

**Syllabus and Scheme of Examination
for
B.Sc. Pass Zoology**

Submitted
to

Utkal University
Bhubaneswar

Under

Choice Based Credit System
June 2016

SCHEME FOR CHOICE BASED CREDIT SYSTEM IN B.Sc. ZOOLOGY PASS

SEMESTER	CORE COURSE	ABILITY ENHANCEMENT COMPULSORY COURSE (2)	SKILL ENHANCEMENT COURSE (SEC) (2)	DISCIPLINE SPECIFIC ELECTIVE DCE (4)
I	NON-CHORDATA, CHORDATA, COMPARATIVE ANATOMY, EVOLUTION AND ANIMAL BEHAVIOUR	ENVIRONMENTAL SCIENCE (2 credits, 100 Marks)		
II	CELL BIOLOGY (1&2), GENETICS, CONSERVATION BIOLOGY, BIostatISTICS AND AQUATIC BIOLOGY	MIL (2 credits, 100 Marks)		
III	DEVELOPMENTAL BIOLOGY, IMMUNOLOGY, ENDOCRINOLOGY AND MICROBIOLOGY		ENGLISH COMMUNICATION, 100 Marks	
IV	PHYSIOLOGY, BIOCHEMISTRY AND MOLECULAR BIOLOGY		SEC-1 Aquarium Fish Keeping (2 Credits, 50 Marks)	

V			SEC- 2 Poultry Farming (2 Credits, 50 Marks)	
				DSE-1 A Economic Zoology (6 Credits, 100 Marks)
VI			SEC-3 Apiculture (2 credits, 50 Marks Project (6 Credits, 100 Marks)	
				DSE- 1 B Agrochemicals and Pest management (6 Credits, 100 Marks)

CORE COURSE: ZOOLOGY
PAPER I
NON-CHORDATA, CHORDATA, COMPARATIVE ANATOMY, EVOLUTION
AND ANIMAL BEHAVIOUR

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

Unit 1: Non-Chordata

General characteristics and classification up to classes, Locomotion and reproduction in Protozoa, Canal system in sponges, Corals and coral reefs, Life cycle of *Fasciola hepatica*, Metamerism in Annelida, Metamorphosis in insects, Foot in Mollusca. Larval forms in Echinodermata.

Unit 1: Chordata

General characters of Protochordata and Chordata with examples, Parental care in fishes and Amphibia, Poison apparatus and biting mechanism of snakes, Flight adaptation in birds, Dentition in mammals.

Unit 3: Comparative anatomy

Structure, functions and derivatives of integument, Alimentary canal and associated glands, Evolution of aortic arches, Succession of kidney, Comparative account of brain of vertebrates.

Unit 4: Evolution

Lamarckism, Darwinism, Neo-Darwinism, Phylogeny of human, Natural selection, Modes of speciation (Allopatric, Sympatric and Parapatric).

Unit 5 : Animal Behaviour

Primary and secondary orientation, Taxes of animals, Social structure in honey bee, Pheromones, Biological clocks.

PRACTICAL

Marks 30

1. Morphology of *Paramecium*, Binary fission and conjugation in *Paramecium*.
2. Life stages of *Plasmodium vivax*.
3. Study of *Sycon* (including T.S. and L.S.), *Hyalonema*, and *Euplectella*.
Temporary mounts of spicules, gemmules, Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, Ephyra larva.
4. Study of adult *Fasciola hepatica* Study of adult *Ascaris lumbricoides*
5. *Balanoglossus*, *Herdmania* and *Branchiostoma*.
6. *Torpedo*, *Notopterus*, *Mystus*, *Heteropneustes*, *Hippocampus*, *Exocoetus*, *Echeneis*, *Anguilla*, *Tetrodon*, *Diodon*, *Anabas* and Flat fish. *Ichthyophis/Ureotyphlus*, *Necturus*, *Duttaphrynus*,

Polypedates, Hyla, Alytes and Salamandra. Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus, Bungarus, Vipera, Naja, Hydrophis and Crocodylus..

SUGGESTED READINGS

1. Arora MP (2006) Non-Chordata-I. 1st edition. Himalaya Publishing House, New Delhi.
2. Arora MP (2008) Non-Chordata-II. 1st edition. Himalaya Publishing House, New Delhi.
3. Barnes RD (1982) Invertebrate Zoology. 6th Edition. Holt Saunders International Edition.
4. Barnes RSK, Calow P, Olive PJW, Golding DW & Spicer JI (2002) The Invertebrates: A New Synthesis. 3rd Edition. Blackwell Science, USA.
5. Boradale LA and Potts EA (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Jordan EL and Verma PS (1963) Invertebrate Zoology. Revised Edition. S. Chand, New Delhi.
7. Mohanty PK (2000) Illustrated Dictionary of Biology. Kalyani Publishers, Ludhiana.
8. Hilderbr and M and Gaslow GE. Analysis of Vertebrate Structure. John Wiley and Sons., USA.
9. Kardong KV (2005) Vertebrates' Comparative Anatomy, Function and Evolution. 4th Edition. McGraw-Hill Higher Education, New York.
10. Kent GC and Carr RK (2000) Comparative Anatomy of the Vertebrates. 9th Edition. The McGraw-Hill Companies, New York.
11. Weichert CK and William Presch (1970) Elements of Chordate Anatomy. Tata McGraw Hill, New York.
12. Agarwal VK (2011) Zoology for degree students. S. Chand, New Delhi.
13. Arora MP (2006) Chordata-1. 1st Edition. Himalaya Publishing House, New Delhi.
14. Hall BK and Hallgrimsson B (2008) *Strickberger's Evolution*. 4th Edition. Jones and Bartlett Publishers Inc., USA.
15. Jordan EL and Verma PS (1963) Chordate Zoology. Revised Edition.S. Chand, New Delhi.
16. Young JZ (2004) *The Life of Vertebrates*. 3rd Edition. Oxford University Press, New York.
17. David McF. Animal Behaviour. Pitman Publishing Limited, London, UK.
18. John A (2001)Animal Behaviour. 7th Edition.Sinauer Associate Inc., USA.
19. Manning A and Dawkins MS. An Introduction to Animal Behaviour. Cambridge University Press, UK.

CORE COURSE: ZOOLOGY
PAPER II
CELL BIOLOGY, GENETICS, CONSERVATION BIOLOGY, BIostatISTICS AND
AQUATIC BIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

Unit 1: Cell Biology

Prokaryotic and Eukaryotic cells, Plasma membrane, Lysosomes, Mitochondria, Ultra structure of nucleus.

Unit 2: Genetics

Ultrastructure of chromosomes, Sex-linked inheritance, Chromosomal mechanisms of sex determination, Chromosomal and Gene mutation.

Unit 3: Conservation Biology

Importance of conservation, Evaluation and management of wildlife, Wildlife (Protection) Act, 1972, Protected areas (Sanctuaries, National Parks, Biosphere reserves).

Unit 4: Biostatistics

Measures of central tendency (mean, median and mode), Measures of dispersion (Standard deviation), Hypothesis and testing of hypothesis (chi square test, t test and Z test), Correlation and regression analysis.

Unit 5: Aquatic biology

Physico-chemical condition of water of fish pond, Ornamental pisciculture, Composite pisciculture, Shellfish culture, Aquatic insects.

PRACTICAL

Marks 30

1. Study various stages of mitosis from permanent slides.
2. Study various stages of meiosis from permanent slides.
3. Preparation of temporary squashing of onion root tip.
4. Study of oral squamous cells.
5. Study of different types of aquatic insects and aquatic weeds.
6. Study of different types of major carps, minor carps and catfishes.
7. Mounting of cycloid and ctenoid scales of fish.

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SUGGESTED READINGS

1. Dunham RA (2004) Aquaculture and Fisheries Biotechnology – Genetic Approaches. CABI publications, U.K..
2. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi.
3. Srivastava CBL (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
4. Becker WM, Kleinsmith LJ, Hardin J and Bertoni G P (2009) The World of the Cell. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008) Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
6. Cooper GM and Hausman RE (2009) The Cell: A Molecular Approach. 5th Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
7. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology. 8th Edition. Lippincott Williams and Wilkins, Philadelphia.
8. Gardner EJ, Simmons MJ, Snustad DP (2008) Principles of Genetics. 8th Edition. Wiley India.
9. Snustad DP, Simmons MJ (2009) Principles of Genetics. 5th Edition. John Wiley and Sons Inc., USA.
10. Chainy, GBN, Mishra G and Mohanty PK. Basic Biostatistics, Kalyani Publisher.
11. Singh JS, Gupta SR and Singh SP (2014) Ecology, Environmental Science and Conservation. S. Chand, New Delhi.

CORE COURSE: ZOOLOGY
PAPER III
DEVELOPMENTAL BIOLOGY, IMMUNOLOGY, ENDOCRINOLOGY AND
MICROBIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

Unit 1: Developmental Biology

Gametogenesis (Spermatogenesis, Oogenesis), Types of eggs, early development of frog and chick up to gastrulation, Placenta.

Unit 2: Immunology

Cells and organs of the immune system, Antigens, Structure and functions of different classes of immunoglobulin, Vaccines.

Unit 3: Endocrinology-I

Types of endocrine glands of human body, Classification of hormones and mechanism of hormone action.

Unit 4: Endocrinology-II

Structure and function of Pituitary, Thyroid and Gonads.

Unit 5: Microbiology

Structure of a typical bacterium, Structure of bacteriophage, Bacterial and viral diseases of human, Microbes of food, agriculture and industry.

PRACTICAL

Marks 30

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages).
2. Temporary preparation of chick embryo.
3. ABO blood group determination.
4. Cleaning of glass wares, Principle and methods of sterilization -moist heat, dry heat and filtration methods.
5. Media preparation: Liquid media, Solid media.
6. Slides of different mammalian endocrine glands.

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SUGGESTED READINGS

1. Arora DR and Arora B (2001) Medical Parasitology. 2nd Edition. CBS Publications and Distributers.
2. Dubey RC and Maheshwari DK (2013) A Textbook of Microbiology. S. Chand, New Delhi.
3. Pelczar MJ, Chan ECS and Krieg NR (1993) Microbiology. 5th Edition, Tata McGraw Hill Publishing Co.Ltd.
4. Abbas KA and Lichtman HA (2003) Cellular and Molecular Immunology. 5th Edition. Saunders Publication, Philadelphia.
5. Balinsky BI and Fabian BC (1981) An Introduction to Embryology. 5th Edition. International Thompson Computer Press.
6. David M, Jonathan B, David RB and Ivan R (2006) Immunology. 7th Edition. Elsevier Publication, USA .
7. Gilbert SF (2010) Developmental Biology. 9th Edition. Sinauer Associates, Inc., USA.
8. Kindt TJ, Goldsby RA, Osborne BA and Kuby J (2006) Immunology. 6th Edition. W.H. Freeman and Company, New York.
9. Wolpert L, Beddington R, Jessell T, Lawrence P, Meyerowitz E and Smith J (2002) Principles of Development. 1st Edition, Oxford University Press, New York.
10. Chatterjee CC (2008) Human Physiology. Vol. I and II. Medical Allied Agency, Kolkata.

CORE COURSE: ZOOLOGY
PAPER IV
PHYSIOLOGY, BIOCHEMISTRY AND MOLECULAR BIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

Unit 1: Physiology I

Digestion, Structural organization, histology and functions of gastrointestinal tract and its associated glands, Mechanical and chemical digestion of food, Respiration: Transport of respiratory gases, Structure of heart and cardiac cycle, Composition and clotting of blood, Blood group.

Unit II: Physiology II

Excretion in human, Structure of neuron and transmission of nerve impulse, Structure of skeletal muscle and muscle contraction.

Unit 3: Biochemistry I

Structures and properties of important mono-, di- and polysaccharides, Fatty acids, triglycerides and steroids, and amino acids and proteins.

Unit 4: Biochemistry II

Glycolysis, Citric acid cycle, Pentose phosphate pathway, β -oxidation of saturated fatty acids, Urea cycle.

Unit 5: Molecular Biology

Structure and types of DNA and RNA, DNA replication, Genetic code, Transcription and Translation.

PRACTICAL

Marks 30

1. Enumeration of red blood cells using haemocytometer.
2. Estimation of haemoglobin using Sahli's haemoglobinometer.
3. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).
4. Colour tests of functional groups in protein solutions.
5. Action of salivary amylase under optimum conditions.

SUGGESTED READINGS

1. Chatterjee CC (2008) Human Physiology. Vol. I and II. Medical Allied Agency, Kolkata.
2. Guyton AC and Hall JE (2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.

3. Tortora GJ and Derrickson B (2012) Principles of Anatomy & Physiology. 13th Edition John Wiley and sons, USA.
4. Berg JM, Tymoczko JL and Stryer L (2007) Biochemistry. 6th Edition, W.H. Freeman and Co., New York.
5. Cox MM and Nelson DL (2008) Lehninger Principles of Biochemistry. 5th Edition. W.H. Freeman and Co., New York.
6. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell, 4th Edition. Garland publishing Inc., New York
7. Cooper GM and Hausman RE (2007) The Cell: A Molecular Approach. 4th Edition, ASM Press, USA.

DISCIPLINE SPECIFIC ELECTIVE – 1 A
ANIMAL BEHAVIOUR
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

Unit 1: Introduction and Mechanisms of Behaviour

Origin and history of ethology, Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate behavior, Objective of behaviour, Behaviour as a basis of evolution, Behaviour as a discipline of science, Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers.

Unit 2: Patterns of Behaviour

Reflexes: Types of reflexes, reflex path, characteristics of reflexes (latency, after discharge, summation, fatigue, inhibition) and its comparison with complex behavior.

Orientation: Primary and secondary orientation, kinesis-orthokinesis, klinokinesis, taxistropotaxis and klinotaxis and menotaxis (light compass orientation) and mnemotaxis.

Learning: Associative learning, classical and operant conditioning, Habituation and Imprinting.

Unit 3: Social Behaviour

Social structure of insects, Honey bee: Society organization, foraging, round dance, waggle dance, Experiments to prove distance and direction component of dance, learning ability in honey bee, formation of new hive/queen, Reciprocal altruism, Hamilton's rule and inclusive fitness with suitable examples.

Unit 4: Sexual Behaviour

Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Infanticide, Consequences of mate choice for female fitness, Sexual conflict for male versus female, parental care and Courtship behaviour in three spine stickleback.

Unit 5: Biological Clocks

Circadian rhythm, Tidal rhythm, Lunar rhythm, Advantages of biological clocks, Jet lag and Entrainment.

PRACTICAL

Marks 30

1. To study different types of animal behaviour such as habituation, social life, courtship behaviour in insects, and parental care from short videos/movies and prepare a short report.
2. To study nests and nesting habits of the birds and social insects.
3. To study the behavioural responses of wood lice to dry condition.
4. To study behavioural responses of wood lice in response to humid condition.
5. To study geotaxis behaviour in earthworm.
6. To study the phototaxis behaviour in insect larvae.
7. Visit to forest and wildlife Sanctuaries/Biodiversity Parks/Zoological Parks to study behavioural activities of animals and prepare a report.

SUGGESTED READINGS

1. David McF. Animal Behaviour. Pitman Publishing Limited, London, UK.
2. John A (2001) Animal Behaviour. 7th Edition. Sinauer Associate Inc., USA.
3. Manning A and Dawkins MS. An Introduction to Animal Behaviour. Cambridge University Press, UK.
4. Paul WS and John A. Exploring Animal Behaviour. Sinauer Associate Inc., Massachusetts, USA.

DISCIPLINE SPECIFIC ELECTIVE – 2 A
ECONOMIC ZOOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

Unit 1: Bee-keeping and Bee Economy (Apiculture)

Varieties of honey bees, Setting up an apiary: Lang troth's/Newton's hive, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees, artificial diet, Diseases of honey bee, honey extraction techniques, Physico-chemical analysis of honey, Other beneficial products from bee; Visit to an apiculture institute and honey processing Units.

Unit 2: Silk and Silk Production (Sericulture)

Different types of silk and silkworms in India, Rearing of *Bombyx mori*, Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons, Silkworm diseases: Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis, and their management; Silkworm pests and parasites: Uzi fly, Dermestid beetles, and their management; Silk reeling techniques and Quality assessment of silk fibre.

Unit 3: Aquaculture I

Brood stock management; Induced breeding of fish, Management of hatchery of fish, Management of nursery, rearing and stocking ponds, Preparation and maintenance of fish aquarium, Preparation of compound diets for fish, Role of water quality in aquaculture, Fish diseases: Bacterial, viral and parasitic, Preservation and processing of harvested fish, Fish by-products.

Unit 4: Aquaculture II

Prawn farming, Culture of crab, Pearl culture and Culture of air breathing fishes.

Unit 5: Dairy and Poultry Farming

Introduction, Indigenous and exotic breeds, Rearing, housing, feed and rationing, Commercial importance of dairy and poultry farming, Varietal improvement techniques, Diseases and their management, Dairy or poultry farm management and business plan, Visit to any dairy farm or Poultry farm.

* Submission of report on anyone field visits mentioned above.

PRACTICAL

Marks 30

1. Study of different types of bees (Queens, Drones and Worker bees).
2. Study of different types of silk moths.
3. Study of different types of pearls.
4. Study of different types of fish diseases.
5. Identification of different types of scales in fishes.
6. Study of different types of fins.
7. Study of different modified structures of fishes (Saw of sawfish, Hammer of hammer head fish, tail of sharks etc.)
8. Identification of various types of natural silks.

SUGGESTED READINGS

12. Dhyan Singh Bisht, Apiculture, ICAR Publication.
13. Dunham RA (2004) Aquaculture and Fisheries Biotechnology – Genetic Approaches. CABI publications, U.K.
14. Hafez ESE (1962) Reproduction in Farm Animals. Lea and Fabiger Publishers, .
15. Knobil E and Neill JD (2006) The Physiology of Reproduction. Vol. 2. Elsevier Publishers, USA..
16. Prost PJ (1962) Apiculture. Oxford and IBH, New Delhi.
17. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi.
18. Srivastava CBL (1999) Fishery Science and Indian Fisheries. KitabMahal publications, India.

DISCIPLINE SPECIFIC ELECTIVE - 3 A
WILDLIFE CONSERVATION AND MANAGEMENT
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

LECTURES: 60

Marks 70

- Unit 1:** Wildlife: Values of wildlife, positive and negative; Our conservation ethics, Importance of conservation, Causes of depletion and World conservation strategies.
- Unit 2:** Habitat analysis; Evaluation and management of wildlife, physical parameters: Topography, Geology, Soil and water, Biological parameters: food, cover, forage, browse and cover estimation, Standard evaluation procedures: remote sensing and GIS, Management of habitats, Setting back succession; Grazing logging, Mechanical treatment, Advancing the successional process, Cover construction and Preservation of general genetic diversity.
- Unit 3:** Population estimation: Population density, Natality, Birth rate, Mortality, fertility Schedules and sex ratio computation, Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method
- Unit 4:** National Organizations involved in wildlife conservation, Wild life Legislation: Wildlife (Protection) Act, 1972, its amendments and implementation, Management planning of wildlife in protected areas, Estimation of carrying capacity, Eco tourism/wildlife tourism in forests, Concept of climax persistence.
- Unit 5:** Management of excess population & translocation, Bio- telemetry, Care of injured and diseased animal, Quarantine and common diseases of wild animal, Protected areas National parks & sanctuaries, Community reserve, Important features of protected areas in India, Tiger conservation: Tiger reserves in India and Management challenges in Tiger reserve.

PRACTICALS

Marks 30

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses).
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna.
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).

SUGGESTED READINGS

1. Singh JS, Gupta SR and Singh SP (2014) Ecology, Environmental Science and Conservation. S. Chand, New Delhi.
2. Jugale K P . Wildlife in India. Daya publishing House, Delhi

DISCIPLINE SPECIFIC ELECTIVE – 1 B
MICROBIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY
LECTURES: 60

Marks 70

- Unit 1:** History of microbiology, microbial world: Characterization, Classification and identification of microbes.
- Unit 2:** Prokaryotes: General morphology and classification of bacteria, their characters and economic importance, Gram-positive and Gram-negative bacteria.
- Unit 3:** Eukaryotes: General morphology of Protista and Fungi, Classification and economic importance.
- Unit 4:** Viruses: structure, genome, replication cycle, Epidemiology of infectious diseases with reference to human hosts: Bacterial (Tuberculosis), Viral (Hepatitis), Protozoan (Amoebiasis) and Fungal (any one) disease.
- Unit 5:** Microbe interactions, Immune responses, Antibiotics and other chemotherapeutic agents; Applied microbiology in the fields of food, agriculture, industry and environment.

PRACTICAL

Marks 30

1. Cleaning of glass wares, sterilization principle and methods - moist heat - dry heat and filtration methods.
2. Media preparation: Liquid media, Solid media, Agar slants, Agar plates. Basal, enriched, selective media preparation - quality control of media, growth supporting properties, sterility check of media.
3. Pure culture techniques: Streak plate, pour plate and decimal dilution.
4. Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description and demonstration of pigment production.
5. Staining techniques: Smear preparation, simple staining, Gram's staining, Acid fast staining and staining for metachromatic granules.
6. Morphology of microorganisms.
7. Antibiotic sensitivity testing: Disc diffusion test - Quality control with standard strains
8. Physiology characteristics: IMViC test, H₂S, Oxidase, catalase, urease test, Carbohydrate fermentation, Maintenance of pure culture, Paraffin method, Stab culture and maintenance of mold culture.

SUGGESTED READINGS

11. Arora DR and Arora B (2001) Medical Parasitology. 2nd Edition. CBS Publications and Distributers.
12. Dubey RC and Maheshwari DK (2013) A text book of Microbiology, S. Chand Publishing, New Delhi.
13. Pelczar MJ, Chan ECS and Krieg NR (1993) Microbiology. 5th Edition, Tata McGraw Hill Publishing Co.Ltd., New York.

**DISCIPLINE SPECIFIC ELECTIVE
AGRO-CHEMICALS AND PEST MANAGEMENT
(CREDITS: THEORY-4, PRACTICALS-2)**

**THEORY
LECTURES: 60**

Marks 70

Unit 1: Fundamentals of Pest Management

Pest: Definition, pest resurgence, secondary pest outbreak, Economic injury level, Economic threshold, Types of pests according to damage (sub economic, occasional, perennial).

Unit 2: Insects of Importance

General morphological features of different groups of insects; Study of biting and chewing, and piercing and sucking type of mouth parts.

Unit 3: Pest Management

Integrated Pest Management: Cultural, biological, chemical, genetic control, Agrochemicals: Pesticides, brief history, nomenclature, mode of action of insecticides, tools and techniques for pesticide application, environmental issues, Measurement of insecticide toxicity by estimation of LD₅₀ value of any one insect pest.

Unit 4: Study of Pest in Laboratory and Field

Visit to agricultural field to study biology, damage and management practices of pests of agricultural crops (*Papilio demoleus*, *Helicoverpa armigera*, *Leptocorisaacuta*, *Leucinodes orbonalis*, *Epilachna vigintioctopunctata*).

Unit 5: Rearing of Pests

Rearing of any two important pests, one each from stored grain and agricultural crop in the laboratory and study their different stages.

PRACTICALS

Marks 30

1. Various types of agrochemicals.
2. Different types of insect pest.
3. Different types of non-insect pest.
4. Different types of host plants of insect pests.
5. Nature of attack of insect pests and collection of those samples from the environment.
6. Collection and preservation of some common insects.
7. Mounting of insects (mosquitoes, ants).
8. Study of different types of mouth parts of insect pests.

SUGGESTED READINGS

1. Atwal, A.S. (1993) Agricultural pest of India and South East Asia. Kalyani Pub., New Delhi.
2. Dennis, S. Hill. (2005) Agricultural Insect pests of the tropics and their management, Cambridge University press, UK.
3. Pedigo L. P. (2002). *Entomology and Pest Management*, Prentice Hall Publication.
4. Pradhan, S. (1969). *Insect Pests of Crops*. National Book Trust, India Book House.
5. Robert F. Norris, Edward P. Caswell-Chen and Marcos Kogan, *Concepts of Integrated Pest Management*, Prentice Hall of India.

SKILL ENHANCEMENT COURSES - 1
PUBLIC HEALTH AND HYGIENE
(Credits 2)

Lectures: 30

Marks 50

Unit 1: Scope of public health and hygiene, Nutrition and health, Classification of foods, Nutritional deficiencies, Vitamin deficiencies.

Unit 2: Pollution: water pollution, air pollution, soil pollution, noise pollution, thermal pollution and radioactive pollution.

Unit 3: Environment and health hazards, Environmental degradation, health hazards due to pollutants.

Unit 4: Communicable diseases and their control measures such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS.

Unit 5: Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

SUGGESTED READINGS

1. Arora DR and Arora B (2001) Medical Parasitology. 2nd Edition. CBS Publications and Distributers.
2. Dubey RC and Maheshwari DK (2013) A text book of Microbiology. S. Chand, New Delhi.
3. Pelczar MJ, Chan ECS and Krieg NR (1993) Microbiology. 5th Edition. Tata McGraw Hill Publishing Co. Ltd., New York.

SKILL ENHANCEMENT COURSES – 2
AQUARIUM FISH KEEPING
(CREDITS 2)

LECTURES: 30

Marks 50

- Unit 1:** The potential scope of aquarium Fish Industry as a cottage Industry, Exotic and endemic species of aquarium Fishes.
- Unit 2:** Common characters and sexual dimorphism of fresh water and marine aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.
- Unit 3:** Food and feeding of aquarium fishes, Use of live fish feed organisms, Preparation and composition of formulated fish feeds.
- Unit 4:** Live fish transport, Fish handling, packing and forwarding techniques, General aquarium maintenance, budget for setting up an aquarium fish farm as a cottage industry.
- Unit 5:** Health education in India, WHO programmes, Government and voluntary Organizations and their health services, Precautions, First Aid and awareness on sporadic diseases.

SUGGESTED READING

1. Dunham RA (2004) Aquaculture and Fisheries Biotechnology – Genetic Approaches. CABI publications, U.K.
2. Srivastava CBL (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.

SKILL ENHANCEMENT COURSES - 3
POULTRY FARMING
(CREDITS 2)

LECTURES: 30

Marks 50

Unit 1: External morphology of variety of fowls such as Plymouth Rock, Light Sussex, Minorca, Rhode Island, Red and White Leghorn.

Unit 2: Classification of fowls based on their use : Meat type such as Broilers, Egg type such as White Leghorn and Commercial layers, Dual purpose varieties, Game and Ornamental purpose varieties.

Unit 3: Feeding Poultry – Management of Egg Layers – Management of Broilers in large scale farms.

Unit 4: Poultry diseases Viral, Bacterial, Fungal, Protozoan and Parasitic Lice etc., Prevention and precautions during vaccination.

Unit 5: Management of a modern poultry Farms – Progressive plans to promote poultry as a Self-employment venture.

SUGGESTED READING

1. Hand book of poultry farming and feed formulation EIRI Board (2008).
2. Chauhan H.V.S. Poultry diseases Diagnosis and Treatment New Age (2007)

SKILL ENHANCEMENT COURSES - 4
APICULTURE
(CREDITS 2)

LECTURES: 30

Marks 50

Unit 1:History – Biology and classification of honey bee species of honey bees Social organization of honey bee colony.

Unit 2: Bee hive, Flora for apiculture, Selection of bees for apiculture, Method of bee keeping and Indigenous method of extraction of honey.

Unit 3: Modern method of apiculture, Appliances for modern method, Diseases of honey bee and control measures.

Unit 4:Products of bee keeping : Honey, Bee wax,
Chemical composition and economic importance of honey bee wax.

Unit 5:Bee enemies, Bee keeping industry, Recent efforts, Modern method in employing honey bees for cross pollination in horticultural gardens.

SUGGESTED READING

1. Dhyan Singh Bisht, Apiculture, ICAR Publication.
2. Prost PJ (1962) Apiculture. Oxford and IBH, New Delhi.
3. Singh S. Beekeeping in India, Indian Council of Agricultural Research, New Delhi.