



School of Sciences

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M.Sc. (ZOOLOGY)

Programme Code: 0902ZY

(2 YEARS FULL TIME POST GRADUATE COURSE)

SEMESTER PATTERN

(2024)

Kishu Singh

President

Vishwajit

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Syllabus M.Sc. ZOOLOGY (Prog Code: 0902ZY)

GENERAL INTRODUCTION OF THE DEPARTMENT

MATS School Sciences (MSS) was established with a vision to create technocrats in the applied branches of Biological and Chemical Sciences to convey updated scientific knowledge. In the school the performances of the students are constantly monitored by continuous assessment. The School believes in supplementing academic input of students with the help of regular Seminar, Guest Lectures, Industrial/Research Institute visits and encouraging the students to participate in National & International Seminars, Conferences and Workshops.

DEPARTMENT HIGHLIGHTS

- Research focus on frontier of Life Sciences and affordable healthcare
- Highly acclaimed scientists as faculty
- State-of-the-art Lab facilities
- Hand-on training on sophisticated equipments
- Academia – Industry interface
- Multidisciplinary research in affordable health care, Agriculture and Food

COURSE DESIGN

The department follows a unique course-design which is contemporary and cutting-edge. It includes modern and advanced papers/ subjects including the papers from Management / Science as given in the curriculum matrix

PEDAGOGY

- Chalk Board, LCD and Projector based teaching
- Research based teaching
- Project based learning
- Separate lab bench for each student

FACILITIES

State-of-the-art facilities include:

- Double beam UV- Visible Spectrophotometer, Cooling Centrifuge, Microfuge, Incubators, Microscopes, Laminar flow hoods, Colorimeter, Micro- and regular balance, Electronic Balance Autoclave, Glass distillation apparatus, Computers, Deep freeze, DNA/RNA & Protein Electrophoresis apparatus, Plant Tissue Culture racks with light arrangements, Shakers, BOD incubator & Orbital Shaking Incubator etc.
- Microbial cell culture
- Microtome
- Various Zoological Specimens
- Various Permanent Slides
- Conservation Biology Lab

FACULTIES

- Well experienced faculties from Academic Institutes and Industries
- Invited lectures by eminent scientists from different countries

M. Sc. Zoology: SCOPE AND CONTENT

Zoology is one of the most popular branches in Science that involves the study of animals and their biological processes. Zoology courses are offered at the graduate and postgraduate levels, both full-time and part-time. Candidates can also opt for

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Ph.D. in Zoology after completing their post-graduation. Candidates in this discipline are basically taught regarding animal anatomy, physiology, biochemistry, genetics, evolution, ecology, behavior, and conservation.

This a great **career** interest for people who are fascinated with nature and would not mind spending time understanding it. There are several specializations that the students pursuing the field can venture into. There are physiologists that study the metabolic processes of animals, then there are taxonomists who deal with the naming and the classification of the animal **species**, one can think of becoming embryologist whose only job is to study and focus on the early stages of the animal life. So similarly there are many such options that one can venture into depending on his/her capabilities and interests.

On choosing this career, the person specializing in the field will be referred to as a **zoologist**. On being a part of this field, one will be carefully have to study the behavior, characteristics, evolutionary trends of the different species of animals and those factors having a direct impact on them.

OBJECTIVES OF THE M.Sc. Zoology PROGRAM

1. To impart knowledge and skills in various aspects of zoology.
2. To train the students for industrial need and to pursue further education.
3. To develop human resource and entrepreneurs in zoology with the ability to independently start their own ventures or small biotech units in the field of zoology.
4. Understand modern zoology-practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.
5. Become familiar with public policy, bio-safety, and intellectual property rights issues related to zoology applications nationally and globally
6. Gain experience with standard molecular tools and approaches utilized: to manipulate genes, gene products and organisms.
7. Develop skills in international teamwork and research collaboration.

ELIGIBILITY FOR ADMISSION:

Interested aspirants for M.Sc. Zoology degree need to fulfill the below mentioned minimum eligibility criteria.

- Completion of UG (10+2+3) level of education.
- Biology as one of the subjects at UG level

Instead of biology, one may even have had any subject related to biological sciences as one of the main subject of study.

PROGRAM OUTCOME:

1. Postgraduates will be able to apply knowledge, concepts to solve issues related to their course.
2. Postgraduates will have ability to identify problems related to their subjects.
3. Postgraduates will have ability to analyze and derive valid conclusions with fundamental knowledge in their respective subjects.
4. Post graduates upon the needs of the environment and society, will be able to fulfill the same in the form of solutions within the safety limit of prevalent rules and guidelines.
5. Postgraduates will have ability to design, conduct experiments, analyze and interpret data for investigating problems in their respective fields.
6. Postgraduates will have the ability to select and apply appropriate tools and techniques.
7. Postgraduates will have knowledge for assessing societal, health, safety and legal aspects and the duties as responsible citizens of the country.
8. Postgraduates will have the knowledge of the need for sustainable development.
9. Postgraduates will have the knowledge of ethics and regulatory norms of their respective course.

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10. Postgraduates will have oral, written communication skill along with team spirit.

PROGRAM SPECIFIC OUTCOMES:

1. Acquire knowledge on the various aspects of life sciences, cell biology, genetics, taxonomy, physiology, applied zoology, general embryology and public health.
2. Understand good laboratory practices and safety, Carry out experimental techniques and methods of Physiology, Cell biology, pathology, Genetics, Applied Zoology, Biological techniques, Toxicology, Entomology, Sericulture, Biochemistry, microtomy
3. Understand the applications of biological sciences in Biotechnology, Apiculture, Poultry, Fisheries, Aquaculture, Agriculture and vermiculture.
4. The students gained the knowledge to use modern sophisticated equipments and tools.
5. Recognize the scientific facts behind natural phenomena

CAREER PROSPECTS:

- The Zoology Industry is constantly growing and in the past 10 years, human resources in the field have grown drastically. Today, the Indian zoology sector comprises of lot many companies and bio suppliers, generating ample amounts of revenues. Zoology industry has rapid growth rate per annum. Wildlife Rehabilitators. It involves the treatment, care and feeding of injured, ill and wounded non-domestic animals, as well as caring for orphaned and abandoned animals, Wildlife Educators, Researchers, National Parks/Wildlife Sanctuary Managers, Animal Breeders, Education.

THE MAIN JOB SECTORS ARE AS FOLLOWS:

Candidates who have completed M.Sc in Zoology have the option for higher education programs like Ph.D in Life Science. Also these candidates can join as Junior Research Fellow or Senior Research Fellow in firms like National Institute of Occupational Health.

ATTENDANCE:

A candidate shall be deemed to have undergone a regular course of study in the University, if he/she has attended at least 60% of the lectures in each subject will be at least 75% in the aggregate of lectures, tutorials and practical in order to be eligible to appear in the Final Examination.

SCHEME OF EXAMINATION, EVALUATION AND DISTRIBUTION OF MARKS

- 1 The overall weightage of a course in the Syllabi and Scheme of Teaching & Examination shall be determined in terms of Marks assigned to the course.
- 2 The evaluation of students in a course shall have two components unless specifically stated otherwise in the Scheme of Teaching & Examination and Syllabi:
 - (i) Evaluation through a semester -end examination (University Examination Marks)
 - (ii) Continuous evaluation by the teacher(s) of the course.
- 3 Continuous Evaluation (Internal Marks)

i) Theory courses

The division of internal marks will of 50% marks for mid semester examination and 50% of marks for the internal class tests. There shall be three class tests held during each semester. The three class tests shall ordinarily be held after 4 weeks, 8 week s and 12 weeks of teaching in accordance with the University Academic Calendar.

(ii) Practical/Laboratory courses

The total internal marks in practical/Laboratory courses shall be based on performance in the laboratory, regularity, practical exercises/assignments, quizzes, etc. The assessment shall be given at three nearly equi-spaced intervals.









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Evaluation through a semester-end examination

The distribution of weightage for various components of the evaluation shall be as given below:

	Bachelor's degree/ Under-graduate diploma	Master's degree/ Post-graduate diploma
A. THEORY COURSES		
(i) Semester-end examination	70%	70%
(ii) Continuous evaluation by the teachers	30%	30%
B. PRACTICAL/LABORATORY COURSES		
(i) Semester-end examination	70%	70%
(ii) Continuous evaluation by the teachers	30%	30%
C. DISSERTATION/THESIS		
(i) Assessment by External Examiner	70%	70%
(ii) Assessment by Internal Examiner	30%	30%

PASSING MARKS:

For postgraduate students, obtaining a minimum of 45% marks in aggregate in each course shall be essential for passing the course and earning its assigned credits. A candidate, who secures less than 45% of marks in a course, shall be deemed to have failed in that course.

GRADING SYSTEM:

For UG:

80% and above – “10 Grade Point” and Letter Grade “O” (Outstanding)

40% and above but below 45% - “Grade Point 4” and Letter Grade “P” (Pass)

For PG:

80% and above – “10 Grade Point” and Letter Grade “O” (Outstanding) 45% and above but below 50% - “Grade Point 4” and Letter Grade “P” (Pass)

PROGRAM DURATION:

The maximum permissible period for completing a program for which the prescribed program duration is **n semesters**, shall be **(n+2)** semesters. All the program requirements shall have to be completed in **(n+2)** semesters.

ATKT criteria:

ATKT Candidate means a candidate who failed in not more than forty percent of the total number of Core and Core bracket papers, excluding the Practical Examination/Project Work/Viva Voce Examination in the Semester Examination and is appearing in the Examination same semester again which is organized with the next Semester Examination. Forty percent (of the total number of Core and Core bracket papers) will be rounded off to higher side in case it is not a whole number. In case a Students fails or was absent in Practical Examination/Project Work/Viva Voce Examination, he/she may be allowed to have ATKT exam on his/her own expenses

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First Semester

Curriculum Matrix M.Sc. Zoology (Prog. Code 0902ZY)							
Semester I					Marks Distribution		
Subject Type	Subject Code	Name of Subject	Hours/week	Credit (L+T+P)	External	Internal	Total
Core Course	0902ZY1101	Endocrinology	4	4 (4+0+0)	70	30	100
	0902ZY1102	Anatomy & Physiology of Human	4	4 (4+0+0)	70	30	100
	0902ZY1103	Tools & Techniques of Biology	4	4 (4+0+0)	70	30	100
	0902ZY1104	Biochemistry	4	4 (4+0+0)	70	30	100
Laboratory	0902ZY1205	Lab Course I (Endocrinology)	4	2 (0+0+2)	35	15	50
	0902ZY1206	Lab Course II (Anatomy & Physiology of Human)	4	2 (0+0+2)	35	15	50
Open Elective	0902OE1307 OR 0902OE1308	Food and Nutrition (0902OE1307) OR Management in Practice (0902OE1308)	4	4 (4+0+0)	70	30	100
Total			28	24 (20+0+4)	420	180	600

Second Semester

Curriculum Matrix M.Sc. Zoology (Prog. Code 0902ZY)							
Semester II					Marks Distribution		
Subject Type	Subject Code	Name of Subject	Hours/week	Credit (L+T+P)	External	Internal	Total
Core Course	0902ZY2101	Molecular Biology and Biotechnology	4	4 (4+0+0)	70	30	100
	0902ZY2102	Non Chordata & Chordata	4	4 (4+0+0)	70	30	100
	0902ZY2103	Immunology and Parasitism	4	4 (4+0+0)	70	30	100
Laboratory	0902ZY2204	Lab Course III (Mol Bio & BT)	4	2 (0+0+2)	35	15	50
	0902ZY2205	Lab Course IV (Immunology and Parasitism)	4	2 (0+0+2)	35	15	50
Open Elective	0902OE2306 OR 0902OE2307	Vaccines and Antibiotics (0902OE2306) OR Nano-Science (0902OE2307)	4	4 (4+0+0)	70	30	100
Total			24	20 (16+0+4)	350	150	500

Prof. Arif

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Third Semester

Curriculum Matrix M.Sc. Zoology (Prog. Code 0902ZY)							
Semester III					Marks Distribution		
Subject Type	Subject Code	Name of Subject	Hours/week	Credit (L+T+P)	External	Internal	Total
Core Course	0902ZY3101	Development Biology	4	4 (4+0+0)	70	30	100
	0902ZY3102	Evolutionary Biology and Economic Zoology	4	4 (4+0+0)	70	30	100
	0902ZY3103	Animal Behaviour	4	4 (4+0+0)	70	30	100
	0902ZY3104	Reproductive Biology, Vertebrate and Applied Zoology	4	4 (4+0+0)	70	30	100
Laboratory	0902ZY3205	Lab Course V (Reproductive Biology)	4	2 (0+0+2)	35	15	50
	0902ZY3206	Lab Course VI (Evolutionary Biology and Economic Zoology)	4	2 (0+0+2)	35	15	50
Open Elective	0902OE3307 OR 0902OE3308	Entmology & Pisciculture (0902OE3307) OR Apiculture (0902OE3308)	4	4 (4+0+0)	70	30	100
Total			28	24 (20+0+4)	420	180	600

Fourth Semester

Curriculum Matrix M.Sc. Zoology (Prog. Code 0902ZY)							
Semester IV					Marks Distribution		
Subject Type	Subject Code	Name of Subject	Hours/week	Credit (L+T+P)	External	Internal	Total
Core Course	0902ZY4101	Neuroscience: Neuroendocrinology and Non Classical Hormones	4	4 (4+0+0)	70	30	100
	0902ZY4102	Toxicology and Medical Zoology	4	4 (4+0+0)	70	30	100
	0902ZY4103	Dissertation	6	6 (6+0+0)	150	50	200
Laboratory	0902ZY4204	LAB VII: Neuroscience: Neuroendocrinology and Non Classical Hormones	4	2 (0+0+2)	35	15	50
	0902ZY4205	LAB VIII: Toxicology and Medical Zoology	4	2 (0+0+2)	35	15	50
Open Elective	0902OE4306 OR 0902OE4307	Research Methodology (0902OE4306) OR Biofertilizer (0902OE4307)	4	4 (4+0+0)	70	30	100
Total			26	22 (18+0+4)	430	170	600

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SEMESTER-I

ENDOCRINOLOGY (0902ZY1101)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Endocrinology.
2. To train the students to pursue further education.
3. To be familiar with Endocrinological concepts.
4. To gain experience of Endocrinological concepts.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Endocrinology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: General characters of hormones, Mechanism of hormone action: Protein hormones, Membrane receptors, G-proteins, biosynthesis and secretion of pituitary gland, Steroid hormones (genomic and non genomic pathways)

UNIT II: Hypothalamus-hypophysial System: General organization, Neuro hypophysial hormones: oxytocin and vasopressin, Neural control of adenohipophysial: hypophysiotropic hormones and actions, Adenohipophysial hormones: chemistry and physiological roles of somatotropin and prolactin, Glycoprotein hormones: FSH, LH and TSH and Pro-opiomelanocortin: ACTH, MSH.

UNIT III: Thyroid hormones: biosynthesis, control of secretion and physiological role of thyroid hormones. Parathyroid: Parathormone, calcitonin and vitamin D in calcium homeostasis; Endocrine pancreas: biosynthesis and physiological actions of insulin and glucagon.

UNIT IV: Gonadal hormones: Steroid hormone biosynthetic pathways, Testis: organization and physiological role of androgens, Ovary: organization and physiological role of estrogen, progesterone, relaxinandinhibin.

UNIT V: Adrenal cortex: Organization Mineral corticoid and glucocorticoid hormone: control of secretion and physiological role. Adrenal medulla: catecholamine biosynthesis, release and physiological role.

List of Recommended Books

1. Bentley: Comparative Vertebrate Endocrinology (1998, Cambridge University Press)
2. Norris: Vertebrate Endocrinology (4thed 2007, Academic press)
3. Hadley: Endocrinology, Prentice Hall (6thed.2007)
4. Brooks and Marshall: Essentials of Endocrinology (1995,Blackwell Science)
5. Turner and Bagnara: General Endocrinology (1984,Saunders)

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6. Larson: Williams Textbook of Endocrinology (10th ed 2002, Saunders)

ANATOMY AND PHYSIOLOGY OF HUMAN (0902ZY1102)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Anatomy and Physiology of Human.
2. To train the students to pursue further education.
3. To be familiar with Anatomical and Physiological concepts.
4. To gain experience of Anatomical and Physiological concepts.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Anatomy and Physiology of Human and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT-I: Comparative Anatomy of various organ systems of vertebrates. Integument and its derivatives: structure of scales, hair and feathers. Alimentary canal and digestive glands in vertebrates. Respiratory Organs Gills and lung, Air-Sac in bird.

UNIT-II: Endoskeleton-Limbs, girdles and vertebrae. Circulatory System - Evolution of heart and aortic arches. Urinogenital System - Kidney and excretory ducts.

UNIT-III: Nervous System - General plan of brain and spinal cord. Endocrine glands - classification and histology. Gonads and genital ducts.

UNIT-IV: Digestion and absorption of dietary components. Physiology of heart, Cardiac cycle and ECG. Blood Coagulation. Respiration-Mechanism and control of breathing.

UNIT-V: Excretion-Physiology of excretion, Osmoregulation. Physiology of Muscle contraction. Physiology of nerve impulse, Synaptic transmission. Ear and Eye - structure and function.

List of Recommended books

1. Conn, Stumpy RK, Bruening and D.C.:Outlines of Biochemistry.
2. Gaviong: Review of Medical Physiology.
3. Eckest, R.: Animal Physiology (W.H.Freeman)
4. Hildbrand: Analysis of Vertebrate structure
5. Kingsley: Outlines of Comparative Anatomy (Central Book Depot)
6. Rouer & Parsons: The Vertebrate Body,(Saunders)
7. Walta & Gyles : Biology of the Vertebrates (Macmillan)

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TOOLS & TECHNIQUES OF BIOLOGY (0902ZY1103)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Tools and Techniques in Biology.
2. To train the students to pursue further education.
3. To be familiar with biological tools and techniques.
4. To gain experience of biological tools and techniques.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Tools and Techniques in Biology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Principles and application of Ultracentrifugation, Electrophoresis, Chromatography (various types), Lambert-Beers Law and colorimetry.

UNIT II: Principles and Application of Light Microscopy and micrometry, Phase Contrast microscopy, Interference microscopy, Fluorescence microscopy, Transmission Electron microscopy. Scanning Electron microscopy

UNIT III: Essay: Chemical essay, Biological essay in vivo and in vitro, Principle of cytological and cytochemical techniques, Fixation: Chemical basis of fixation by formaldehyde, glutaraldehyde, Chromium salts, mercury salts, osmium salts, alcohol and acetone, Chemical basis of staining of carbohydrates, protein, lipids, and nucleic acid.

UNIT IV: Principles and Techniques: Nucleic acid and hybridization and cot curve, Sequencing of protein and nucleic acids, Freeze techniques, Media preparation and sterilization, Inoculation and growth monitoring.

UNIT V: Principles: Laminar Air flow, Autoclave, Incubator, Chromatography, PCR, Soxhlet Extraction Unit, Hot Air Oven, spectrophotometry, Flowcytometry.

List of recommended books

1. Introduction to Instrumental Analysis: Robert Braun, McGraw Hill International Edition
2. A biologist guide to principles and techniques of practical biochemistry: K Wilson and K. H. Goulding ELBs Edition
3. Instrumentation: Upadhyay and Nath, Meerut Publications Instrumentation and Techniques: R.C. Bajpayee, Himalayan Publications.

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BIOCHEMISTRY (0902ZY1104)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Biochemistry.
2. To train the students to pursue further education.
3. To be familiar with concepts of Biochemistry.
4. To gain experience of Biochemical techniques.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Biochemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Properties of Proteins: Structure and properties of amino acids, Classification of proteins. Structure of proteins, Biological Functions of Proteins, Protein Metabolism.

UNIT-II: Carbohydrates: Classification of carbohydrates, Structure & Functions of carbohydrates, Carbohydrate metabolism. Lipid: Lipid structure and functions, Lipid metabolism.

UNIT-III: Vitamins: Water- and Fat-soluble vitamins, Chemistry, occurrence and physiological role. Enzymes: Classification and nomenclature, Mechanism of action, Regulation of enzyme activity and functions of Co-enzymes.

UNIT IV: Nucleic acid: Chemistry of DNA, Chemistry of RNA, Biological importance of nucleic acids, Nucleoproteins, Metabolism of nucleic acids.

UNIT V: Cell structure and function of Viruses: structure and replication; Bacteriophage (Lambda phage, phi x 174); Animal DNA virus (SV 40); Retroviruses (HIV); Bacteria: Structure and reproduction of *E. coli*, Plasmid and their functions; Eukaryotes: cell Membrane, Transport across the cell membrane,

List of Recommended Books

1. Lehninger: Principles of Biochemistry, Fourth Edition, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman
2. Biochemistry: Donald Voet, Hardcover: 1616 pages, Publisher: Wiley.
3. Principles of Biochemistry with a Human Focus: Reginald H. Garrett, Charles M. Grisham Publisher Brooks Cole
4. The Molecular Basis of Cell Cycle and Growth Control: Gary S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt, Publisher:Wiley-Liss
5. Experiments in Biochemistry: A Hands-On Approach: Shawn O. Farrell, Ryan T. Ranallo, Publisher: Brooks Cole.

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LAB COURSE I ENDOCRINOLOGY (0902ZY1205)

Total Marks: 50 (35+15)

The practical work in general shall be based on the syllabus prescribed in theory. The students will be required to show the knowledge of the following:

1. Handling, sexing, numbering and maintenance of rat
2. General survey of endocrine glands in rat
3. Study of vaginal smear preparation in rat
4. Demonstration of the following surgical operations in rat: orchidectomy, ovariectomy
5. Study of histological slides of the following endocrine glands in rat: pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary Demonstration of endocrine glands in cockroach
6. Demonstration of frog metamorphosis by models and charts

LAB COURSE II

ANATOMY AND PHYSIOLOGY OF HUMAN (0902ZY1206): -

Total Marks: 50 (35+15)

The practical work in general shall be based on the syllabus prescribed in theory. The students will be required to show the knowledge of the following:-

1. Study of the representative examples of the different chordates (Classification and character)
2. Simple microscopic technique through unstained or stained permanent mounts.
3. Study of prepared slides histological, as per theory papers.
4. Study of limb girdles and vertebrae of frog, varanus, fowl and Rabbit.

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FOOD AND NUTRITION (0902OE1307)

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Food and Nutrition.
2. To train the students to pursue further education.
3. To be familiar with dietetics and nutritional requirements.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Food and Nutrition and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I

Cereal: Types, Structure and composition, Nutritional value, Storage and Care.

Pulses: Types, Composition and Nutritional Value.

Nuts and Oil seeds: Classification, Nutritional value and Importance.

UNIT II

Milk and Milk Products: Composition of Milk, Properties, Effect of Heat and Nutritional value.

Fruits and Vegetables: Composition, Classifications, Nutritional value and Storage.

Flesh Foods: Meat, Fish and Poultry uses, Nutritional value and Storage.

UNIT III

Nutrition: Food as Nutrients, Types of Nutrients, Functions of Food.

Carbohydrates: Classification, Source and Functions.

Fats and Oils: Classification, Source and Functions.

Protein: Sources, Functions, Essential and Non-essential Amino acids.

UNIT IV

Vitamins: Definition, Types, Source, Functions and Deficiency.

Minerals: Source, Functions and Deficiency.

Balance Diet: Definition, Composition, Balance Diet for Adult Man, Woman and Young Children.

RDA: Definition, RDA for Average Indians.

UNIT V

Energy: Definition, Unit of Energy, Body's need for Energy, BMR

Malnutrition: Protein-Energy Malnutrition, Malnutrition and Infection, Malnutrition and Behaviour.

Nutrition and Fitness: Diet and Aerobic Fitness, Fitness Plan.

Nutrition and Disease: Obesity, Diabetes and Heart Disease.

List of Recommended Books

1. Food and Nutrition: Don Ross; Oxford Book Company.

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2. Nutritional Biochemistry: Tom Brody; Academic Press.
3. Nutrition Now: Judith E Brown; Wadsworth Cengage Learning.
4. A Text Book of Foods, Nutrition & Dietetics: M R Begum; Sterling Publishers Pvt. Ltd.
5. Nutrition and Dietetics: Subhangini A Joshi; Tata McGraw Hill Education Pvt. Ltd.

MANAGEMENT IN PRACTICE (0902OE1308)

Credit: 4

Total Marks: 100 (70+30)

Course Objectives:

1. To understand the basic functions of management.
2. To know the basic qualities of a manager so that they can be utilized in practical situation.
3. To develop understanding of basic know-how of industrial planning, market assessment, future projections, etc.

Course Outcome:

Skills that students obtain after completion of the course:

1. To prepare business plan and its execution according to market available.
2. Ability to dissect a problem in to its key features.
3. Apply the basic concepts of management to different situations.

UNIT I

Introduction to Management: - Meaning, nature and importance. Evolution of Management-Classical, Neo-classical, Scientific Theory, Administrative Theory; Functions of a Manager. Qualities of a manager. Social Responsibilities of a Manager, Management as a Process-Planning-Meaning and Importance. Organizing-Meaning and Importance. Staffing- Meaning and Importance. Directing – Meaning and Function.

UNIT II

Human Resource Management-Meaning. Importance of Human Resource management. Manpower Planning- Meaning and Importance. Difference between Human Resource Development and Human Resource Planning. Recruitment-Meaning and Importance. Selection- Meaning and Methods Training Meaning. and Types. Performance Appraisal- Meaning and Types.

UNIT III

Organization Behavior- Introduction to Organization Behavior- Meaning, Importance and scope. Motivation- Meaning, Process and Importance. Motivational Theories- Maslow, Herzberg and McClelland. Attitude- Meaning and Importance, Components of attitude in Organization Behavior. Perception- Meaning and Importance in the context of Organization Behavior.

UNIT IV

Marketing Management- Meaning, Importance and Implications. Marketing Mix- Product- Meaning, types and Importance. Place- Meaning and Importance. Price- Meaning, Methods and Importance; Promotion- meaning. Instruments and Importance to make a marketing decision.

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UNIT V

Financial Management- Meaning and Importance. Relationship with other managerial functions. Financial Analysis- Meaning and Importance; Tools of financial management, Fund Flow – Meaning, Process; Fixed and Working Capital- Meaning and Importance.

List of Recommended Books

1. Principles of Management: L. M. Prasad
2. Management by Robbins.
3. Marketing Management-Raja Gopal.
4. Financial Management for Non-Finance Executives by Dr. Prasanna Chandra
5. Human Resource Management by C. V. Matoria
6. Organizational Behavior by S. Robbins
7. Management by Stoner
8. Financial Management by Khan and Jain
9. Financial Management by Dr. Prasanna Chandra
10. Marketing Management by Philip. A. Kotler
11. Human Resource Management by Edward Flipo

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SEMESTER-II

MOLECULAR BIOLOGY AND BIOTECHNOLOGY (0902ZY2101)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Molecular Biology and Biotechnology.
2. To train the students to pursue further education.
3. To be familiar with concepts of Molecular Biology and Biotechnology.
4. To gain experience of standard tools in Molecular Biology and Biotechnology.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Molecular Biology and Biotechnology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Bio membranes: Molecular composition and arrangement Transport across membrane, Structure and function Mitochondria, Golgi complex, Lysosome Ribosome.

UNIT II: DNA replication, Transcription, Translation, Genetic code, Mechanisms of initiation, elongation and termination, Regulation of translation.

UNIT III: Genome organization, Chromosomal organization: morphological and structural types., Non-coding DNA, Molecular mapping of genome, Genetic and physical maps, Polymerase Chain Reaction (PCR) and blotting techniques, Molecular markers in genome analysis.

UNIT IV: Transgenic animals and knock-outs, Production and applications, Embryonic stem cells Application of genetic engineering, Medicine, Agriculture, Industry

UNIT V: Biotechnology: Scope, Importance and Applications, Plant tissue culture techniques: Importance and application, Scope.

List of Recommended Books

1. Molecular Cell Biology: Lodish, W.H. Freeman & Co. NewYork
2. Lehninger: Principles of biochemistry, Fourth Edition-David L Nelson, Michael M.Cox
3. Molecular Cell Biology: Lodish M. Baltimore, Scientific American books “Essentials Of Cell & Molecular biology” Roberties & Roberties, Halt Saunders International Edition.
4. Cell & Molecular Cell biology: Gerald Karp, Willey & Sons Co.
5. Medical Cell biology: Flickinger E.J. Brown J.C. Halt Saunders International Edition
6. Cell Biology: Powar C.B. Himalaya Publishing House.

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NON-CHORDATA AND CHORDATA (902ZY2102)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Non Chordata and Chordata.
2. To train the students to pursue further education.
3. To be familiar with concepts of Non Chordata and Chordata.
4. To gain experience of concepts of Non Chordata and Chordata.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of concepts of Non Chordata and Chordata and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Protozoa: Nucleus and reproduction; Origin of metazoans; Porifera: Canal system; Cnidaria: Polymorphism in Siphonophora, Annelida: Adaptive radiation in polychaetes, Trochophore larva.

UNIT II: Mollusca: Torsion in gastropods, larval forms; Arthropoda: Evolutionary significance of Trilobites, Crustacean larvae and their significance. Echinodermata: larval forms and their significance.

UNIT III: Salient features and affinities of Placozoa, Mesozoa, Rotifera, Phoronida, Sipuncula and Hemichordata

UNIT IV: Characteristic features and affinities of Protochordata and Cyclostomata; Origin of the Fish, Amphibian, Special character of amphibian: Parental care

UNIT V: Characteristic features and affinities of Reptile, Bird, Mammal, Adaptive radiations in vertebrates: Aquatic, Terrestrial, Aerial, Arboreal, Fossorial. Special characters: Venom in ophidians, Poisonous and Non-poisonous snakes; Biting mechanisms of snakes, Migration in birds' Flightless birds.

List of Recommended books

1. Jordan & Verma: Chordate Zoology (1998, S.Chand),
2. Kotpal: The Birds (4th ed, 1999, Rastogi Publications),
3. McFarland *et.al.*: Vertebrate Life (1979, Macmillan Publishing)
4. Parker & Hashwell: Textbook of Zoology, Vol.II (1978, ELBS), Romer & Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan).
5. Sinha, Adhikari & Ganguli: Biology of Animals Vol.II (1988, New Central Book Agency).

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IMMUNOLOGY AND PARASITISM (0902ZY2103)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Immunology and Parasitism.
2. To train the students to pursue further education.
3. To be familiar with concepts of Immunology and Parasitism.
4. To gain experience of concepts of Immunology and Parasitism.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of concepts of Immunology and Parasitism and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Introduction of immunity, General account about Immune system of human body, Production of Monoclonal antibodies.

UNIT II: Cells of immune system: B-Lymphocytes, T-lymphocytes, Null Cells, Mononuclear cells, Granulocytic cells (Neutrophils, Eosinophils and Basophils), Mast cells, Dendritic cells, Organs of immune system, Primary lymphoid organs (Thymus, bone marrow), Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue, cutaneous associated lymphoid tissue)

UNIT III: Immunoglobulin structure and function, Molecular structure of Ig, Light chain and Heavy chain, Immunoglobulin classes IgG, IgM, IgE, IgD.

UNIT IV: Antigens: Immunogenicity, Contribution of the immunogens, Contribution of Biological system. Antigen – Antibody Interaction, Antibody affinity and activity, Cross reactivity, Agglutination reactions, Precipitation Reaction, Vaccine, Active and passive immunization, Whole organism vaccine, Recombinant vector vaccine, DNA vaccines.

UNIT V: Immune system in Health disease, Immune response to infectious disease, Immune response in cancer, Pathophysiology of parasitic infection, Viral infections, Bacterial infection, Helminths infection, AIDS.

List of Recommended Books

1. Immunology: Kuby, W.H. Freeman USA
2. Fundamental of Immunology: W.Paul, Essential Immunology: I.M. Roitt, ELBs Edition
3. Immunology: Richard M. Hyde, Robert A. Patnode, A Wiley
4. Medical Publications Reproductive Physiology: Gayton.

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LAB COURSE III

MOLECULAR BIOLOGY AND BIOTECHNOLOGY (0902ZY2204)

Total Marks: 50 (35+15)

- 1 Isolation of DNA/RNA
- 2 Study of mitochondria from buccal epithelium by staining with supravital stains.
- 3 Culture of amoeba, paramecium, euglena.
- 4 Study of cell division mitosis/meiosis by squash and smear preparation of root tip and cockroach/grasshopper testis.
- 5 Study of giant chromosome in the salivary gland of Chironomous larvae or Drosophila..
- 6 Study of Barr body and human chromosome.
- 7 Culture and study of drosophila.
- 8 Preparation of culture media and culture of bacteria.
- 9 Other exercise. Related to theory paper.

LAB COURSE IV

IMMUNOLOGY AND PARASITISM (0902ZY2205)

Total Marks: 50 (35+15)

1. Total and differential counting of leucocytes.
2. Protein estimation by Lowry's method in normal and infected blood sample.
3. Determination of Blood group.
4. Study of permanent slides (for spotting); thymus, lymph nodes, spleen, bone marrow, types of cells squamous, cuboidal, columnar, epithelial cells, blood cells, nerve cells, muscles cells, connective tissue of various types, adipose tissue, mitotic and meiotic chromosomes and their different phases cancer cells of various types etc.
5. Study of parasites in fish
6. Study of various parasites through slides and specimen.

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VACCINES AND ANTIBIOTICS (0902OE2306)

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Vaccines and Antibiotics.
2. To be familiar with different tools of Vaccines and Antibiotics
3. To train the students to pursue further education.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Vaccines and Antibiotics and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

UNIT I

Vaccines: History and Nature; Types of Vaccines with examples: Simple and Mixed Vaccines, Univalent and Polyvalent Vaccines, Inactivated vaccine, Attenuated Vaccine, Live Vector Vaccine, Recombinant Vaccines, Subunit Vaccines, Conjugate Vaccines, Peptide Vaccines, DNA Vaccines, Cell Culture Vaccine.

UNIT II

Preparation, Standardization and Storage of Vaccines; Multivaccine System; Principles of vaccination, passive and active immunization, immunization programs and role of WHO in immunization programs.

UNIT III

Hybridoma Technology: Theory; Monoclonal antibodies, Production and applications; Monoclonal Antibodies as Vaccines.

UNIT IV

Historical background of Antibiotics; Classification of antibiotics: On the basis of Source, Mode of Action and Chemical structure with examples; Antibiotic resistance; Toxicity of antibiotics.

UNIT V

Broad Spectrum antibiotics: General Structure and Mode of action of Streptomycin, Penicillin, Tetracycline, Chloramphenicol, Quinolone, Sulfonamide, Fusidic acids; Applications of antibiotics.

List of Books Recommended

1. An instruction to industrial Microbiology by Dr. P. K. Sivakumaar, Dr. M. M. Joe, Dr. K. Sukesh.
2. Biotechnology, by Mohan P. Arora.
3. Medical Microbiology and Immunology by Warren Levinson and Ernest Jawetz.
4. Biotechnology by Wufu Crueger and Anneliese Crueger.
5. Microbiology: Principles and Explorations by Jacquelyn G. Black.
6. Microbiology by Prescott, Harley and Klein.

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7. Medicinal Chemistry by Ashutosh Kar.

NANOSCIENCE (0902OE2307)

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Nanoscience.
2. To be familiar with different tools of Nanoscience
3. To train the students to pursue further education.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Nanoscience and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

UNIT I

Introduction to Nanotechnology: The Nanoscale Dimension and Paradigm; Definition, History and Current practices; Types of Nanomaterials and their Classifications; Over view of Physical and Chemical Fundamentals of Nanomaterials.

UNIT II

Properties and Characterizations: Optical (UV-Vis/Fluorescence); X-ray diffraction; Imaging and size (Electron microscopy, Light scattering, Zetapotential). Methods of Preparation of Nanomaterials: Top down and bottom up approaches-emulsifiers, Homogenizers, Sonicator; Over view of Biological Synthesis of Nanoparticles.

UNIT III

Nanomedicine: Nano carriers for Drug delivery, Nanoparticle mediated Drug delivery, Nanotechnology in Drug discovery, Nano-formulation of Herbal Medicine; Nanoscaffolds and their use in Cell culture, Organ culture and Tissue Engineering, Regulatory aspects in the approval of Nano medicine, Nano-Cosmetics and other use.

UNIT IV

Nanomaterials and Toxicity Evaluation: Cyto-toxicity, Geno-toxicity, in vivo tests/assays etc.; Toxicological considerations in Nano medicine and Nano-delivery system.

UNIT V

Environmental Applications: Nano clays, Nano adsorbents, Zeolites, Release of Nutrients and Pesticides, Biosensors - Green Technologies - Molecular biomimetic; Nano remediation: Identification and characterization of Hazardous waste; Nano pollution: air - water - soil contaminants; Treatment waters using nano-particles.

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List of Books Recommended

1. Nanoscience: Nanobiotechnology and Nanobiology: Boissaeu, Houdy & Lehmani.
2. A-Z Nanobiology: Albert Shawn.
3. Nanotechnology in Biology and Medicine: Methods, Devices and Application, 2007, Tuan Vo-Dinh. CRC press
4. Nanoscience : Nanobiotechnology and Nanobiology (2009) P. Boisseau, P. Houdy and M.Lahmani, (Eds.) Springer, Heidelberg

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SEMESTER-III

DEVELOPMENT BIOLOGY (0902ZY3101)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Development Biology Human.
2. To train the students to pursue further education.
3. To be familiar with concepts of Development Biology.
4. To gain experience of concepts of Development Biology.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Development Biology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Oogenesis: Differentiation and growth of oocytes, Organization of egg cytoplasm and egg cortex, Vitellogenesis. Spermatogenesis: Differentiation and ultra-structure of sperm, Capacitation.

UNIT II: Fertilization: Biological role of fertilization, Basic requirements of fertilization, Activation of egg metabolism, Biochemistry of fertilization, Cleavage, Characteristics and mechanisms of cleavages, Extra embryonic membrane.

UNIT III: Formative movements: Fate maps, Utility and comparative topographical relationship of the Presumptive areas in early embryos of Amphioxus, Fishes, Amphibian, Birds, Differentiation.

UNIT IV: Cell and tissue interactions in development, Primary embryonic induction, Competence, Concept of organizer, Metamorphosis, Teratology.

UNIT V: Evidences of organic evolution. Theories of organic evolution. Variation, Mutation, Isolation and Natural selection. Evolution of Horse.

List of Recommended Books

1. Animal Gametes: Vishmanath, Asia Publishing House
2. Foundation Of Embrology: Bradley M.Patten, McGrow Publication
3. Fertilization in Animals: Brain Dale, Arlond Heiniman, Gulab Vazerani Publication
4. Development Biology: N.J. Berril, Tata McGraw Hill Publication N. Delhi Embryology of Vertebrates: Nelson.

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EVOLUTIONARY BIOLOGY AND ECONOMIC ZOOLOGY

(0902ZY3102)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Evolutionary and Economic Zoology.
2. To train the students to pursue further education.
3. To be familiar with concepts of Evolutionary and Economic Zoology.
4. To gain experience of concepts of Evolutionary and Economic Zoology.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Evolutionary and Economic Zoology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: An overview of evolutionary thoughts, development and the concept of synthetic theory, Population genetics: Gene frequencies in Mendelian population, Hardy-Weinberg equilibrium Conditions for the maintenance of genetic equilibrium. Elemental forces of evolution: Mutation, Selection (types of selection and selection coefficient), Random genetic drift, Migration.

UNIT II: Chromosomal, allozyme and DNA polymorphisms: Adaptive genetic polymorphism, Balanced polymorphism and heterosis, Genetic co-adaptation and linkage disequilibrium. Isolating mechanisms: Concepts of species and models of speciation: allopatric, sympatric and stasipatric.

UNIT III: Evolution at molecular level: Genomic and proteomic changes, Molecular phylogenies, Neutral theory, Molecular clock.

UNIT IV: Beneficial and harmful insects, including insect vectors of human diseases. Pests of sugar cane (*Pyrrilla pusilla*), oil seed (*Achaea janata*) and rice (*Sitophilus oryzae*). Insects in forensic investigations; Industrial fish, prawn and molluscs of India. Apiculture, sericulture, lac culture, carp culture, pearl culture, prawn culture.

UNIT V: Major infectious and communicable diseases (small pox, plague, malaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention. Cattle and livestock diseases, their pathogens (helminths) and vectors (ticks, mites, *Tabanus*, *Stomoxys*).

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List of Recommended Books

1. P A Moody: Introduction to Evolution
2. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath), Strickberger's Evolution
3. Verma and Agrawal, Ecology – 2000, S Chand
4. Kormondy, E.J. Concepts of Ecology, 4th Ed. PHI Learning, 2011.

List of Recommended Books for Economic Zoology

1. Shukla and Upadhyaya: Economic Zoology (Rastogi Publishers, 1999-2000)
2. Shrivastava: Test book of Applied Entomology, Vol. I & II (Kalyani Publishers, 1991), Mani: Insects, NBT, India, 2006.
3. Jabde: Text Book of Applied Zoology: Vermi culture, Apiculture, Sericulture, Lac culture, Agricultural Pests and their control, 2005 Discovery Publishing House.

ANIMAL BEHAVIOUR (0902ZY3103)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Animal Behaviour.
2. To train the students to pursue further education.
3. To be familiar with concepts of Animal Behaviour.
4. To gain experience of concepts of Animal Behaviour.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Animal Behaviour and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Historical perspectives- Ethology, Behavioral patterns, Innate behavior, Biological rhythms, Types of biological rhythm, Biological clock

UNIT II: Communications, Auditory, Visual, Chemical, Learning and Memory, Conditioning, Habituation, Reasoning, Reproductive behavior.

UNIT III: Orientation, Echolocation in bats, Bird migration and navigation. Fish migration, Neural and hormonal control of behavior

UNIT IV: Hormonal effect on behavioral patterns., Social behavior, Social organization in insects and primates, Schooling in fishes and Flocking in birds, Homing, territoriality, dispersal, Altruism, Host-parasite relation.

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UNIT V: Introduction to Ethology. Patterns of Behavior Taxes, Rellexes, Drives and Stereotyped Behavior. Reproductive Behavioral Patterns. Hormones, Drugs and Behavior.

List of Recommended Books

1. Animal Behavior – Mc Farland (English Language Book Society).
2. Animal Behavior – Arora M.P. (Himalaya Publishing House, Mumbai).
3. Animal Behavior - Reena Mathur (Rastogi Publications, Meerut).

REPRODUCTIVE BIOLOGY, VERTEBRATE AND APPLIED ZOOLOGY (0902ZY3104)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Reproductive Biology, Vertebrate and Applied Zoology.
2. To train the students to pursue further education.
3. To be familiar with concepts of Reproductive Biology, Vertebrate and Applied Zoology.
4. To gain experience of concepts of Reproductive Biology, Vertebrate and Applied Zoology.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Reproductive Biology, Vertebrate and Applied Zoology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: General Characters of Hormones. Hormone Receptor Biosynthesis and secretion of thyroid, Adrnal; Ovarian and testicular hormones. Endocrine disorder due to hormones and another gland.

UNIT II: Reproductive cycle in vertebrate. Menstruation, Lactation and pregnancy. Mechanism of parturition. Hormonal regulation of gametogenesis. Extra embryonic membrane.

UNIT III: Evidences of organic evolution. Theories of organic evolution. Variation, Mutation, Isolation and Natural selection. Evolution of Horse.

UNIT IV: Introduction to Ethology. Patterns of Behavior Taxes, Rellexes, Drives and Stereotyped Behavior. Reproductive Behavioural Patterns. Hormones, Drugs and Behavior.

UNIT V: Aquaculture, Sericultural, Apiculture, Pisciculture, Poultry keeping, Elements of Pest Control - Chemical control, Biological Control.

List of Recommended Books

1. Neerja Kapoor: Practical Zoology(Vertebrates)
2. R. Gupta, N. K. Arora: Animal Behavior
3. R. Radheshyam, N.K. Pandey: Reproductive Endocrinology.
4. Rastogi: anatomy physiology and reproductive biology

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LAB COURSE V REPRODUCTIVE BIOLOGY (0902ZY3205)

Total Marks: 50 (35+15)

The practical work in general shall be based on the syllabus prescribed in theory. The students will be required to show the knowledge of the following.

1. Study of prepared slides histological, as per theory papers.
2. Study of Reproductive cycle in vertebrate. Menstruation, Lactation and pregnancy.
3. Identification of species and individuals of honeybee.
Life cycle of honey bee and silkworm

LAB COURSE VI EVOLUTIONARY BIOLOGY AND ECONOMIC ZOOLOGY (0902ZY3206)

Evolutionary Biology

Total Marks: 50 (35+15)

1. Study of quantitative inheritance in *Drosophila*: sternopleural bristle phenotypes in *D. melanogaster*.
2. Demonstration of natural selection under laboratory conditions by making competition between red eyed and white eyed *D. melanogaster*.
3. Demonstration of Hardy-Weinberg equilibrium in human populations by taking examples of MN and ABO blood group systems.
4. Study of inversion polymorphism in *Drosophila*.
5. Study of sexual isolation between two closely related and sympatric species of *Drosophila*: *D. bipunctata* and *D. malerkotliana*.

Economic Zoology

1. Study of life cycle of silkworm through chart/specimens.
2. Study of life cycle of honey bee through chart/specimens.
3. Study of external morphology of different castes of honeybee.
4. Dissection of sting apparatus of honeybee.
5. Study of life cycle of lac insect through chart.
6. Visit to the local dairy farm to study the pests of cattle.

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7. Visit to the local dairy farm to study the dairy management.
8. Visit to local poultry to study the rearing methods.
9. Visit to local fish culture site to study the fish culture methods.

ENTOMOLOGY AND PISCICULTURE (0902OE3307)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Entomology and Pisciculture.
2. To train the students to pursue further education.
3. To be familiar with concepts of Entomology and Pisciculture.
4. To gain experience of concepts of Entomology and Pisciculture.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Entomology and Pisciculture and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I Importance and taxonomic richness of insects: External anatomy: Segmentation and tagmosis; Integument: structure and functions of cuticle, sclerotization; Types of antennae and mouth parts; Sensory system: Tactile mechanoreceptor and position receptor, Compound eye, Endocrine system and function of hormones.

UNIT II Internal anatomy and physiology: Nervous system, Circulatory system: heart and haemolymph; Respiratory system: Aerial respiration (Spiracles, Trachea and Tracheoles), Aquatic respiration; Digestive system: Structure of gut; sound production, bioluminescence

UNIT III Excretory system and waste disposal: Malpighian tubules, nitrogen excretion. Reproductive system; Insects as friends and foes, General methods of insect pest management.

UNIT IV Integument: Epidermis (Mucogenic and Keratinized), Epidermal derivatives: microridges, integumentary glands; Dermis: General organization; Scales: cosmoid, gnathoid, placoid, ctenoid and elasmoid; Chromatophores: melanophores, iridophores, xanthophores and erythrophores; Factors affecting colour change; adaptive significance.

UNIT V Ichthyology and its scope, Growth and energetics: concept of growth, determination of age and growth, correlation of growth in relation to body weight and length; role of minerals and vitamins in growth regulations, economic importance of fishes.

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List of Recommended Books

1. Chapman: The Insects: structure and function (4th ed, 1998, ELBS).
2. Imms: A general text book of entomology, 2 vols (1997, Asia Publishing House).
3. McGavin: Essential Entomology (2001, Oxford Univ Press).
4. Srivastava: A text book of applied entomology, Vol I & II (1993, Kalyani Publishers).
5. Wiggles worth: Principles of Insect Physiology (1972, ELBS).

List of Recommended Books

1. Brown: Physiology of fishes, Vol. 1 and 2 (1957, Academic press).
2. Gupta and Gupta: General and applied Ichthyology (Fish and Fisheries) (2006, S. Chand).
3. Hoar and Randall: Fish Physiology, Volumes I-XV (1969-onwards, Academic Press).
4. Khanna and Singh: A textbook of Fish Biology and Fisheries (2003, Narendra Publishing House).
5. Norman and Greenwood: A History of Fishes (3rd ed 1975, Ernest Benn Limited)
6. Srivastava: A Textbook of Fishery Science and Indian Fisheries (1985, Kitab Mahal)
7. Srivastava: Fishes of U.P. and Bihar (2002, Vishwavidyalaya Prakashan)
8. Parihar: Fish Biology and Indian fisheries (1999, Central publishing House Allahabad)

APICULTURE (0902OE3308)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Apiculture.
2. To train the students to pursue further education.
3. To be familiar with concepts of Apiculture.
4. To gain experience of concepts of Apiculture.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Apiculture and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Biology of Bees: History, Classification and Biology of Honey Bees Social Organization of Bee Colony

UNIT II: Rearing of Bees: Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture Bee Keeping Equipment Methods of Extraction of

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Honey (Indigenous and Modern)

UNIT III: Diseases and Enemies: Bee Diseases and Enemies Control and Preventive measures

UNIT IV: Bee Economy: Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

UNIT V: Entrepreneurship in Apiculture: Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

List of Recommended Books

1. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
2. Bisht D.S., Apiculture, ICAR Publication.
3. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.

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SEMESTER IV

NEUROSCIENCE: NEUROENDOCRINOLOGY AND NON-CLASSICAL HORMONES (0902ZY4101)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Neuroscience.
2. To train the students to pursue further education.
3. To be familiar with concepts of Neuroscience.
4. To gain experience of concepts of Neuroscience.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Neuroscience and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Neuroendocrinology- Hypophysiotropic hormones: localization, secretion and mechanism of action, TRH, GnRH, CRH, GHRH and PACAP, Somatostatin, Monoamines

UNIT II: Adenohypophysis -Role of transcription factors in pituitary differentiation, Paracrine/autocrine secretions, Neural control of ACTH, TSH, prolactin and growth hormone

UNIT III: Pineal gland- Pineal, biological clock and calendar, Melatonin and photoperiodic measurement

UNIT IV: Non - classical hormones - Growth factors: cellular origin, secretion and functions, Epidermal growth factor family (EGF and TGF α), Transforming growth factor β family (TGF β , anti-Mullerian hormone, inhibins and activins) Platelet-derived growth factor family, Fibroblast growth factor family, Insulin family (IGF-I and IGF-II), Nerve growth factor family

UNIT V: Hematopoietic growth factors (erythropoietin, thrombopoietin and colony stimulating factor), Immunoinflammatory hormones (interleukines, TNF α and TNF β), Eicosanoids (prostaglandins, thromboxanes and leukotrienes), Leptin.

List of Recommended Books

1. Bolander: Molecular Endocrinology (3rd ed 2006, Elsevier)
2. De Groot and Jameson: Endocrinology (5th ed 2006, Vol 1, Elsevier-Saunders)
3. Larson. Williams Textbook of Endocrinology (10th ed 2002, Saunders)
4. Norman and Litwack, Hormones (2nd ed 1997, Academic press)
5. Henson and Castracane: Leptin and Reproduction (2003, Plenum, Publishers)

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6. Norris and Lopez: Vertebrate Endocrinology (5thed, Vol 5, 2011, Academic press)
7. Brooks and Marshall: Essentials of Endocrinology (1995, Blackwell Science)
8. Bolander: Molecular Endocrinology (3rded 2006, Elsevier)
9. De Groot and Jameson: Endocrinology (5thed 2006, Vol 1, Elsevier-Saunders)
10. Larson. Williams Textbook of Endocrinology (10thed 2002, Saunders)
11. Norman and Litwack. Hormones (2nded 1997, Academic press)
12. Henson and Castracane: Leptin and Reproduction (2003, Plenum Publisher).

TOXICOLOGY AND MEDICAL ZOOLOGY (0902ZY4102)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Toxicology and Medical Zoology.
2. To train the students to pursue further education.
3. To be familiar with concepts of Toxicology and Medical Zoology.
4. To gain experience of concepts of Toxicology and Medical Zoology.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Toxicology and Medical Zoology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: Aims and scopes of Ecology, Major ecosystems of the world-Brief introduction, Population- Characteristics and regulation of densities, Communities and Ecosystems, Biogeochemical cycles, Air and water pollution, Ecological succession.

UNIT II: Laws of limiting factors, Food chain in a freshwater ecosystem, Energy flow in ecosystem- Trophic levels, Conservation of Natural resources, Environmental impact Assessment.

UNIT III: Definition of Toxicity, Classification of toxicants, Principle of systematic toxicology, Toxic agents and their action- Metallic and inorganic agents, Animal poisons - Snake-venom, Scorpion and bee poisoning, Food poisoning.

UNIT IV: General and Applied microbiology, Microbiology of Domestic water and sewage, Microbiology of milk and milk products, Industrial microbiology.

UNIT V: Brief introduction to pathogenic microorganism, *Rickettsia*, *Spirochaetes* and Bacteria, Brief account of life-history and pathogenicity of the following pathogens with reference to man; Prophylaxis and treatment - (a) Pathogenic Protozoans - *Entamoeba*, *Trypanosoma*, and *Giardia* (b) Pathogenic helminths - *Schistosoma* (c) Nematode Pathogenic parasites of man 3. Vector insects.

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List of recommended Books

1. P. D. SHARMA: ecology and environment
2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin, Cummings.
3. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc
4. Park, K. (2007) Preventive and social medicine. XVI, Edition.

DISSERTATION (0902ZY4103)

Total Marks: 200 (150+50)

(A) : Project work/ Dissertation

Topic will be based on the major elective opted by students. Project will include laboratory/field-based work followed by submission of report and presentation.

(B) : Seminar

Students are required to deliver a seminar on a current topic related to the subject and to be evaluated by a panel of examiners.

LAB COURSE VII

NEUROSCIENCE: NEUROENDOCRINOLOGY AND NON-CLASSICAL HORMONES (0902ZY4204)

Total Marks: 50 (35+15)

1. Study of pituitary and pineal cell types through prepared slides.
2. In situ study of pituitary gland for portal circulation.
3. Transplantation of pituitary in kidney capsule.
4. In situ study of pineal gland and associated epithalamic complex.
5. Anatomical mapping of hypothalamic centres (SON, PVN, AR, VMO mammillary nucleus, median eminence).
6. Ascorbic acid depletion bioassay for LH.
7. ELISA/RIA of TSH organodotropons.

LAB COURSE VIII

TOXICOLOGY AND MEDICAL ZOOLOGY (0902ZY4205)

Total Marks: 50 (35+15)

The Practical work in general shall be based on syllabus prescribed in theory. The candidates will be required to show knowledge of the following:

1. Estimation of population density, Percentage frequency, Relative density.
2. Analysis of Producers and consumers in grassland.

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3. Detection of gram-negative and gram-positive bacteria.
4. Blood group detection (A, B, AB &O).
5. R.B.C., W.B.C. count.
6. Blood coagulation time.

RESEARCH METHODOLOGY (0902OE4306)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Research Methodology.
2. To train the students to pursue further education.
3. To be familiar with concepts of Research Methodology.
4. To gain experience of concepts of Research Methodology.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Research Methodology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Unit I: Foundations of Research, Meaning, Objectives, Motivation: Research Methods vs Methodology, Types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied.

Unit II: Research Design Need for research design: Features of good design, important concepts related to good design- Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs.

Unit III: Data Collection, Analysis and Report Writing

Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies.

UNIT IV: Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology.

Unit V: Ethical Issues Intellectual property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement.

List of Recommended Books: -

1. Anthony, M, Graziano, A.M. and Raulin, M.L. 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Walliman, N. 2011. Research Methods- The Basics. Taylor and Francis, London, New York.
3. Wadhwa, B.L.: Law Relating to Patents, Trade Marks, Copyright Designs and Geographical Indications, 2002, Universal Law publishing
4. C.R. Kothari: Research Methodology, New Age International, 2009
5. Coley, S.M. and Scheinberg, C.A. 1990, "Proposal writing". Stage Publication.

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BIOFERTILIZER (0902OE4307)

Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Biofertilizer.
2. To train the students to pursue further education.
3. To be familiar with concepts of Biofertilizer.
4. To gain experience of concepts of Biofertilizer.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Biofertilizer and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

UNIT I: General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier-based inoculants, Actinorrhizal symbiosis.

UNIT II: Azospirillum: isolation and mass multiplication – carrier-based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter, inoculum, maintenance and mass multiplication.

UNIT III: Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

UNIT IV: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

UNIT V: Organic farming – Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – bio compost making methods, types and method of vermin composting – field Application.

List of Recommended Books

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.

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