.

Unit-IV

Plant resistance to insects: Types and mechanism of resistance- antibiosis, antixenosis, tolerance, factors mediating resistance, JH Mimics & MH-agonist;

Transgenic plants: history, *Bacillus thuringiensis* and its mode of action on insect, different sub species of *Bt*, development of *Bt* plant by recombinant DNA technology, resistance management of *Bt* crop, prospective and controversies of *Bt* crop.

Inoculation, augmentation and conservation of natural enemies (Pathogens, predators and parasitoids),

Unit-V

Integrated Pest Management: History, principle, concept of pest and pest status, practices and different phases of pest control, Quarantine, genetic and biotechnological methods of control.

Suggested Books:

1. Schoonhoven, L. M., van Loon, J.A., & Dicke, M., Insect Plant Biology, Publisher Oxford University Press, USA
2. Jolivet, P., Interrelationship between insects and Plants, CRC Press, USA
3. Pedigo, L. P., Entomology & Pest Management, Prentice Hall, New Jersey, USA
4. Norris, Caswell-Chen and Kogan, Concepts of IPM, Prentice-Hall, USA
5. Hill, D. S., Agricultural insects pests of the tropics and their control, Cambridge University Press, UK .



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Course Code: ZOOL 573 A

Credit: 02

Course Name: Agricultural Entomology

Unit –I

Definition of pest, pest status, factors responsible for achieving the status of pest, General equilibrium position (GEP), Economic injury level (EIL), economic threshold level (ETL), action threshold, Damage boundary (DB), pest spectrum, pest complex, carrying capacity, causes of pest outbreak, secondary pest outbreak, pest surveillance and sampling.

Theory of co-evolution, role of allelochemicals in host plant mediation, tritrophic interaction, host-plant selection by phytophagous insects, establishment of insect population on a plant surface.

Unit-II

Systematic position, host plants, seasonal history, nature of damage and outlines of the life cycle of the following pests of field crops, vegetables and fruits:

Paddy: *Scirpophaga incertulas* (yellow stem borer), *Hieroglyphus banian* (Rice grass hopper), *Dicladispa armigera* (Rice Hispa), *Leptocorisa varicornis* (Gundhi bug).

Wheat: *Macrosiphum miscanthi* (wheat aphid), *Tanymecus indicus* (Ghujhia weevil), *Pseudaletia separata* (Army worm), *Sesamia inferens* (Wheat stem borer).

Maize : *Chilo partellus* (maize stem borer), *Helicoverpa armigera* (corn worm), *Agrotis ipsilon* (cut worm).

Unit-III

Cotton: *Pectinophora gossypiella* (Pink bollworm), *Empoasca devastans* (cotton jassid), *Bemisia tabaci* (cotton white fly), *Dysdercus cingulatus* (Red cotton bug), *Mylocerus maculosus* (Cotton grey weevil).

Sugarcane: *Pyrilla perpusilla* (Sugarcane leaf hopper), *Aleurolobus barodensis* (Sugarcane white fly), *Scirpophaga nivella* (Sugarcane top borer), *Chilo infuscatellus* (Sugarcane shoot borer).

Oilseed: *Lipaphis erysimi* (mustard aphid), *Spodoptra littura* (tobacco caterpillar), *Dasineura lini* (linseed gall midge), *Spilosoma obliqua* (Bihar hairy caterpillar)

Pulses: *Helicoverpa armigera* (Gram pod borer), *Maruca testulalis* (spotted pod borer), *Riptortus pedestris* (pod bug), *mylabris phalerata* (blister beetle), *Chromatomyia horticola* (leaf miner)

Unit-IV

Vegetables: *Pieris brassicae* (Cabbage caterpillar), *Plutella xylostella* (Diamond-black moth), *Phthorimaea operculelela* (potato tuber moth), *Epilachna vigintioctopunctata* (Hadda beetle), *Raphidopalpa foveicollis* (Red Pumpkin beetle), *Bactrocera cucurbitae* (fruit fly).

Fruits: *Drosicha mangiferae* (Mango mealy bug), *Dacus dorsalis* (Mango fruit fly), *Diaphorina citri* (Citrus psylla), *Qudraspidiotus perniciosus* (san jose scale), *Erisoma lanigerum* (wooly apple aphid).

Unit -V

Pests of stored food products with particular reference to their habits, nature of damage caused by them and outlines of their life cycles :

Callosobruchus maculatus (Pulse beetle), *Sitophilus oryzae* (Rice weevil), *Rhizopertha dominica* (Lesser grain borer), *Trogoderma granarium* (Khapra beetle), *Tribolium castaneum* (Rust-red flour beetle), *Sitotroga cerealella* (Angoumois grain moth);

Locust- different species and phases, phase transition, periodicity, migration, biology and control measures.

Suggested Books:

1. Matthews, Robert W., **Matthews**, Janice R., Insect Behaviour, Springer, Dordrecht
2. Pedigo, L. P., Entomology & Pest Management, Prentice Hall, New Jersey, USA
3. Norris, Caswell-Chen and Kogan, Concepts of IPM, Prentice-Hall, USA
4. Hill, D. S., Agricultural insects pests of the tropics and their control, Cambridge University Press, UK .
5. S. Pradhan, Agriculture Entomology and Pest Control, Indian Council of Agriculture Research.



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SEMESTER- III

Course Code: ZOOL 575

Credit: 02

Course Name: Entomology Lab I

1. Morphology: Study of head and its sclerites.
2. Study of wings and their venation,
3. Study of different types of mouth parts of Insects
4. Study of different types of antennae and legs of insects.
5. Taxonomy: Identification of insects belonging to different groups up to orders and sub orders.
6. Study of various types of social insects and their nests.
7. Dissection/Demonstration of Alimentary canal, Reproductive system, Circulatory system, Excretory system and Nervous system of insects
8. Estimation of LD50 and LC 50 through data provided.
9. Agricultural Entomology: Collection and identification of economically important insects and various stages of their life history.
10. Identification of important insect pests of different crop plants and stored products.
11. Visits to agricultural fields and forests for on spot study of pests and damage caused by them.
12. Study of life history stages of medically important insects.
13. Identification and anatomical studies of major vector species of Anopheles, Culex and Aedes.

Suggested Books:

6. Pedigo, L. P., Entomology & Pest Management, Prentice Hall, New Jersey, USA
7. Norris, Caswell-Chen and Kogan, Concepts of IPM, Prentice-Hall, USA
8. Hill, D. S., Agricultural insects pests of the tropics and their control, Cambridge University Press, UK .
9. S. Pradhan, Agriculture Entomology and Pest Control, Indian Council of Agriculture Research.



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SEMESTER- III

Course Code: ZOOL 561 A

Credit: 02

Course Name: Fish Taxonomy and Physiology

UNIT I

Characters and classification:

Outline classification of fishes with special reference to distinctive features, geographical distribution classification and typical examples of the following sub- divisions: 1. Chondrichthyes 2. Actinopterygi 3. Crossopterygi 4. Dipnoi

Epidermis and Exoskeleton: Histology, Functions of Integument, Coloration, mechanism of colour change, Significance & uses of coloration, Types of scales & their uses.

Fins and their origin: Structure, median fins, caudal fin & its types; Paired fins & their origin

UNIT II

Cardio- Vascular System: Structure of heart in *Scoliodon* , Structure of heart in teleosts & its working, composition of blood.

Brain and Cranial Nerves: Fore brain, Mid Brain, Hind Brain, Spinal Cord and Nerves.

Respiratory organs: Structure and functions of gills, air breathing organs, swim bladder and weberian ossicles

UNIT III

Food, Feeding habits and Respiration:

Feeding habits of Teleosts, Carnivorous, Herbivorous and Omnivorous fishes, Alimentary canal and its diversity in fishes, Fish Nutrition and artificial food.

UNIT IV

Excretion and Osmoregulation:

Structure of Kidney, Histology of Kidney, Functions and Osmoregulation, Stenohaline and Euryhaline Fishes.

UNIT V

Reproduction, Development and Spawning:

Reproductive organs & their histology, Stages in maturation of an Oocyte, Fecundity, Survival and mortality in fishes, Sex dimorphism, mating and Parental care,

Books Recommended

1. Lynwood, S. Smith. Narendra Publ. House, Delhi. 2003. Introduction to the fish physiology.
2. Arvind Kumar and Pushaplata Dubey. Daya Publ. House, Delhi. 2006. Fish Management and Aquatic Environment
3. Lagler, Bardock, Miller & Possino, John Wiley & Sons, N.Y., London: 2012. Ichthyology, 2nd Ed.
4. Halver and Hardy. Acad. Press. 2002: Ash Nutrition . An Imprint



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SEMESTER- III

Course Code: ZOOL 562A

Credit: 02

Course Name: Fish and Fisheries of India

Unit I

Introduction, scope & status of fishery science. Pisciculture, Advantage of pisciculture, Freshwater water Culturable fishes, Economic importance of fishes.

Unit II

Definition, Purpose, Scope and Status of Aquaculture, Types of culture – Traditional, Extensive, Semi- Intensive, Intensive and Super- intensive culture, Criteria for selection of Sites, Culture Techniques: Carp culture, Trout Culture, Cage Culture.

Unit III

Fish Management and Marketing: Fishery management- Selection of cultivable species, Improvement of fish pond, Use of artificial food and correct stocking rate, Weeds of fish pond and their control, Fish enemies and their control,

Unit IV

Biochemical Composition, Preservation, Fish spoilage and Rigor mortis, Fish Processing, Principles and processes of: Drying, Salting, Freezing, Refrigeration.

Unit V

Induced breeding- Advantages of induced breeding, technique of induced breeding, factors affecting induced breeding. Migration in Fishes.

Books Recommended:

1. H.S. Bhamra and Kavita Juneja. 2001. An Introduction to Fishes
2. Arvind Kumar. 2004. Fishery Management
3. Heatranpf. 2002. handbook on Ingredients for Aquaculture feeds.
4. V.G. Jhingran. 1975. Fish and Fisheries of India.



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SEMESTER- III

Course Code: ZOOL 563

Credit: 02

Course Name: Limnology of Lakes, Streams and Ponds

Unit – I

Limnology, its history and scope

Origin and classification of water bodies – Lakes and ponds

Hydrological cycle

Ecology of ponds and lakes – Structure and dynamics

Unit – II

Abiotic (Physicochemical Factors in Freshwater Ecosystem): Physical characteristics of water: Temperature, thermal stratification, Light, Density, Water movement and thermal exchange.

Chemical characteristics of water: Hydrogen ion concentration (pH), Dissolved oxygen, Free carbon-dioxide, Total dissolved solids (T.D.S), Carbonates and Bicarbonates.

Turbidity: Causes and impact on aquatic organisms.

Unit – III

Inland Fisheries Resources: Riverine fisheries- Ganga river system, Brahmaputra river system, East coast river system.

Aquatic/Natorial adaptations of freshwater fauna.

Productivity of water bodies – Primary, secondary, tertiary - Factors affecting primary production.

Unit – IV

Plankton of freshwater biotopes – Phyto and Zooplankton, Plankton sampling: Methods of collection, preservation and identification.

Unit V

Aquatic pollution: Sources and kinds, effect of pollution on physico- chemical parameters of water, Effect of pollution on biota.

International problems and future: Acidification, Global warming, Biomagnification, Eutrophication.

Reference Books:

1. Welch, P.S. Limnology. McGrawHill, NY, 1952.
2. Hutchinson, G.E. A Treatise on Limnology, Vols. I & II. John Wiley & Sons, 1957.
3. Ruttner, F. Fundamentals of Limnology. Translated by D.G. Frey and F.E.Fry. University of Toronto Press, 1968.
4. Wetzel, R.G. Limnology. W.B. Saunders Co., 1975.
5. Reid, G.K. & R.D. wood. Ecology of inland waters and Estuaries. Van Nostrand Company, 1976.



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SEMESTER- III

Course Code: ZOOL 566

Credit: 02

Course Name: Fisheries and Limnology Lab-I

Practical classes based on syllabus of ZOOL 561 A, ZOOL 562A and ZOOL 563.



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SEMESTER- III

Course Code: ZOOL 402

Credit: 04

Course Name: Biodiversity and Evolution

Course Contents:

UNIT-I

An overview of evolutionary biology, concept of organic evolution during pre- and post-Darwin era; evolution and molecular biology- a new synthesis; from molecules to life, life originated from RNA, introns as ancient component of genes

UNIT - II

Origin and diversification of bacteria and archea; diversification of genomes; the nature of bacterial and archeal genomes; origin of genomes by horizontal gene transfer; role of plasmid and genomic islands in DNA transfer.

UNIT-III

Origin and diversification of eukaryotes- origin of cells and first organisms; early fossilized cells; evolution of eukaryotic cell from prokaryotes- a case of symbiosis; evolution of eukaryotic genomes; gene duplication and divergence.

UNIT-IV

Mode of speciation- factors responsible for speciation; tempo of evolution; systematic - definition and role in biology, biological classification- theories and objectives, types of taxonomy, taxonomic diversity- definition and types, origination and extinction, rates of change in origination and extinction, causes of extinction, causes of differential rates of diversification,

UNIT -V

Current status and future of biodiversity; human evolution- human evolutionary history; placing humans on tree of life; genomics and humanness; current issues in human evolution.

Suggested Literature:

1. Evolution, Barton, N. H., Briggs, D. E.G., Eisen, J. A., Goldstein, A. E., Patel, N. H., Cold Spring Harbor Laboratory Press, New York, USA
2. Evolution, Hall, B. K. and Hallgrimsson, B., Jones and Bartlett Publisher, Sudbury, USA
3. Evolution, Futuyma, D. J., Sinauer Associates, Inc., Sunderland, USA
4. What Evolution Is, Mayr, E., (2001), Basic Books, New York, USA