



**Parishkar College of Global Excellence
(Autonomous), Jaipur**

CHOICE BASED CREDIT SYSTEM (CBCS)

M.Sc. (ZOOLOGY)

Faculty Members

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PREAMBLE

The University Grants Commission (UGC) has initiated several important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. The HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.
 - 2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The College may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
 - 2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.
 - 2.3 **Discipline Specific Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Discipline Specific Elective. A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Discipline Specific Elective.

Department Overview

With the new era of education under CBCS system of UGC the department aims to develop a curriculum for **Parishkar** in such a way that the students have a complete holistic development of their character and values. Many qualified minds worked together to provide “a cut above” to the ever growing demands of the industry and to prepare students for higher studies and research devoted to society. The interactive method of teaching at **Parishkar College of Global Excellence** is to bring about attitudinal changes to future professionals of the industry with an edge of creativity.

The Department of Zoology was established in Parishkar 2014 onwards. The department imparts equal importance to practical, theoretical and co-curricular activities apart from experiential and digital modes of learning. Projects and Industrial projects form are an integral part of the curriculum. Along with the syllabus, **Parishkar College of Global Excellence** emphasizes on Value Addition Programs and a complete Holistic development of students through open elective programmes and Placement Training Programs, training students in group discussions, facing interviews and so on.

Program Outcomes

On successful completions of the M.Sc. Programme students will be able to

- Understand and apply the fundamental principles, concepts and methods in key areas of science and multidisciplinary fields
- Demonstrate problem solving, analytical and logical skills to provide solutions for the scientific requirements.
- Develop the critical thinking with scientific temper.
- Communicate the subject effectively.
- Understand the importance and judicious use of technology for the sustainable growth of mankind in synergy with nature.
- Understand the professional, ethical and social responsibilities.
- Enhance the research culture and uphold the scientific integrity and objectivity.
- Engage in continuous reflective learning in the context of technological and scientific advancements.
- Express proficiency in oral and written communications to appreciate innovation in research.

Duration of the Course

The duration of Masters of Science in Zoology shall be of two academic years. Each year shall be divided in two semesters i.e. semester-1, semester-2. Accordingly, the two years shall consist of four semesters. However, a student is required to pass out the said course within a maximum period of 4 years from the date of admission to 1st semester where after he/she shall stand unfit for the course.

Types and Nomenclature of Courses in Zoology for MSc

Core Courses

1. Systematics and Taxonomy
2. Structure and Functions of Invertebrates
3. Cell and Molecular Biology
4. Physiology and Biochemistry
5. Structure and Functions of Chordates
6. Modern Genetics
7. Developmental Biology
8. Evolutionary Biology

Discipline Elective Courses

1. Introduction to ~~Microbiology~~ Microbiology
2. Research Methodology
3. Food Microbiology
4. Food, Nutrition and Health

Discipline Specific Elective Courses (Special Course)

- | | |
|---------------------------|----------------------|
| Set A | Set B |
| 1. Environment Science I | 1. Cancer Biology I |
| 2. Environment Science II | 2. Cancer Biology II |

Course Description

The student will have to study twelve core courses, four Discipline Specific Elective courses for successful completion of the MSc degree Program.

Course Assessments

1. Assessments will be in form of written exams, Assignments and lab work.
2. Examinations in one semester will be one midterm and one final.
3. Assignments will be judged upon the timely submission and contents.
4. Lab work will be assessed as routine lab work, lab assignment and project.

Grading system

Grades for one semester would depend on routine work of a student. It will be in form of written exams, assignments and projects.

Projects and Assignments will be graded for total 10 marks, with a division of timely submission and content of the assignment.

Midterms, project and assignment grades will be converted into internal marks earned by the students and will reflect in for final markings.

Grading Scheme:

Mid-term Exam

Final Exam

Assignment

Project (including a paper and poster)

To qualify the grade, minimum 50% is required.

Scheme for Masters of Science in Zoology

| SNo | Types of Courses | No. | Credits | Total Credit |
|-----|--|--------|-----------|--------------|
| 1 | Core Course | 12 | 6x12 = 72 | 72 |
| 2 | Discipline Elective Course | 2 | 6x2 = 12 | 12 |
| 3 | Discipline Specific Elective Course (Special Paper) | 2 | 6x2= 12 | 12 |
| 4 | Computer Skill And Seminar | 1 | 4x1 =4 | 4 |
| 5 | Summer Internship | 1 | 4x1=4 | 4 |
| 6 | Project+ Social Welfare Program (SWP) OR Dissertation | 1 | 8 | 8 |
| 7 | Research Paper Writing + Synopsis Writing | 1 | 8x1=8 | 8 |
| | In All | | | 120 |
| | Semester 1 | | Credits | |
| 1 | Core Course | 4 | 4x4=16 | 16 |
| 2 | Discipline Elective Course I | 1 | 4 | 4 |
| 3 | Computer Skill and Seminar | 1 | 4 | 4 |
| 4 | Practical 1 | 4 Core | 4x2=8 | 8 |
| 5 | Practical 2 | 1 DEC | 1x2=2 | 2 |
| | In All | | | 34 |
| | Semester 2 | | Credits | |
| 1 | Core Course | 4 | 4x4=16 | 16 |
| 2 | Discipline Elective Course II | 1 | 4 | 4 |
| 3 | Summer Internship | 1 | 4 | 4 |
| 4 | Practical 1 | 4 Core | 4x2=8 | 8 |
| 5 | Practical 2 | 1 DEC | 1x2=2 | 2 |
| | In All | | | 34 |

| Semester 3 | | | Credits | |
|-------------------|---|--------------------|---------|-------|
| 1 | Core Course | 3 | 3x4=12 | 12 |
| 2 | Discipline Specific Elective Course I (DSE)(Special Paper) | 1 | 4 | 4 |
| 3 | Synopsis Writing | 1 | 4 | 4 |
| 4 | Research Paper Writing | 1 | 4 | 4 |
| 4 | Practical 1 | 3x2 Core Practical | 6 | 6 |
| 5 | Practical 2 | 1x2 DSE Practical | 2 | 2 |
| | In All | | | 32 |
| | | | | |
| | | | | |
| Semester 4 | | | Credits | Total |
| 1 | Core Course | 1 | 1x4=4 | 4 |
| 2 | Discipline Specific Elective Course II (DSE)(Special Paper) | 1 | 1x4=4 | 4 |
| 3 | Practical 1 | 1 | 4 | 4 |
| 4 | Project+ Social Welfare Program (SWP) OR Dissertation | 1 | 8 | 8 |
| | | | | |
| | In All | | | |
| | | | | 20 |
| | | | | |
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| SEMESTER I | | | | | |
|-------------------------------|--|---------------------|---------------|------------------|----------------|
| Paper/ course code | Nomenclature of paper/course | Courses type | Theory | Practical | Credits |
| 1 | Systematics and Taxonomy | CC | 4 | 0 | 4 |
| 2 | Structure and functions of Invertebrates | CC | 4 | 0 | 4 |
| 3 | Cell and Molecular Biology | CC | 4 | 0 | 4 |
| 4 | Physiology and Biochemistry | CC | 4 | 0 | 4 |
| 5 | Introduction to Microbiology/ Research Methodology | DEC I | 4 | 0 | 4 |
| 6 | Practical- I (combined for 1,2 & 3 courses) | CC | 0 | 6 | 6 |
| 7 | Practical- II (combined for 4 & 5 courses) | CC | 0 | 4 | 4 |
| 8 | Computer Skills and Seminar | GEC | 0 | 2 | 4 |
| | Total | | | | 34 |
| SEMESTER II | | | | | |
| Paper/ course code | Nomenclature of paper/course | Courses type | Theory | Practical | Credits |
| 8 | Structure and Functions of chordates | CC | 4 | 0 | 4 |
| 9 | Modern Genetics | CC | 4 | 0 | 4 |
| 10 | Developmental Biology | CC | 4 | 0 | 4 |
| 11 | Evolutionary Biology | CC | 4 | 0 | 4 |
| 12 | Food Microbiology/ Food, Nutrition & Health | DEC II | 4 | 0 | 4 |
| 13 | Practical- I (combined for 8,9 & 10 courses) | CC | 0 | 6 | 6 |
| 14 | Practical- II (combined for 11 & 12 courses) | CC | 0 | 4 | 4 |
| 15 | Summer Internship | GEC | 0 | 4 | 4 |
| | Total | | | | 34 |

| SEMESTER III | | | | | |
|-------------------------------|---|---------------------|---------------|------------------|----------------|
| Paper/ course code | Nomenclature of paper/course | Courses type | Theory | Practical | Credits |
| 1 | Principles of Ecology | CC | 4 | 0 | 4 |
| 2 | Immunology & Endocrinology | CC | 4 | 0 | 4 |
| 3 | Applied Zoology | CC | 4 | 0 | 4 |
| 4 | Computational Biology, Bioinformatics & Biostatistics | CC | 4 | 0 | 4 |
| 5 | Discipline Specific Elective Special paper I | DSE | 4 | 0 | 4 |
| 6 | Practical- I (combined for 1,2 & 3 courses) | CC | 0 | 6 | 6 |
| 7 | Practical- II (combined for 4 & 5 courses) | CC | 0 | 4 | 4 |
| 8 | Project Writing and Scientific Paper writing | GEC | 0 | 4 | 4 |
| | Total | | | | 34 |
| SEMESTER IV | | | | | |
| Paper/ course code | Nomenclature of paper/course | Courses type | Theory | Practical | Credits |
| 1 | Ethology | CC | 4 | 0 | 4 |
| 2 | Discipline Specific Elective Special paper II | CC | 4 | 0 | 4 |
| 3 | Practical- I (combined for 8,9 & 10 courses) | CC | 0 | 6 | 4 |
| 4.a | Social Welfare Program + Project Working | 1 | 2x4=8 | 8 | 8 |
| 4.b | Dissertation | 1 | 8 | 8 | 8 |
| | In All | | | | 20 |

SEMESTER - I

CORE COURSE-I

Systematics and Taxonomy

Course Objective-

- Zoology is the study of all animal life.
- It provides students with the knowledge and skill base that would enable them to undertake further studies in Zoology and related 12 areas or in multidisciplinary areas that involve advanced or modern biology and help develop a range of Discipline Specific Elective skills that are relevant to wage employment, self-employment and entrepreneurship.
- Having Zoology as backbone of the curriculum, this course, with the department centric electives will enhance the skills required to perform research in laboratory and experimental research.
- There is a need for the students to compete with the globe, therefore, the main focus of this curriculum is to enable the student to be professionally competent and successful in a career.

Learning Outcomes: At the end of the course, students will be able to...

- Demonstrate in-depth knowledge and understanding about the fundamental concepts,
- Principles and processes underlying the academic field of Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture).
- Study concepts, principles and theories related with animal behavior and welfare.
- Understand and interpret data to reach a conclusion.

Unit – I

16 Hours

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

Principle and Method of Taxonomy and Biosystematics

1. Define taxonomy and biosystematics
2. Origin and maintenance of Biodiversity in Biosystematics
3. History, Scope and application of Biosystematics
4. Concept of species and hierarchical taxa
5. Biological nomenclature

Unit – II

15 Hours

6. Modern Taxonomy
 - Behavioral Taxonomy
 - Chemo Taxonomy
 - Cytotaxonomy
 - Molecular Taxonomy
 - Neo Taxonomy
 - Numerical Taxonomy

Unit – III

14 Hours

7. Taxonomic collection preservation and Identification
8. Taxonomic keys
9. Systematic publication
10. Different kinds of publication

Unit – IV

15 Hours

11. Five kingdom concept.
12. Economic importance of protozoa, bacteria, virus
13. Evolutionary relationships among taxa
14. Unicellular and multicellular organisms
15. Level of grade of organization in protozoa to human
16. Adaptive radiation

Essential Readings

- Kohli KS, Sahni Kavita, Jain, (2016), Animal Diversity and Evolution, RBD Publishing House.
- Kotpal RL, (2017) Modern Text Book of Zoology Invertebrates: Animal Diversity I Rastogi Publications, ISBN: 9789350780404

Suggested Readings

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

CORE COURSE- II

Structure and Function of Invertebrates

Course Objective:

- Having Zoology as backbone of the curriculum, this course, with the department centric electives will enhance the skills required to perform research in laboratory and experimental research.
- It provides students with the knowledge and skill base that would enable them to undertake further studies in Zoology.
- The students can choose to focus on a “whole animal” or a “bits of animals” approach.

Learning outcomes: At the end of the course, students will be able to...

- Skills related to specialization areas within Zoology as well as within subfields of Zoology, including broader interdisciplinary subfields (Chemistry, Physics and Mathematics).
- Understand scientific principles underlying animal health, management and welfare.
- Assess problems and identify constraints in management of livestock.
- Understand fundamental aspects of animal science relating to management of animal

Syllabus

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

Unit – I

14 Hours

1. Origin of Protozoa, Parazoa and Metazoan
2. Origin and evolution of coelom. Importance and advantages of Coelom in animals
3. Origin and types of Metamerism
4. Origin of Radiate and Bilateria

Unit – II

15 Hours

5. Locomotory organ and mechanism of locomotion in invertebrates
6. Feeding and Digestion in Invertebrates
7. Excretory and Osmoregulatory organs and their mechanism in Invertebrate

Unit – III

15 Hours

8. Respiration in Invertebrates
9. Nervous system in Invertebrates: (i) Primitive nervous system- Coelentrata, Echinodermata
(ii) Advance nervous system- Annelida, Crustacea, Insecta, Mollusca
10. Reproduction in Invertebrates
Arthropoda as biggest phylum, Pearl culture and identification of pearls

- Minor phyla – Onychophora, Phoronida, Rotifera, Mesozoa, Hemichordata
- Larval forms and their significance, free living, marine, fresh water larval form, (cnidarian, larva of Platyhelminthes, Annelida), Crustacean larva, Mollusca and insect larval form, parasitic larval form

Essential Readings

- Jordan & Verma (2021) Invertebrate Zoology, S Chand and Company Pvt Ltd. ISBN: 9788121903677
- Kohgli KS. Trigunayat, Mohan Madan, Sahni Kavita, (2017) Invertebrate: Structure and functions RBD Publishing House, ISBN: 9788181422248

Suggested Readings

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

CORE COURSE-III

Cell & Molecular Biology

Course Objective

- To Study the Structural and Functional Aspects of Cell Organelles as well as Mechanism of Gene Regulation and Compression.
- To emphasize that Cell is the Structural and Functional Unit of the Living System.

Learning Outcomes: At the end of the course, students will be able to

- Know about the Physical and Chemical Organization of Living Organism.
- Learn and Describe the Molecular Mechanism of Gene Expression and Control of Transcription.
- Know about the how Cells are Grow, Divide and Die.
- Emphasize the Molecular Mechanism of DNA Replication, Repair Protein Synthesis.

Unit-I

14 Hours

1. Membrane Structure and Function

- Structure of Model Membrane
- Lipid Bilayer and Membrane Protein Diffusion
- Osmosis
- Ion Channels
- Active Transport
- Membrane pumps
- Mechanism of Sorting and Regulation of Intracellular Transport
- Electrical Properties of Membranes.

2. Organization of Genes

- Operon
- Unique and Repetitive DNA
- Interrupted Genes
- Gene Families

3. Cell Division and cell Cycle

- Mitosis and Meiosis
- Their Regulation
- Steps in cell Cycle
- Regulation and Control of cell Cycle.

Unit-II

15 Hours

4. Cell Signaling

- Hormones and Their Receptors
- Cell Surface Receptor
- Signaling Through G-Protein Coupled Receptors
- Signal Transduction Pathways
- Second Component Systems
- Light Signaling in Plants
- Bacterial Chemotaxis and Quorum Sensing.

5. Cellular Communication

- Regulation of Hematopoiesis
- General Principles of cell Communication
- Cell Adhesion and Roles of Different Adhesion Molecules
- Gap Junctions
- Extracellular Matrix
- Integrins
- Neurotransmission and its Regulation.

6. Cancer

- Genetic Rearrangements in Progenitor Cells
- Cancer and the Cell Cycle
- Metastasis
- Interaction of Cancer Cells with Normal Cells
- Apoptosis

Unit-III

16 Hours

7. DNA Replication, Repair and Recombination

- Unit of Replication
- Enzymes Involved
- Replication Origin and Replication Fork
- Fidelity of Replication
- Extrachromosomal Replication
- DNA damage and Repair Mechanisms
- Homologous and Site-Specific Recombination.
- How quickly has human DNA changed during evolution.
- DNA of Alzheimer and Parkinsons Diseases.
- Study oh the DNA of Corona virus.

8. RNA synthesis and Processing

- Transcription Factors and Machinery
- Formation of Initiation Complex
- Transcription activator and Repressor
- RNA Polymerases
- Capping and Termination
- RNA Processing
- RNA Editing
- Splicing
- And Polyadenylation
- Structure and Function of Different Types of RNA
- RNA Transport.

Unit-IV

15 Hours

Protein Synthesis and Processing

- Ribosome
- Formation of Initiation Complex
- Initiation Factors and Their Regulation and Elongation Factors
- Termination
- Genetic Code
- Aminoacylation of tRNA-Identity
- Aminoacyl tRNA Synthetase
- Translational Proof-Reading
- Translational Inhibitors
- Post-Translational Modification of Proteins.

9. Control of Gene Expression at Transcription and Translation Level

- Regulating the Expression of Phages
- Prokaryotic and Eukaryotic Genes
- Role of Chromatin in Gene Expression and Gene Silencing.

Essential Readings

- Powar CB, (2016), Cell Biology Himalaya Publishing House Pvt Ltd, ISBN: 9789350246696.
- Verma PS, Agarwal (2016) Molecular Biology S Chand and Company Pvt Ltd , 2016, ISBN: 9788121931915
- Gupta PK (2020) Molecular Biology Rastogi Publications, ISBN: 9789350781210

Suggested Readings

- Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

- Becker, W.M.; Kleinsmith, L.J.; Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.
- P.K. Gupta, (2020) Molecular Biology, Rastogi Publications

CORE COURSE- IV

Physiology & Biochemistry

Course Objectives-

- The primary objective of the Physiology course is to ensure that students understand how the vital functions performed in body.
- Students will be able to relate the functions and the anatomy and histology of each organ system.
- Demonstrate knowledge and understanding of the principles that govern the structure of macromolecules.

Learning Outcomes: *At the end of the course, students will be able to...*

- Student understand the principle of various fields of Biochemistry.
- Able to explain concept of biochemistry.
- Students will able to define the main molecular structures composing human body.
- Able to explain the basic knowledge of human anatomy and physiology.

SECTION A- Physiology

UNIT- 1

16 Hours

Research paper will be discussed and analyzed

Unit- 1

1. Digestive system
 - Digestion, absorption of macronutrients.
 - Energy balance, BMR
2. Circulatory System
 - Blood and its components, Haemoglobin
 - Blood volume, blood volume regulation,
 - Blood groups, ImmUnity, Haemostasis
 - Anatomy of heart structure
 - Myogenic heart, ECG- its principle and significance
 - Cardiac cycle, blood pressure
3. **Respiratory system**
 - Pulmonary ventilation, anatomical consideration

- Transport of gases, Exchange of gases
- Neural and chemical regulation of respiration
- Hypoxia, Anoxia and Oxygen therapy

Unit-2

14 Hours

4. Excretory system
 - Types of kidneys
 - Physiology of excretion
 - Urine formation and regulation
 - Acid-base balance, electrolyte balance, water balance and Homeostasis
 - Renal function test, effect of Renal Disease (Diabetes Insipidus, Dialysis)
5. Endocrinology
 - Endocrine glands in vertebrate, hormones and related disease
 - Basic mechanism of hormone action

Section – B Biochemistry

Unit- 3

14 Hours

6. Protein structure
 - Primary structure, peptide bond
 - Secondary structure
 - α - helix, β - pleated sheet and bends
 - Ramachandran plot
 - Tertiary structure
 - Forces stabilizing tertiary structure
 - Domains and motifs
 - Quaternary structure
7. Lipids (RU)
 - Fatty acids : Structures, phospholipids, sphingolipids, glycolipids, lipoproteins
 - Function of lipids

Unit – 4

14 Hours

8. Enzymes
 - Enzyme as biocatalyst, principle of enzyme catalysis, proteases and polymerases
 - Mechanism of action
 - Active site, substrate binding
 - Concept of regulation of enzyme activity
 - Co-enzymes and Co- factors, isozymes
9. Metabolism
 - Concept of Metabolic pathways
 - Energy transduction : glucose and fatty- acids as energy source

Essential Readings

- Bhatia AL, Kohli KS (2015), Animal physiology and biochemistry, RBD Publishing House, ISBN: 9788181422453
- Agarwal, R A, Srivastava Anil K and Kumar, Kaushal, (2017) Animal Physiology And Biochemistry, S Chand and Company Pvt Ltd , 2016, ISBN: 9788121904476

Suggested Readings

- R. Eckert (2017) Animal Physiology mechanisms and adaption, 5th edition, W.H. freeman and company, New York.
- W.S. Hoar , General and Comparative Animal physiology. Prentice Hall of India.
- K.S. Schiemdt Neilsen, (2017) Animal physiology: Adaptation and Environment, University press, Cambridge, UK.
- R.H. Frey, P.A. and Jencks, W.P. Jones,(1992) Biochemistry, Albert's, and Bartlett Publisher, Boston/London.

Discipline Elective Course- I

Introduction to Microbiology

Course objective:

- To impart knowledge of the basic principles of bacteriology,
- To understand the difference of virus
- To investigate all about Fungus
- To grab pathogenic microorganisms, pathogenesis, laboratory diagnosis, transmission, prevention and control of diseases.

Course outcomes: *At the end of the course, students will be able to...*

- Students will have basic knowledge about microbiology and its diversity.
- Students will know about nutritional and maintenance aspects of bacterial culture.
- Conclusive knowledge about bacterial genetics and its physiology.
- Getting in depth with industrial microbiology and knowing various aspects of environmental biology.

Unit 1

14 Hours

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

1. History and Development of various fields of Microbiology in 20th century; The spontaneous generation vs Biogenesis of microorganisms;
2. Microbes - causative agents of disease; Microbes- fermentation and putrefaction; Medical importance of microbes.
 - Preparation of microbiological media;
 - Physical and chemical methods of sterilization.
3. Microscopy - Light and Electron Microscopes.

Unit 2**15 Hours**

4. Microbial classification - Haeckel's classification- lower and higher Protista;
5. Woese's three kingdom classification systems – Archaea, Eubacteria, Eukarya;
6. Organization of archaea, bacteria and eukaryotic cell;
7. Different types of acellular microorganisms-Viruses, viroid's and prions. Viral disease (Corona, AIDS, Hepatitis)

Unit 3**14 Hours**

8. General features and classification of Bacteria, Algae, Fungi and Protozoa;
9. Bacterial growth and metabolism; Photosynthetic bacteria;
10. Photoheterotrophs; Chemolithotrophs and Chemoheterotrophs;
11. Microbes in Extreme Environment – Characteristic features of the thermophilic, methanogenic and halophilic archaea; Microbes in other extreme conditions – Deep Ocean, arctic and Antarctic region and space.

Unit 4**17 Hours**

12. Scope of Microbiology - Cycle of matter in nature; Microbial interactions – Symbiosis and parasitism;
13. Biodegradation and Bioremediation; Biofilms;
14. Microbes in composting; Biofertilizers and Biopesticides;
15. Microbes and Industry - SCP, microbial enzymes and fermented foods.
16. Human diseases and their causative agents; Vaccines and antibiotics;
17. Phytopathogenic bacteria.

Essential readings

- Bhatia AL, Jain Narendra (2017), Immunology microbiology and biotechnology RBD Publishing House, ISBN: 9788181421012
- Pelczar, Michael J, CHAN, E C S and KRIEG, Noel R (2016) Microbiology, McGraw Hill Education (India) Private Limited, ISBN: 9780074623206

Suggested readings:

- Brock TD (1961). Milestones in Microbiology, Infinity Books.
- Madigan MT, Martinko JM, Parker J (2015). Brock Biology of Microorganisms, 14th edition, Pearson Education Ltd, Prentice-Hall, Englewood Cliffs, NJ, Inc USA.
- Pelczar MJ, Chan ECS, Kreig NR (1993). Microbiology: Concepts and Application, 5th edition, Tata McGraw Hill, New Delhi.
- Stainier RY, Ingraham JL, Wheelis ML, Painter PR (1976). General Microbiology, 4th edition, MacMillan, New Jersey, USA.

DISCIPLINE ELECTIVE COURSE- II

RESEARCH METHODOLOGY

Course Objectives

- The course provides an insight into research Process
- Identifying problem and deducing into a problem statement
- What could be the best method to solve the problem
- The method of resolving
- Applying right analysis methodology

Learning Outcomes

After successfully completing this course the student will be able to

- Develop complete research
- Develop understanding about the problem statement
- Devise strategy to manage the parameters and data analyzing
- Undertake measures or start experiment for writing a paper or thesis.
- Mentioning and managing references correctly.

Unit 1

12 Hours

1. Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.
2. Research Methodology – Presentation of data, Types and Characteristics of good tables. Diagrams, Graphs, Various statistical Methods, Limitations of the statistical methods.

Unit 2

16 Hours

Types of Research:

1. On the basis of nature of information:
 - Qualitative Research
 - Quantitative Research
2. On the basis of utility of content or nature of subject matter of research:
 - Basic/ Fundamental /pure or Theoretical Research: Its utility is universal.
 - Experimental or Applied Research: Its utility is limited.

Unit 3

16 Hours

Types of Research:

3. On the basis of approach of research: (i) Longitudinal Research: (ii) Cross-Sectional Research
4. On the basis of method of research (i) Philosophical Research: (ii) Historical Research: It is both qualitative as well as quantitative in nature and deals with past events.
5. Survey Research: discretionary, correlational and exploratory types of research.
6. Experimental Research
7. Case-Study Research

Unit 4

16 Hours

Difference between research Journal and science magazine, qualities of good Journal, National and International Journal in Zoology. Importance of journal in Zoology, Importance of patent in research, Process of getting patent rights.

Practical

- Review and analysis of one research published already paper.
- Conducting a Survey and complying it into research paper.

Suggested Readings: -

- Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
- Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
- Research Methodology – C.R.Kothari
- Select references from the Internet
- Definition, concept and research in science and forensic science.

Practical Course 1

Practical of the following or any related to the theory courses. Dissection can be explained through virtual labs. Virtual labs can be treated as good as lab performed.

1. How to work in Lab.
 2. How to investigate in Zoology? Process
 3. How to write scientific findings?
 4. Use of Microscope.
 5. Identification, classification and study of animal from major invertebrate group (Protozoa- Hemichordata) including minor phyla using museum specimens.
 6. Problem based on Shannon Weiner index, dominance index, estimation of population density of given sample by mark recognition recapture method.
 7. Determination of population density by quadrat method.
 8. Museum specimen- identification, classification and distinguishing feature of important representatives from various groups -(Protozoa- Hemichordata)
 9. Study of permanent preparation – Obelia, Cercaria, Daphnia, Cyclops, Zoea, Megalopa, Mysis
 10. Mouth part and Salivary gland of Cockroach.
 11. Anatomy: Leech- Alimentary canal, Nephridia, Reproductive system, Crab- Nervous system, Cockroach- Nervous, Reproductive system, Sepia and Unio- Nervous system
- Anatomy: Study of systems of the prescribed types with the help of dissection.
 - With reference to microscopic slides in case of non- availability, the exercise should be substituted with diagram\photographs.
 - It should be ensure that animals used in the practical exercise are not covered under the wild life act 1972 and amendments made subsequently.

Practical Course 2

Practical 2 All practical of the following or any related to the theory courses. Dissection can be explained through virtual labs. . Virtual labs can be treated as good as lab performed.

1. How to work in Lab.
2. How to investigate virtual Labs? Process
3. How to write scientific findings?
4. Uses of instruments in lab.
5. Photometric determination of haemoglobin in blood sample.
6. Determination of MCV, MCH, MCHC and colour index of the given sample of blood.
7. Demonstration of the blood clotting time and erythrocyte sedimentation rate.
8. Determination of urea in blood.
9. Determination of the glucose in blood.
10. Demonstration of location of endocrine glands in rat through virtual videos.
11. Squash and smear preparation of testis of Cockroach and Grasshoper using stains .
12. Study of Mitosis in onion Root Tip.
13. Study of Giant Chromosome in Salivary Gland of Chironomous of Drosophila Larva.
14. Paper Chromatography: unidimensional chromatography, using amino acid From purified samples and biological materials (Ascending and Descending)
15. Electrophoresis: Paper/Horizontal/Vertical-Protein/DNA/RNA.
16. Study of Prepared Microscope Slides, including Those Showing various cell types,mitosis,meiosis and giant chromosomes.
17. Determination of pH of different solutions
18. Microbiology Good Laboratory Practices and Biosafety.
19. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
20. Preparation of culture media for bacterial cultivation.
21. Sterilization of medium using Autoclave and assessment for sterility
22. Sterilization of glassware using Hot Air Oven and assessment for sterility
23. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
24. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
25. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts
26. Study of Spirogyra and Chlamydomonas, Volvox using temporary Mounts
27. Study of the following protozoans using permanent mounts/photographs: Amoeba, Entamoeba, Paramecium and Plasmodium
28. Quantities estimation of the following in various tissues-
 - Proteins: Total protein
 - Lipids: total Lipid & Cholesterol
 - Enzymes: Acid and Alkaline phosphatase
 - Determination of serum protein through paper/ PAGE electrophoresis.

Semester- II

CORE COURSE- V

Structure and Function of Chordates

Course Objective

- To understand the animal, Kingdom.
- To understand the Origin and Evolutionary Relationship of Different Phylum from Pisces to Mammals.
- To Understand the Taxonomic Position of Pisces to Mammie.
- To Understand the Basic Classification, Concepts of Biodiversity and a Descriptive Account of the Classes Under Chordata.

Learning Outcomes: *At the end of the course, students will be able to..*

- Know the Presence of Parental care among Lowes Animals.
- Know about Various Birds and The Mechanism of Fight.
- Appreciate and apply in real life.
- The Course Gives an Overall Idea an Classification of Chordates. and Highlights the Differences Between Different Classes of Chordates.
- It Also helps in the Identification of Poisonous and Non-Poisonous Snakes and Migration in Bird and Fishes.

Unit-I

Hours-15

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

1. Proto Chordata to Cyclostome.

- Origin and General Characters of Vertebrates.
- Key Difference Between Pro chordates and Vertebrates, Evolutionary Perspective and Phylogenetic Relationship
- General Characters of Hemi Chordata Urochordata and Cephalo Chordata Characters & Activities.
- Extinct Animals. In relation to conserving recent animals
- Origin and Evolution of the Following Firth, Amphibia, Reptile, Bird, Mammal.
- Adaptive Radiation in Vertebrates Aquatic, Terrestrial, Aerial, Arboreal, Fossorial.

Unit-II

Hours-14

2. Fish

- General Characteristics and Classification Pisces up to Class.
- Origin 2 of Evolution of Lung Fish.
- Migration and Viviparity in Fish and Type of Scales.
- Importance of Fishes and their Biological Significance.
- Importance of Fishes and their Biological Significance.

Unit-III

Hours-15

3. Amphibia and Reptilia

- Parental Care and Pedomorphosis.
- Identification of Poisonous Snakes, Poison Apparatus, Biting Mechanism and Snake venom.
- Poisonous and Non-Poisonous Snake.
- **Venom of snakes and other organism, their application in medicine.**
- Venom of snakes.

Unit-IV

Hours-16

4. Aves and Mammalia

- Origin of Birds, Flight Adaptations and Migration in Birds Flightless Birds.
- Aquatic mammals and Dentition in Mammals.
- Evolution of Man: Relationship of man with Other Primates, Fossil Record Mans Ancestry.
- Primitive Mammals (Proto Theria and Meta Theria) Projecting new advances of human
- Skull in Reptiles, Venom Ophidians.
- Modification of Beak, feet, and Palate in Birds.

Essential readings

- Sharma Asha(2017) Vertebrates : Structure and functions, RBD Publishing House , ISBN: 9788181421371
- Kotpal, R L(2017) Modern Text book of Zoology Vertebrates : Animal Diversity - II , Rastogi Publications, ISBN: 9789350780954

Suggested reading

- DeVeer ,S.G: Embryos and Ancestors, Claredon Press,Oxford. Messers H.Man I
- Kingsley,JS: outline of Comparative Anatomy of vertebrates central book Depot, Allahabad.
- Alexander,Rm: The chordate, Cambridge uni. Press London.

CORE COURSE- VI

MODERN GENETICS

Course Objectives:

- Genetics is offered as a core course that provides fundamental knowledge of how organisms, populations and species maintain their characters.
- The concept of Gene will be unfolded with all details.
- Methods of mapping to detect the similarities and anomalies will be worked.
- The work process and expression of genes will be explicated.
- Application of genetics in the interest of human race will be explained.

Course Learning outcomes: *At the end of the course, students will be able to...*

- It would be clear organisms, populations and species maintain their characters.
 - The concept of Gene will be unfolded with all details.
 - Methods of mapping to detect the similarities and anomalies will be worked.
 - The work process and expression of genes will be explicated.
 - Application of genetics in the interest of human race will be explained.
- Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.**

Unit 1

15 Hours

1. Mendel's laws and their chromosomal basis; extension of Mendel's principles:
2. Allelic variation and gene function-
 - Incomplete dominance and co-dominance,
 - Allelic series,
 - Testing gene mutations for allelism;
3. Gene action- from genotype to phenotype–
 - Penetrance and expressivity,
 - Gene interaction, epistasis, pleiotropic.
4. Evolution of the concept of gene.
5. Fine structure of Gene.
6. Methods of gene mapping:
 - 3- point test cross in Drosophila,
 - Gene mutation, types of gene mutations,
 - methods for detection of induced mutations;
 - P- Element insertion mutagenesis in Drosophila.
 - Superman genetics.
 - Are alcohol and drug addiction genetically transmitted?

Unit 2

16 Hours

Regulation of Gene Expression:

- Regulation of gene activity in lac and trp operons of E. coli.;

- General introduction to gene regulation in eukaryotes at transcriptional and posttranscriptional levels;
 - Chromatin organization and gene expression,
 - Transcription factors, enhancers and silencers, non-coding genes.
 - Chromosome banding, karyotype and nomenclature of metaphase chromosome.
 - Genetics and Diet
7. Mechanisms of sex determination and Dosage Compensation:
 - Human, Drosophila and C. elegans.
 8. Genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, and threshold traits.

Unit 3

15 Hours

9. Oncogenes: DNA repair genes and genomic instability,
10. Epigenetic modifications, telomerase activity, centrosome malfunction.
11. Genetic heterogeneity and clonal evolution.
12. Genetic models for familial cancer: retinoblastoma, colorectal cancer, breast cancer.
13. Tumor progression: angiogenesis, metastasis SS
14. Tumor-specific chromosome rearrangements, tumor specific markers.

Unit 4

14 Hours

15. Genetic Engineering And Applied Genetics - Restrictive enzymes - Recombinant DNA techniques.
16. Applications of Recombinant DNA technology.
17. Applied Genetics - Application of genetics in animal breeding.
18. Application of genetics in Crime and Law - DNA fingerprinting, Genetic basis of intelligence. Studies on Twins.

Essential readings

- Gupta P K,(2021) Cytology Genetics and Evolution, Rastogi Publications, 2021 ISBN: 9789350781364
- Gupta, P K, (2015) Genetics, Rastogi Publications.
- Ahmad, Waseem Faridi(2013) Genetics And Genomics ,Dorling Kindersle Pvt. Ltd ,

Suggested Readings:

- Snustad and Simmons (2015) Modern Genetic Analysis: Integrating Genes and Genomes, Griffiths, J.F., Gilbert, M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA [Latest edition] .
- J. Russell, Genetics, Benjamin-Cummings Publishing Company, San Francisco, California, USA [Latest edition]

CORE COURSE - VII

Developmental Biology

Course Objectives-

- To provide a comprehensive understanding of the concepts of early animal development.
- To list the types of characteristics that make a organism.
- Able to observe and identify morphological changes in developing embryo.
- Understand the development from unicellular to multicellular organism.

Learning Outcomes-

- Student have knowledge of normal development processes of animals.
- Able to describe the morphological processes that transform a fertilized egg into a multicellular organism.
- Student understand the molecular, genetics and cellular aspects of building organism.
- Identify model organisms used to investigate developmental biology.

UNIT- 1

14 Hours

- 1. Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.**
2. Scope and application of Developmental Biology.
- 3. Patterns of Reproduction**
 - Asexual, sexual breeding Cycles in Vertebrates
 - Compare reproductive system of Tetrapod
 - Types of Reproductive Cycles in Mammals.
- 4. Gametogenesis**
 - Production of Sperms, Structure, biochemistry and types of sperms
 - Production of Ovum, Vitello-genesis
 - Reproductive health

UNIT- 2

15 Hours

- 1. Fertilization**
 - Cell Surface molecules in sperm-egg recognition in animals, acrosomal reaction.
 - Prevention of Polyspermy
 - Activation of egg metabolism
- 2. Early development**
 - Characteristic and mechanism of cleavage.
 - Formation of Blastula in amphibians
 - Gastrulation, formation of germ layers in frog, chick and mammals.

UNIT- 3

16 Hours

- 3. Morphogenesis and organogenesis in animals**
 - General concept of potency, commitment, specifications, induction, competence determination.

- **Differentiation and pattern formation.**
 - Axis formation in amphibians.
 - Axis formation in birds and mammals.
- **Organogenesis**
 - Vulva formation in *Caenorhabditis elegans*
 - Neurulation (Formation of neural tubes) in vertebrates
 - Eye lens induction
 - Limb development invertebrates-role of HOX
 - Differentiation of neurons.

UNIT- 4

15 Hours

- 4. Hormonal regulation of metamorphosis in amphibians**
- 5. Sex determination**
- 6. Regeneration of salamander limb.**
- 7. Teratogenesis**
 - Various teratogens and their effects – Radiations, Chemicals, Pathogens, Environmental factors.
 - Teratogenic effect in Pregnancy

Essential readings

- Sharma, Asha (2015), Developmental Biology, RBD Publishing House
ISBN: 9788181421067
- Sastry K V, Shukla, Vineeta , (2017) Developmental Biology, Ed. . Meerut :
Rastogi Publications, ISBN: 9788171339006

Suggested Readings:

- Alberts et al: Molecular Biology of the Cell (4th ed 2002, Garland)
- Balinsky: An introduction to Embryology (5th ed 1981, Saunders)
- Gilberts: Developmental Biology (8th ed 2006, Sinauers)
- Kalthoff: Analysis of Biological development (1996, McGraw)

CORE COURSE – VIII

Evolutionary Biology

Course Objectives:

- This is a core course that provides fundamental knowledge of how organisms, populations development through the ages.
- The concept of evolution and its theories will be unfolded in details.
- Methods of study to understand evolution will be worked.
- The stages of human evolution will be clear.

Course Learning outcomes: *At the end of the course, students will be able to..*

- It would be clear how organisms, populations and species evolved.
- The concept of evolution will be unfolded with all details.
- Theories and studies will be explicated.
- The stages of how human evolved will be explained.

Unit 1

15 Hours

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

1. An overview of evolutionary biology: concept of organic evolution during
2. Pre- and post- Darwin era;
3. Evolution and molecular biology- a new synthesis; from molecules to life,
4. Life originated from Life, s
5. RNA introns as ancient component of genes.

Unit 2

16 Hours

6. The universal common ancestor and tree of life,
7. Molecular phylogeny: history, terms, definition and limitations,
8. Construction of phylogenetic trees using molecular data,
9. Construction of phylogenetic trees by using 16S rRNA gene.
10. Origin of new genes and proteins.

Unit 3

16 Hours

11. Molecular Evolution: Concepts of neutral evolution,
12. Molecular divergence and molecular clocks;
13. Molecular tools in phylogeny,
14. Classification and identification;
15. Protein and nucleotide sequence analysis;

Unit 4

13 Hours

16. Population genetics and evolution
17. Changes in human genomics after 10 thousand years
18. Genes in populations, The Hardy-Weinberg Equilibrium,

19. Factors that change allele frequencies in populations :
 - Mutations, Migration,
 - Natural selection, Changes in natural after 10 thousand and its effect on human
 - Random genetic draft and
 - Genetic code.
20. Origin and evolution of species,
21. Biological species concept,
22. Anagenesis and cladogenesis,
23. Allopatric, parapatric and sympatric speciation

Essential readings

- Tomar and Singh (2020) Evolutionary Biology, Rastogi Publications, ISBN: 9789350781272

Suggested Readings:

- Gardner, E.J.; Simmon, M.J. and Snustad, D.P. Principles of Genetics, John wiley & Sons, inc. NY Weaver, R.F. and Hedrick, P.W. Genetics. Wm C. Brown Publishers.
- Brown, T.a. Genetics- A Molecular, Approach, Chapman & Hall.
- Mitra, S. Genetics-A Blueprint of life, Tata McGraw Hill
- Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
- Dobzhansky, Th; Ayala, F.J.; Stebbins, G.L. and Valentine, J.M. Evolution, Surjeet Publihsers, Delhi.
- Futuyama, D.J. Evolutinary Biology, Suinuaer Associations. INC Publishers. Dunderand.
- King, M. Species, Evolution –The role of chromosomal change. The Cambridge University Press, Cambridge.
- Merrel, D.J. Evolution and Genetics Holt. Rinchart and Winston, Inc.
- Strikberger, M.W. Evolution Jones and Barlett Publishers. Boston London.

DISCIPLINE ELECTIVE COURSE- III

Food Microbiology

Course Objective:

- In this course the meaning of food microbiology and interaction between microorganism and foods and how food spoilage will be study.
- The pathogenic and non-pathogenic microorganism that found in food and how can they contaminated the foods will be study, in the other hand mycotoxins which is one of the toxin secreted by fungi will be study.
- After knowledge of contamination of foods by microorganism the way for preservation of foods from contamination will be study.

Learning outcomes: At the end of the course, students will be able to...

- Illustrate the role of microorganisms in food safety
- Cultivate and enumerate microorganisms from various food samples
- Compare various physical and chemical methods used in the control of microorganisms
- Explain the factors that affect microbial growth in food

Unit 1

15 Hours

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

1. Food and Microorganisms - Historical developments,
2. Microorganisms important in food - Molds, yeast and bacteria –
3. General characteristics, classification and importance;
4. Factors affecting growth of microorganisms –
5. Nutrient content, inhibitory substances and cell structures.

Unit 2

15 Hours

1. Spoilage of different foods - Microorganisms associated with plants, soil, animals, water and air;
2. Chemical composition of various foods and their spoilage- Vegetables, fruits, cereals, sugar and its products,
3. Milk and its products, meat and meat products, poultry, fish and sea foods.
4. Principles of Food preservation - Types of preservation methods used – Physical, Chemical and Biological.

Unit 3

15 Hours

1. Food fermentation - Production methods of bread, cheese, fermented vegetables and dairy products;
2. Production of vinegar, wine, beer and oriental fermented foods on industrial scale,
3. Microbes as a single cell protein (quorn and pruteen);
4. Production of Mushroom and some indigenous Indian fermented foods.

Unit 4

15 Hours

1. Food borne infections and intoxications - Bacterial and non-bacterial infection - Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia, fungi, viruses, nematodes and
2. Emerging food-borne pathogens;
3. Foodborne outbreaks;
4. Laboratory testing procedures and preventive measures;
5. Food sanitation in manufacture and retail trade.

Essential readings

- Pelzar Michael Chan J ECS, Krieg Noel (2016) Microbiology McGraw Hill Education (India) Private Limited , ISBN: 9780074623206

Suggested Readings:

- Adams MR, Moss MO (2005). Food Microbiology, 2nd edition, Royal Society of Chemistry Publication, Cambridge.
- Frazier WC, Westhoff DC (2007). Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi.
- George J Banwart (1989). Basic Food Microbiology, AVI publication, New Delhi.
- Jay JM (2008). Modern Food Microbiology, 6th edition, Aspen Publishers, Inc, Gaithersburg, Maryland.
- Peppler HJ, Perlman D (1979). Microbial Technology, 2nd edition, Academic Press, USA.
- Ray B (2005). Fundamental Food Microbiology, 3rd edition, CRC Press, New York, USA.

DISCIPLINE ELECTIVE COURSE- IV

Food, Nutrition and Health

Course Objective

- The course covers the basic concepts of balanced diet.
- Balanced diet for people of different ages.
- Consequences of malnutrition and
- The deficiency diseases and
- The diseases caused due to poor hygiene.

Learning outcomes

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

- Understand the role of food and nutrients in health and disease.
- Provide culturally competent nutrition services for diverse individuals.
- Implement strategies for food access, procurement, preparation, and safety that are relevant for the culture, age, literacy level, and socio-economic status of clients and groups.
- Perform food system management and leadership functions that consider sustainability in business, healthcare, community, and institutional arenas.

Unit 1

15 Hours

Research paper will be discussed and analyzed. Question will be formed by students. Any hypothesis will be accepted.

1. Nutrition and dietary nutrients: Basic concept of Food: Components and nutrients.
2. Concept of balanced diet, nutrient requirements and dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.
3. Macro nutrients and micronutrients

Unit 2

15 Hours

4. Nutritional Biochemistry: Macronutrients.
 - Carbohydrates Definition, Classification, their dietary source and role
 - Lipids Definition, Classification, their dietary source and role
 - Proteins- Definition, Classification, their dietary source and role.
5. Micronutrients.
 - Vitamins- Water-soluble
 - Fat-soluble vitamins- their sources and importance.
6. Important minerals viz Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.

Unit 3**15 Hours**

7. Malnutrition and nutrient deficiency diseases
8. Definition and concept of health: Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus), Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives, if any.
9. Life style dependent diseases- hypertension, diabetes mellitus, and obesity their causes and prevention.
10. Social health problems- smoking, alcoholism, narcotics.
11. Acquired Immuno Deficiency Syndrome (AIDS): causes, treatment and prevention.
12. Other ailments viz., cold, cough, and fever, their causes and treatment.

Unit 4**15 Hours**

13. Diseases caused by microorganisms
14. Food hygiene: Potable water- sources and methods of purification at domestic level.
15. Food and Water-borne infections: Bacterial diseases: cholera, dysentery; typhoid fever, viral diseases: Hepatitis, Poliomyelitis etc.,
16. Protozoan diseases: amoebiasis, giardiasis;
17. Parasitic diseases: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention.
20. Causes of food spoilage and its prevention.

Practical

1. Detecting adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric.
2. Estimation of Lactose in milk.
3. Titrimetric method for Ascorbic acid estimation.
4. Estimation of Calcium in foods by titrimetry.
5. Study of the stored grain pests from slides/ photograph (*Sitophilus Oryzae*, *Trogoderma granarium*, *Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.
6. Project- Computer aided diet analysis and nutrition counselling for different age groups.
7. Group discussion or Seminar presentation on one or two related topics from the list.

Essential Readings

- Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; New Age International Publishers
- Srilakshmi, B. (2002). Nutrition Science; New Age International (P) Ltd.

Suggested Reading

- Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
- Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
- Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw, G.M. and Hampl, J.S. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
- Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.
- Manay, M.S. and Shadaksharaswamy, M. (1998). Food-Facts and Principles; New AgeInternational (P) Ltd.

- Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

Semester II

Practical 1

Practical of the following or any related to the theory courses. Dissection can be explained through virtual labs. Virtual labs can be treated as good as lab performed.

- 1. How to investigate in Zoology? Process writing.**
2. How to work in Lab
3. How to write scientific Paper?
- 4. Anatomy**
5. Cranial nerves of *Wallago attu*.
6. Cervical nerves of Rat.
- 7. Study of Museum Specimens/models/Charts/Digital Media**
 - Lower chordates – *Salpa*; asexual and sexual stage, *Doliolum*- oozoid, *Botrylus*, *Hardmania*, *Amphioxus*.
8. **Pisces-** *Petromyzon*, *Myxine*, *Rhinobatus*, *Pristis*, *Trygon*, *Chimera*, *Polydon*, *Acipenser*, *Amia*, *Lepidosteus*, *Protopaterus*, *Lepidoserena*, *Neoceratodus*, *Notopterus*, *Exocoetus*, *Echineis*, *Diodon*, *Tetradon*, *Lophis*, *Hippocampus* *Anguilla*, *Labeo*, *Ophiocephalus*.
9. **Amphibia-** *Ichthyophis*, *Necturus*, *Proteus*, *Ambystoma*, *Axolotl*, *Salamander*, *Siren*, *Alytus*, *Pipa*, *Bufo*, *Hyla*, *Rhacophorus*, *Rana*.
10. **Reptilia-** *Testudo*, *Chaelone*, *Sphenodon*, *Calotes*, *Hemidactyles*, *Phrynosoma*, *Draco*, *Varanus*, *Chameleon*, *Cobra*, *Hydrophis*, *Rattle Snake*, *Viper*, *Krait*, *Eryx*, *Gavialis*.
11. **Aves-** *Tailor Bird*, *Indian Koel*, *Jungle Fowl*, *Peacock*, *Columba*, *Parrot*, *Woodpecker*, *Owl*, *Flamingo*, *Great Indian Bustard*.
12. **Mammals-** *Ornithorynchus*, *Echidna*, *Macropus*, *Hedgehog*, *Manis*, *Loris*, *Bat*, *Mongoose*, *Hystrix*, *Otter*.
- 13. Study Of Microscopic Slides-**
14. **Lower Chordates-** *Hardmania* Spicules, Tadpole Larva, *Amphioxus*-T.S. Passing Through Oral Hood, Pharynx, Testes, Ovary, Intestine, Caudal Region. *Ammocoete* Larva Larva.
15. **Pisces-** Placoid Scales, Cycloid Scales Ctenoid Scales.
16. **Amphibia** –V.S. of Skin of Frog, T.S. Passing Through Stomach, Duodenum, Intestine, Liver, Pancreas, Lungs, Kidney, Testis, Ovary, Spinal Cord, Bone.
17. **Reptilia-** V.S of Skin of Lizard.
18. **Aves-** V.S. Skin of Birds Contour Feather, Down Feather.
19. **Mammals-** V.S. of Skin of Mammals, T.S of Stomach, Intestine, Liver, Pancreas, Kidney, Testes, Ovary, Thyroid Gland, Adrenal Gland, Lung, Bone, Spinal Cord.
20. Detailed study of early embryonic development of an amphibian, chick and a mammal through preserved material; whole mounts and serial sections.
21. Study of morphogenesis and histogenesis of some selected organs such as limb, heart, eye, brain etc. during embryonic or larval development of vertebrates through preserved materials whole mounts and sections.
22. Alizarin preparation of a late chick embryo or frog fetus/tadpole.
23. Study of oestrous cycles in a rodent.

24. Simple exercise on preparation of glass instruments; fine agar film stained with vital dyes; culture media such as embryo extract, plasma clot etc.
25. **Genetics**
26. Phylogeny establishing
 27. Phylogeny and genetic counselling.
 28. Isolation of plant cellular DNA.
 29. Two point and Three-point crosses
 30. Simple genetic problems solving
 31. Human Karyotype analysis
 32. Simple Mendelian traits in humans and pedigree analysis
 33. Unknown samples and establishing Mendelian laws.
 34. Evolutionary biology
 35. Comparing RNA
 36. Biochemical changes in RNA
 37. Study of Fossils
 38. Study of Fossils with the help of Computers.

Practical 2

Practical of the following or any related to the theory courses. Dissection can be explained through virtual labs. Virtual labs can be treated as good as lab performed.

1. **How to investigate in food microbiology? Process writing.**
2. How do things work analysis of food industry?
3. How to write findings in Scientific Paper form?
4. Development of Human fetus through video
5. Detailed study of early embryonic development of an amphibian, chick and a mammal through preserved material; whole mounts and serial sections.
6. Study of morphogenesis and histogenesis of some selected organs such as limb, heart, eye, brain etc. during embryonic or larval development of vertebrates through preserved materials whole mounts and sections.
7. Alizarin preparation of a late chick embryo or frog fetus/tadpole.
8. Study of estrous cycles in a rodent.
9. Simple exercise on preparation of glass instruments; fine agar film stained with vital dyes; culture media such as embryo extract, plasma clot etc.

Food Microbiology

10. Isolation of Yeast from starchy food
11. Isolation of Molds
12. Isolation of Bacteria
13. Microbial examination of fruits and vegetables
14. Microbial examination of Canned food.
15. Microbial examination of Meat
16. Quantitative analysis of edibles

Visit to food industry and instruments of food industry.