Course Title	Course Code	Credit
Animal Diversity I: Comparative study of Non-Chordates	ZOOUGMCC1101	4 (Theory 3, Practical 1)

Course Objectives

The learning objectives of this course are as follows:

- *The course would provide an insight to the learner into 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 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 Outcomes

By studying this course, students will be able to:

- *Learn about the importance of systematics, taxonomy and structural organization of animals. Appreciate the diversity of non-chordates living in diverse habits and habitats.*
- *Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.*
- *Critically think about the organization, complexity and characteristic features of Non chordates.*
- *Getting familiarized 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.*
- *Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.*

Theory

Unit 1: Basis of Classification

Basis of animal classification, Zoological nomenclature; Concepts of taxonomy & systematics.

Unit 2: Protozoa

General characters and classification up to classes with examples. Osmoregulation: Contractile vacuoles and mechanism of osmoregulation; Locomotion: Locomotor organelles and methods of locomotion; Nutrition: Holozoic, Holophytic, Saprozoic and Myxotrophic nutrition; Reproduction: Asexual and sexual

Unit 2: Porifera

General characters and classification upto classes with examples; Cellular Organization: Pinacoderm, Choanoderm, Mesenchyme and Skeleton: Spicules and spongin. Canal System: Types and functions of canal system.

Unit 3: Coelenterata and Ctenophora

General characters and classification up to classes with examples; Polymorphism: Basic forms and patterns, Importance of polymorphism; Corals: coral polyp, coral skeleton, types of corals; General Organization and affinities of Ctenophora.

Unit 4: Platyhelminthes and Aschelminthes

General characters and classification upto classes with examples; Parasitism in Platyhelminthes and Aschelminthes with emphasis on Morphological and physiological adaptations; Larval stages of Trematodes and Cestodes; General organization and affinities of Rotifers.

Unit 5: Annelida
General characters and classification upto classes with examples; Coelom and Metamerism in Annelids; Segmental organs, Filter feeding, Adaptive radiation in Polychaetes.

Unit 6: Arthropoda
General characters and classification upto classes with examples; Larval forms of Crustacea, Parasitism in Crustacea, Respiration in Arthropods; Vision in Arthropoda, Metamorphosis in Insects.

Unit 7: Mollusca
General characters and classification upto classes with examples; Respiration, Nervous system, Foot in Mollusca, and Torsion and detorsion in Gastropods.

Unit 8: Echinodermata
General characters and classification upto classes with examples, Water vascular system, Larval forms and Affinities.

Practical

Unit 1: Non-chordates I: Protista to Pseudocoelomates

1. Study of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium
2. Examination of pond water collected from different places for diversity in protista
3. Identification (Phylum and specimen characters):
   i. Hyalonema, Euplectella, Spongilla
   ii. Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium,Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora
   iii. One specimen/slide of any ctenophore
4. Study of adult Fasciola hepatica, Taeniasolium and their life cycles (Slides/microphotographs)

Unit 2: Non-chordates II: Coelomates

1. Annelids - Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima,Hirudinaria
2. Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Bombyx, Periplaneta, termites and honey bees.
3. Onychophora–Peripatus.
4. Molluscs - Chiton, Dentalium, Pila, Unio, Sepia, Octopus, Nautilus.
5. Echinodermates - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumariaand, Antedon.
6. One Local-Outdoor Trip for Biodiversity Studies.

Note: Classification to be followed from "Ruppert and Barnes (2006) Invertebrate Zoology, 8th edition, Holt Saunders International Edition"

Suggested Readings

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition. 2. 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
2. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and

Nelson.

Course Title	Course Code	Credit
Biomolecules	ZOOUGMCC1102	4 (Theory 3, Practical 1)

Course Objectives
This course is designed to give the students • *The understanding of acids, bases and buffers and their relevance in living systems.* • *The information about the structure and function of various biomolecules such as carbohydrate, protein (including their role as biocatalysts) and nucleic acids.* • *The knowledge about enzymes and catalysis.* • *Use of various techniques involved in biochemical analysis.*
Course Outcomes
After completion of the course, a student will be able to achieve these outcomes: • *The students will learn about the chemical structures of carbohydrates, and their structural and metabolic role in cellular systems.* • *The students will learn about structure and function of lipids, circulating lipids and inflammatory lipid mediators etc.* • *They will also learn about primary, secondary, tertiary, quaternary structure of proteins.* • *The students will understand about the structure and function of nucleosides and nucleotides.* • *The students will learn about the enzymes and various enzymatic mechanisms in the biological system.* • *Students will learn the application of various techniques used in biochemical analysis.*

Theory

Unit 1: Water and Buffer
Physical properties of water, structure of water molecules, Ionization of water, Bronsted – Lowry concept of acid and bases, Concept of pH of weak acids and weak bases, Henderson-Hasselbalch equation, concept of buffer, strength of buffer, buffer value, important biological buffers (with the help of numerical problems). Forces involved in biomolecular interactions with examples: Van der Waals interactions, electrostatic interactions, hydrogen bond and hydrophobic interaction.

Unit 2. Stereochemistry
General concepts on: Plane of symmetry, centre and axis of symmetry; Concepts of chirality; optical isomerism; geometrical isomerism; DL, RS nomenclature; Projection formula (Fischer & Howarth); Isomers: anomers, epimers; Stereochemistry of cyclohexane: idea of axial & equatorial bonds (related to chair form conformation). Configuration versus conformation.

Unit 3: Carbohydrates
Structure and Biological importance of Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates.

Unit 4: Lipids
Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids

Unit 5: Proteins

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 6: Nucleic Acids
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- Hyperchromaticity of DNA

Unit 7: Enzymes
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 Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

Unit 8. Vitamins
Classification and characteristics with suitable examples, sources and importance

Practical

1. Concept of molarity, normality, percentage, dilutions, pH and buffers.
2. Preparation of buffers and Numerical problems to explain the concepts.
3. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
4. Paper chromatography of amino acids.
5. Protein Estimation

Suggested Readings

1. *Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, VEdition, W.H. Freeman and Co., New York.*
2. *Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition,W.H. Freeman and Co., New York.*
3. *Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition,International Edition, The McGraw- Hill Companies Inc.*
4. *Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, IIEdition, BIOS Scientific Publishers Ltd., U.K.*
5. *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 Harbor Lab.Press, Pearson Pub.*
6. *Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons*

Course Title	Course Code	Credit
Biology for Sustainable Development	ZOOUGSEC1101	3

Course Objectives
The learning objectives of this course are as follows: • This course intends to develop awareness about the importance of sustainable development in the modern world • Implementation and achievement of sustainable development goals • To understand the significance of sustainable development in ecological context • To harness various biological concepts in achieving sustainable development goals
Course Outcomes
By studying this course, students will be able to: • Learn the concept of sustainable development in modern world • Understand the implications of biology in achieving sustainable development goals • Traditional and modern techniques in organic farming, soil and water conservation • Recent developments on biodegradable and bio-based alternatives for commercial use • Understanding the concepts of bioenergy and its potential • Implications of biowaste and recycle management for sustainable development

Unit 1: Sustainable development: Concept of sustainable development; Brief introduction to sustainable development goals; Role of Biology in sustainable development.

Unit 2: Organic farming: Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – bio compost making methods, types and method of vermicomposting – field Application.

Unit 3: Bioenergy: Biotech feed, Silage, Bio manure, biogas, biofuels – advantages and processing parameters, Next-generation biofuels, concept of waste-to-energy conversion, various aspects of bioenergy technology.

Unit 4: Soil and water conservation: Advanced green technologies, biologicals and bioreactor-based waste water treatment strategies. Application of algae in soil conservation. Role of plants in rehabilitation of agricultural lands. Bioremediation and phytoremediation techniques for sustainable development.

Unit 5: Biodegradable and bio-based alternatives: Biodegradable polymers and bioplastics, eco-friendly and sustainable packaging techniques, concept of bio-based alternatives and revival of pre-plastic era.

Unit 6: Biowaste and recycling management: Concept and types of biowaste, environmental effects of biowaste and biomedical waste. Impact of biowaste management in bioeconomy, concept of zero-waste management and its implication in sustainable biowaste recycling.

Suggested readings

1. Mamta Bansal, Basics of Organic Farming, CBS Publishers and distributers, ISBN: 9789386478351.
2. Baskar Gurunathan (Editor), Renganathan Sahadevan (Editor), Zainul Akmar Zakaria (Editor), Biofuels and Bioenergy: Opportunities and Challenges, Elsevier 1st ed. 0323852696
3. Amrat Sinore, Endalikachew Kissi, Abebayehu Aticho, The effects of biological soil conservation practices and community perception toward these practices in the Lemo District of Southern Ethiopia, International Soil and Water Conservation Research, Volume 6, Issue 2, 2018, Pages 123-130, ISSN 2095-6339, https://doi.org/10.1016/j.iswcr.2018.01.004.

Course Title	Course Code	Credit
Animal Diversity II: Chordate Biology	ZOOUGMCC1203	4 (Theory 3, Practical 1)

Course Objectives
The learning objectives of this course are as follows: • *To understand the animal kingdom.* • *To understand the taxonomic position of Protochordata to Mammalia.* • *To understand the general characteristics of animals belonging to Fishes to Reptilians.* • *To understand the body organization of Chordata.* • *To understand the taxonomic position of Protherian mammals*
Course Outcomes
By studying this course, students will be able to: • *Describe the diversity in form, structure and habits of Chordates.* • *Explain general characteristics and classification of different classes of vertebrates* • *The students will learn Origin and phylogeny of the vertebrates.* • *Imparts conceptual knowledge of vertebrates, their adaptations and associations in relation to their environment.* • *The students will learn about the characteristics of chordates, their adaptations and associations in relation to their environment.*

Theory

Unit 1: Introduction
Introduction to Chordates, General characteristics and outline classification. General characteristics of Hemichordata, Urochordata and Cephalochordata; Retrogressive metamorphosis in Urochordata. Origin of Chordata

Unit 2: Fish
General characteristics and classification of cyclostomes up to class, General characteristics of Chondrichthyes and Osteichthyes, classification upto order. Osmoregulation in fish. Osmoregulation in fish.

Unit 3: Amphibia
General characteristics and classification up to order; Parental care in Amphibians.

Unit 4: Reptilia
General characteristics and classification up to order; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes

Unit 6: Aves
General characteristics and classification up to order; Archaeopteryx- a connecting link. Flight adaptation of birds, Aerodynamics of bird's flight.

Unit 7: Mammals
General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages.

Unit 8: Vertebrate Integument and its Derivatives
Development, general structure and functions of skin and its derivatives; Glangs scales, horns, claws, nails, hoofs, feathers and hairs

Unit 9: Comparative anatomy of vertebrates

Comparative anatomy of Digestive System, Circulatory System, Respiratory System, Skeletal System, Urinogenital system, Nervous system.

Practical

1. Protochordata Balanoglossus, Herdmania, Branchiostoma.
2. Agnatha; Petromyzon, Myxine
3. Fishes; Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas, Flat fish (Different marine and freshwater fishes)
4. Amphibia; Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra
5. Reptilia; Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus.
6. Key for Identification of poisonous and non-poisonous snakes
7. Assay of circadian rhythms in fish, monitoring the core body temperature and melatonin levels, Estimation of body pigments in fish.
8. Aves; Study different common birds from different orders. Types of beaks and claws
9. Mammalia; Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous.
10. Bone types in vertebrates

Suggested Readings

1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
4. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition.Jones and Bartlett Publishers Inc.

Course Title	Course Code	Credit
Animal Controlling and Coordinating Systems	ZOOUGMCC1204	4 (Theory 3, Practical 1)

Course Objectives
The learning objectives of this course are as follows: • *To educate students about the various controlling and coordinating systems of animal and human physiology.*

- *The course will provide a thorough understanding of the normal body function and helps to determine the cause of disease.*
- *It will enable the development of new and more effective treatments and guidelines for maintaining good health.*
- *It will equip the students with an ability to pursue career in medical and healthcare sector, pharmaceuticals and other related areas.*
- *It will help in understanding how these systems interact among themselves to maintain stability or homeostasis.*

Course Outcomes

By studying this course, students will be able to:

- *Appreciate human physiology and have its enhanced knowledge.*
- *Recognize and identify principal tissue structures and functions*
- *Understand the functions of important physiological systems including the nervous system, muscular system, endocrine and reproductive system*
- *Learn an integrative approach to understand how these separate systems interact to yield integrated physiological responses to maintain homeostasis in the body along with feedback mechanisms.*
- *Synthesize ideas to make the connection between knowledge of physiology and real-world situations, including healthy lifestyle decisions and problems faced due to homeostatic imbalances*
- *Perform, analyze and report on experiments and observations in physiology.*
- *Know the fundamentals and understand advanced concepts so as to develop a strong foundation that will help them to acquire skills and knowledge to pursue an advanced degree.*

Theory

Unit 1: Tissues

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue.

Unit 2: Blood

Components of blood and their functions; Structure and functions of haemoglobin. Haemostasis: Blood clotting system, Kallikrein-Kinninogen system, Complement system & Fibrinolytic system, Haemopoiesis. Blood groups: Rh factor, ABO and MN.

Unit 3: Bone and Cartilage

Structure and types of bones and cartilages, Ossification, bone growth and resorption.

Unit 4: Muscle

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

Unit 5: Nervous System

Structure of neuron, resting membrane potential, Origin of action potentialand its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and, Neuromuscular junction; Reflex action and its types - reflex arc; Physiology of hearing and vision

Unit 6: Reproductive System

Histology of testis and ovary; Physiology of male and female reproduction– spermatogenesis, oogenesis, follicular development, steroidogenesis, implantation, pregnancy, and mammary gland development. Puberty, Methods of contraception in male and female

Unit 7: Endocrine System

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

hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones.

Practical

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,
5. Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.
6. Microtomy: Preparation of permanent slide of any five mammalian (Goat/whiterat) tissues.
   *(*Subject to UGC guidelines)*

Suggested Readings

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd.
1. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins

Course Title	Course Code	Credit
Biostatistics	ZOOUGMDC1202	3

Course Objectives
The learning objectives of this course are as follows: • *To introduce students to the basic concepts of statistics, probability and probability distributions.* • *To teach them the different probability distributions and their application in statistical analysis* • *To familiarize them with various tests of fit analysis methods.* • *To introduce the concept of database, in-silico tools for biological sciences* • *To expose them about the various stages of drug development.*
Course Outcomes
After completion of the course the students would be • *Well versed with sampling methods for biological sciences and their statistical analysis.* • *Able to analyse of data for test of fit analysis* • *Able to access the various biological databases and retrieve the information* • *Enabled to analyse the data using different in-silico tools.*

Unit 1: Descriptive Statistics

Data in Biology: Development in biostatistics, samples and populations, techniques of sampling (random and stratified), sampling and non-sampling errors, variables in biology, univariate and bivariate frequency distributions

Measures of Central Tendency: means, mode, median.

Measures of Dispersion: Range, standard deviation, coefficient of variance and covariance.

Measures of Skewness: Pearson's coefficients of skewness; Measures of Kurtosis.

Unit 2: Probability and Probability Distributions

Probability: Basic concepts, addition and multiplication rules of probability, conditional probability

Probability Distributions: Probability mass function, probability density function and distribution function. Binomial distribution, Poisson distribution, normal distribution and exponential distribution along with their properties and relationships.

Unit 3: Correlation and Linear Regression

Correlation Analysis: Scatter diagrams, Pearson's and Spearman's coefficients of correlation, coefficient of determination.

Regression Analysis: Method of least squares, equations of lines of regression and their applications in biostatistics.

Unit 4: Hypothesis Testing

Sampling distributions and standard error, null and alternate hypothesis, basic concept and illustrations of type I and type II errors, concept of confidence interval estimation.

Student's t-distribution: test for single mean, difference of means and paired t- test, chi-square distribution.

Unit 5: Statistical software

Study of different statistical software, data analysis using different software.

Suggested Readings

1. A. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
2. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.

Course Title	Course Code	Credit
Economic Biology	ZOOUGSEC1202	4 (Theory 3, Practical 1)

Course Objectives
The learning objectives of this course are as follows: • *To inculcate self-reliant skills from biology perspectives.* • *To enhance commercial viability of biological knowledge in real-time world.* • *To generate human resources that can establish small-scale industries that can generate job opportunities for the lowest of the lows in society.* • *To develop "Atmanirbhar Bharat" and producing bioentrepreneurs for sustainable development of the society as a whole.*
Course Outcomes
By studying this course, students will be able to: • *Develop knowledge in wide range of traditional and modern applications of biology in commercial perspective.* • *Gain knowledge in apiculture and sericulture, both of which are commercially viable skills that can be established as a small-scale startup programme.* • *Gain knowledge of aquaculture that will help the students to initiate startup in fisheries related to food or ornamental aquariums.* • *Establish home-grown mushroom cultivation that is a rich source of protein and vitamins. Mushroom cultivation is among the trending small-scale startup ideas that require minimum financial capital but have significant monetizing potential.* • *Gain skills in horticulture, establish nurseries of economically important plant saplings including ornamental and medicinal plants. There is also high demand for professional garden maintenance companies in modern residential and commercial complexes.* • *Knowledge of applications of microbes in consumer-based industries can help generate skills of producing unique flavors and aroma in various food items. It also opens up options of producing intellectual properties that may have monetizing potential.*

Unit 1: Apiculture

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth. Bee Pasturage; Selection of Bee Species for Apiculture; Bee Keeping Equipment; Methods of Extraction of Honey (Indigenous and Modern). Bee Diseases and Enemies Control and Preventive measures. Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc.

Unit 2: Sericulture

Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races. Exotic and indigenous races; Mulberry and non-mulberry Sericulture. Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances; Disinfectants: Formalin, bleaching powder, Silkworm rearing technology: Early age and Late age rearing. Types of mountages; Spinning, harvesting and storage of cocoons.

Unit 3: Aquaculture

Principles, definition and scope; Water-quality criteria for Aquaculture: Role of temperature, pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate

Fish Nutrition: Regulation of food intake, environmental factors and feed intake, digestive physiology and nutrient digestibility in fishes, Fish growth estimation, Feed content estimation and food formulation

Difference between major and minor carps with examples; Composite fish farming: General concepts, advantages and disadvantages; Induced breeding: method and advantages; Integrated fish farming.

Unit 4: Mushroom Culture Technology

Types of edible mushrooms available in India – *Volvariella volvacea, Pleurotus sajor-caju, Calocybe indica,*

Agaricus bisporus. Mushroom cultivation Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low-cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low-cost technology, Composting technology in mushroom production.

Unit 5: Horticulture

Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. **Vegetative propagation:** Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house. Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

Unit 6: Microbes in industry

Microbes in food, dairy, pharma and industry. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water.

Suggested Readings

1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
3. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
4. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore.
5. Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn.& Pub. Govt. Press, Bangalore
6. Bisht D.S., *Apiculture*, ICAR Publication.
7. Singh S., *Beekeeping in India,* Indian council of Agricultural Research, NewDelhi.
8. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
9. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
10. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.
11. Handbook of Fisheries and Aquaculture, Indian Council of Agricultural Research, ICAR, (2006), DIPA, New Delhi, INDIA