



Syllabi of Subjects at Undergraduate Level

University of Jammu

Faculty of Life Sciences

INDEX

S.No.	Faculty of Life Sciences
1.	Botany
2.	Zoology
3.	Sericulture
4.	Industrial Fish and Fisheries
5.	Biotechnology

Botany

Semester-I

Subject: Botany

Max. Marks: 100

Course Title: Cell Biology and Genetics

Internal Assessment: 20

External Examinations: 80

Duration: 3hrs

Objectives: The course has been devised to acquaint the students with the structural and functional aspects of cell, chromosomes and genes and alterations generally found in these.

Unit-I Cell Structure.

- 1.1 Cell wall; Primary cell wall, its structure, formation and function.
- 1.2 Plasma membrane; The lipid bilayer structure, fluid mosaic model; functions of plasma membrane.
- 1.3 Cell organelles; structure and functions of endoplasmic reticulum, golgi bodies, chloroplasts, mitochondria and ribosomes.
- 1.4 Ultrastructure of nuclear membrane, organization and function of nucleolus.

Unit-II Chromosome structure and multiplication.

- 2.1 Physical and chemical structure of chromosome; structure and importance of centromere and telomere; concept of sex chromosomes.
- 2.2 Reductional and equational divisions: Various stages; detailed structure of pairing and crossing over.
- 2.3 DNA: structure and replication; satellite and repetitive DNA.
- 2.4 Extranuclear genome: structure and function of mitochondrial and plastid DNA; Plasmids.

Unit-III Genome Organization and function/Gene to protein.

- 3.1 Organization of DNA in prokaryotic and eukaryotic genomes, role of proteins; nucleosome model.
- 3.2 Concept of gene; genetic code; structure and functions of mRNA and tRNA.
- 3.3 Protein synthesis; transcription; regulation of gene expression in prokaryotes and eukaryotes.
- 3.4 Protein synthesis: translation; primary, secondary and tertiary structure of proteins.

Unit-IV Alterations of the genome.

- 4.1 Structural alterations; types, effect and detection of intrachromosomal alterations (deletions, duplications and inversions).
- 4.2 Mechanism, effect and detection of interchromosomal alterations (translocations).
- 4.3 Euploidy-types, origin and effect with suitable examples (wheat and cotton).
- 4.4 Aneuploidy-types, origin and effect with suitable examples.

Unit-V Alterations in the basic unit of inheritance and inheritance patterns.

- 5.1 Mutations-types, sources (spontaneous and induced), uses and mechanisms of induction.
- 5.2 Concept and salient features of transposable elements in prokaryotes (IS and Tn) and eukaryotes (Ac-Ds). DNA damage and repair mechanisms.
- 5.3 Mendelism, laws of segregation and independent assortment; allelic and non-allelic interactions.
- 5.4 Linkage and recombination, role of linkage in mapping of genes.

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Suggested Readings:

- 1. Albert B., Bray, D., Raff, M., Roberts, K and Watson J.D. 2004. Molecular Biology of Cell. 3rdEdn. Garland Science. New York, USA.
- 2. Atherly, A.G., Gorton, J.R. and Mc.Donald, J.F. 1999. The Science of Genetics. Diane Publishing. Co. Fort Worth, USA.
- 3. Gupta, PK. 1999. A Text Book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
- 4. Kleinsmith, L J. And Kish, V. M. 1995. Principles of Cell and Molecular Biology. 2ndEdn. Harper Collins College Publishers, New York, USA.
- 5. Lodish, H., Berk, A., Zipursky, S.L., Matsudaria P., Baltimore, D and Darnell, J. 2000. Molecular Cell Biology. 5thEdn. W.H. Freeman & Co. New York, USA.
- 6. Russell, P J. 1998. Genetics. The Benjamin Cummings Publishing Co. Inc., USA.
- 7. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics. John Wiley & sons, Inc. USA.
- 8. Wolfe, S.L. 1993. Molecular and Cell biology. Wadsworth Publishing Co. California, USA.

Suggested Laboratory Exercises.

1. To study cell structure from onion leaf peels and demonstrate staining and mounting methods.
2. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*. Study of cyclosis in *Tradescanti* petal cells.
3. Study of plastids to examine pigment distribution in plants (e.g. *Cassia*, *Lycopersicon* and *Capsicum*).
4. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
5. Study of electron micrographs of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.
6. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
7. Preparation of karyotypes from dividing root tip cells and pollen grains.
8. Cytological examination of special types of chromosomes; barr body, lampbrush and polytene chromosomes.
9. Working out the laws of inheritance (monohybrid, dihybrid, gene interactions) using seed mixtures.
10. Working out the mode of inheritance of linked genes from test cross and / or F₂ data.

Semester-II

Subject: Botany

Max. Marks: 100

Course Title: Diversity of Microbes & Cryptogams

Internal Assessment: 20

External Exam: 80

Duration: 3hrs

Objectives:

The course is designed to familiarise the students with microbes and cryptogams. These plant groups are of great human use in agriculture, horticulture, medical and biotechnology based industries. Therefore, students need to know about their structural diversity, biology and utilisation.

Unit-I Microbes and Microbiology

- 1.1 General account of plant viruses (TMV), transmission and control; concept of viroids and prions.
- 1.2 Bacteria-Ultrastructure, nutrition and reproduction, general account of Mycoplasma and Cyanobacteria.
- 1.3 Genetic recombination in bacteria (transformation, transduction and conjugation).
- 1.4 Economic importance of bacteria and plant viruses.

Unit-II Algae

- 2.1 General characteristics and classification of algae (Parker, 1982) up to class level.
- 2.2 Important features of Chlorophyceae and Xanthophyceae; life histories of *Volvox*, *Oedogonium*, *Chara* and *Vaucheria*.
- 2.3 Important features of Phaeophyceae and Rhodophyceae; Life histories of *Ectocarpus* and *Polysiphonia*.
- 2.4 Economic importance of algae (as food and feed; algal blooms and toxins).

Unit-III Fungi

- 3.1 General characteristics and classification of fungi (Ainsworth 1971), Economic importance of fungi, General account of Lichens.
- 3.2 Important features of Mastigomycotina; Life histories of *Pythium* and *Allomyces*.
- 3.3 Important characteristics of Zygomycotina and Ascomycotina; Life histories of *Rhizopus*, *Eurotium* and *Morchella*.

- 3.4 Important characteristics of Basidiomycotina and Deuteromycotina; Life histories of *Puccinia*, *Agaricus*, *Colletotrichum* and *Cercospora*.

Unit-IV Bryophytes

- 4.1 Bryophytes as the earliest land dwellers; general characteristics, classification (Smith, 1955) and alternation of generations.
- 4.2 Structure and reproduction in Hepaticae with reference to *Marchantia*.
- 4.3 Structure and reproduction in Anthocerotae and Musci with reference to *Anthoceros* and *Funaria*.
- 4.4 Evolution of sporophyte in bryophytes; importance of bryophytes in preventing soil erosion; monitoring and controlling pollution; geobotanical prospecting; in horticulture and as source of antibiotics.

Unit-V Pteridophytes

- 5.1 General characteristics, classification (Sporne, 1975) and origin of pteridophytes (the first vascular plants); stelar system and alternation of generations.
- 5.2 Important characteristics of Psilopsida and Lycopsidea; Structure and reproduction in *Psilotum*, *Lycopodium* and *Selaginella* (excluding development).
- 5.3 Important characteristics of Sphenopsida; structure and reproduction in *Equisetum* (excluding development).
- 5.4 Important characteristics of Pteropsida; structure and reproduction in *Pteris* and *Marsilea* (excluding development).

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Suggested Readings

1. Bilgrami, K.S. and Saha L.C. 1992. A Textbook of Algae. CBS Publishers and Distributors, Delhi.
2. Dube, H.C. 1990. An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
3. Parihar, N. S. 1996. The Biology and Morphology of Pteridophytes. Central Book Distributors, Allahabad.
4. Puri, P. 1980. Bryophyta: Broad perspectives. Atma Ram & Sons, Delhi.

5. Rashid A. 1976. An Introduction to Pteridophytes- Diversity and Differentiation. Vikas Publishing House.
6. Smith, G.M. 1971. Cryptogamic Botany. Vol-I: Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
7. Smith, G.M. 1971. Cryptogamic Botany. Vol. II; Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
8. Sporne, K. R. 1970. The Morphology of Pteridophytes. Hutchinson Univ. Library, London.
9. Sumbali, G. and Mehrotra, R. S. 2009. Principles of Microbiology. The McGraw Hill Education Pvt. Ltd. New Delhi.
10. Sumbali G. 2010. The Fungi. 2nd Edn. Narosa Publishing House, New Delhi.

Suggested Laboratory Exercises

1. Study of the genera included under algae and fungi.
2. Study of morphology, reproductive structures and anatomy of the examples cited in theory under Bryophyta and Pteridophyta.
3. Observation of disease symptoms in hosts infected by fungi, viruses and mycoplasma. Section cutting of diseased materials and identification of the pathogens as per the theory syllabus.
4. Gram staining of bacteria.
5. Study of crustose, foliose and other types of lichen thalli.

Zoology

Semester-I

Course No. Zool-101

1.	Course /Paper Title	:	Life and Diversity of Invertebrates
2.	Total Contact Hours	:	90 hrs.
3.	Maximum Marks	:	100
	i) External (Univ. Exam.)	:	80
	ii) Internal Assessment	:	20
4.	Minimum Pass Marks		
	i) External	:	29
	ii) Internal	:	07
5.	Duration of Univ. Exam.	:	3 Hrs.

OBJECTIVES

The paper is meant to unfold the magnitude of diversity as it exists in the non- chordate world from microscopic protozoa to macroscopic but fascinating marine 'Echinodermata'. Besides introducing animal diversity to beginners in Zoology, it is expected that the student, will appreciate the streaks of unifying biological principles common to all these diverse organisms. It is also expected that as the teaching of this syllabus progresses, a student will start appreciating the advent and evolutionary sequence from a cellular protozoa, through loose cell-aggregate in parazoa (sponges) to tissue grade organization in metazoa. The syllabus exposes students to the adaptive modifications fixed by specific habitats inhabited by diverse organisms.

SYLLABUS

UNIT –I Protozoa and Porifera

- 1.1 Introduction to kingdoms of organisms (Five kingdom system -a brief overview viz Monera, Protista, Fungi, Plantae & Animalia).
- 1.2 Protozoa
 - 1.2.1 Salient features and classification (upto class level)

1.2.2 Structure, Locomotion, osmoregulation and reproduction of the following types:

1.2.2.1 *Paramecium*

1.2.2.2 *Amoeba*

1.2.2.3 *Euglena*

1.3 Porifera

1.3.1 Salient features and classification (upto class level)

1.3.2 Sycon

1.3.2.1 Structural and functional morphology of Sycon

1.3.2.2 Reproduction of Sycon

1.3.2.3 Histological elements of Sycon

UNIT II Coelentrata and Helminthes

2.1 Coelentrata

2.1.1 Salient features and classification (upto class level)

2.1.2 Structure, Histology and life-cycle of the following types:

2.1.2.1 *Metridium* (Sea Anemone)

2.1.2.2 *Obelia*

2.2 Helminthes

2.2.1 Salient features and classification of Platyhelminthes (upto class level)

2.2.2 Structure, reproduction, life cycle and pathogenesis of the following types:

2.2.2.1 *Fasciola hepatica*

2.2.2.2 *Taeniasolium*

UNIY III Annelida and Arthropoda

3.1 Annelida

3.1.1. Salient features and classification (upto class level)

- 3.1.2. Structural and functional morphology with special reference to locomotion, digestive system, circulatory system, excretory system, reproductive system and nervous system of Earthworm
- 3.2. Arthropoda
 - 3.2.1 Salient features and classification (upto class level)
 - 3.2.2. Structural and functional morphology with special reference to digestive system, Nervous system, reproduction system, circulatory system and respiratory system of the following types:
 - 3.2.2.1 Prawn
 - 3.2.2.2 Grasshopper

UNIT IV Mollusca and Echinodermata

- 4.1 Mollusca
 - 4.1.1 Salient features and classification (upto class level)
 - 4.1.2 Structure, digestive, respiratory, nervous and reproductive system in *Pila*
 - 4.1.3 Shell in Mollusca
 - 4.1.4 Torsion in Mollusca
- 4.2 Echinodermata
 - 4.2.1 Salient features and classification (upto class level)
 - 4.2.2 Structure, water vascular, digestive, circulatory and reproductive system of star fish

UNIT V Animal forms, functions in Invertebrates

- 5.1. Canal system in Porifera
- 5.2 Polymorphism in Siphonophora
- 5.3 Coral reef-formation, types & significance.
- 5.4 Metamerism in Annelids.
- 5.5 Concept of Coelom
- 5.6 Structure & significance of trochophore larva.

- 5.7 Nutrition in protozoa
- 5.8 Larval forms in Crustaceans
 - 5.8.1 Nauplius
 - 5.8.2 Zoea
 - 5.8.3 Mysis
 - 5.8.4 Megalopa.
- 5.9 Larval forms in Echinodermata
 - 5.9.1 Bipinnaria
 - 5.9.2 Pluteus
 - 5.9.3 Auricularia

Note for Paper Setter

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Books Recommended

- I. Text book of Zoology-Hymen series McGraw Hills.
2. Protozoology-Kudo, Books & Periodicals Corporation (India).
3. Text-book of Zoology-Sedwick series. Central Book Depot.
- 4 Text-book of Zoology-Parker and Haswell Vol. I. Mac Millan & Co. 1986, New York.
- 5 Protozoology-Mackinen and Hawez, Canb University.
- 6 Treatise in Zoology-Lankester series.
- 7 Parasitic protozoa-Baker. Allen & Unwin, Inc. USA.
- 8 Antropod Anatomy-Snod,.Grass. Principles of insect morphology (1935) Snodgrass, R.E. McGraw Hill London, New York.
9. Invertebrate-Bordale and Potts. C.L.

10. Medical & Veterinary Entomology. Roy D & Broman A W A (1970).Banglore Printing &Publishing Co. Ltd.
11. Integrated principles of Zoology by Hickman, C.P. Jr., F.M. Hickman & L.S. Roberts. (Mosby College Publ.St. Louis.).
12. Manual of Zoology Vol. I (invertibrata) part I and II. Ayyar, E.K. & T.N. Ananlha-Krishnan (S. Vishwanathan, Printers & Publ. Pvt. Lid. Madras).
13. Invertebrate Zoology-Jordan,E.L. & P.S. Verma (S. Chand & Co. Ltd. Madras).

LABORATORY COURSE **Practical**

25 MARKS

Practical related to Non-chordates:

1. Study of external features of the following:

- 1.1 *Nereis*: External features with special emphasis on Head & Parapodia and Heteronereis phase.
- 1.2 Leech: External morphology
- 1.3 Prawn: External morphology & Appendages of Cockroach: External features.
- 1.4 Scorpion: External morphology & mouthparts
- 1.5 *Pila*, *Unio*: External morphology of Shell.
- 1.6 Starfish: External features.

2. Distinguishing characters & classifications of Protozoa to Echinodermata upto class only:

- 2.1 *Euglena*, *Trypanosoma*, *Amoeba*, *Vorticella*, *Monocystis*, *Plasmodium*
- 2.2 *Sycon*, *Euspongia*, *Euplectella*, *Hyalonema*
- 2.3 *Hydra*, *Obelia*, *Companularia*, *Stylester*, *Millipora*, *Tubularia*, *Sertularia*, *Plumularia*, *Physalia*, *Velella*, *Porpita*, *Aurelia*, *Rhizostome*, *Heliochystis*, *Seaanemone*, *Corals*
- 2.4 *Beroe*, *Planaria*, *Fasciola*, *Dicrocoelium*, *Polystomum*, *Diplozoon*, *Schistosoma*, *Caryophyllus*, *Taenia*, *Echinococcus*
- 2.5 *Ascaris*, *Enterobius*, *Ancylostoma*, *Gordius*, *Echinorhynchus*, *Branchiolus*,
- 2.6 *Nereis*, *Heteronereis*, *Aphrodite*, *Tubicola*, *Chaetopterus*, *Polygordius*, *Terebella*, *Serpula*, *Arenicola*, *Dero*, *Nais*, *Allolobophora*, *Entypheas*, *Lumbricus*, *Pheretima*, *Hirudinaria*, *Gephyreas*, *Sipunculus*, *Bonellia*, *Bugula*, *Saquitta*, *Pontobdella*, *Glossiphonia*, *Hirudo*
- 2.7 *Balanus*, *Lepas*, *Crayfish*, *Prawn*, *Squilla*, *Hermit-crab* *Sacculina*, *Common insects*, *Scorpion*, *spider*, *Limulus*, *Millipede*, *Centipede*
- 2.8 *Chiton*, *Mytillus*, *Unio*, *Pecten*, *Lamellidens.*, *Anodonta*, *a pearl Oyster*, *Nucula*, *Paramye solar*, *Teredo*, *Proleonema*, *dentalium*, *Patella*, *Haliotus*, *Murex*, *Buccinum*, *Aplysia*, *Doris*, *Caunane*, *Helix*, *Lymnaea*, *Planorbis*, *Loligo*, *Sepia*, *Octopus*, *Nautilus*

2.9 *Antedon, Asterias, Tentaceros, Astropecten, Holothuria, Echinus, Echinarchinus, Ophiothrix.*

3. Dissection of the following animals to expose and study the various systems:-

3.1 *Nereis*: Alimentary Canal, Nervous system.

3.2 Earthworm: Alimentary canal, Reproductive system

3.3. *Palaemon*: Alimentary canal, Nervous system

3.4 *Pila*: General anatomy, Nervous system.

4. Preparation of permanent stained mounts of the following:

Obelia, Dicrocoelium, Parapodium of *Neries*, Nephridium of Earth worm, Ovary of Earthworm, Statocyst of Prawn, Mouthparts and trachea of Cockroach, mouth parts of mosquito and radula of *Pila*.

Semester- II

Course No. Zool-102

Theory

1.	Course /Paper Title	:	Cell Biology Genetics and Evolution
2.	Total Contact Hours	:	90 hrs.
3.	Maximum Marks	:	100
	i) External (Univ. Exam.)	:	80
	ii) Internal Assessment	:	20
4.	Minimum Pass Marks		
	i) External	:	29
	ii) Internal	:	07
5.	Duration of Univ. Exam.	:	3 Hrs.

OBJECTIVES

This paper deals with nuclear cytology, introducing students to various aspects of mitosis, meiosis, chromosome structure type and changes. This study along with the study of genetics gives the student an idea of raw material of evolution. The paper also exposes students to history of evolutionary thought, pre and post Lamarckian, besides the process of natural selection and specialization. Biogeography and paleontology are the two important facts of life through which a student is made to understand past and present distribution of animals and also understand the importance of evidences (geological) supporting the idea of evolution.

UNIT -I Cell Structure and Functions

- 1.1 Introduction to cell, cell theory: prokaryotic and Eukaryotic cell
- 1.2 Organizaton of cell
 - 1.2.1 Structure of cell membrane withspecial emphasis on ‘Fluid mosaic Model’
 - 1.2.2 Cytoplasmic organelles
 - 1.2.2.1 Mitochondria, Endoplasmic reticulum, Golgi apparatus, Ribosomes, Microbodies, Centrioles.
 - 1 .2.3 Nuclear organization
 - 1.2.3.1 Cell nucleus, nuclear membrane, nuclear matrix and nucleolus.

UNIT II Chromosome structure and cell reproduction

- 2.1 Chromosome structure and types
 - 2.1.1 Morphology including matrix, chromonema, chromomere and telomere
 - 2.1.2 Primary and secondaryconstrictions, chromatids and arms ratio
 - 2.1.3 Types of chromosomes
 - 2.1.3.1 Specialized chromosomes a) Lampbrush b) Polytene and c) Supernumerary chromosomes
 - 2.1.4 Chromosomal models
- 2.2 Cell Reproduction
 - 2.2.1 Cell cycle
 - 2.2.1.1 Interphase
 - 2.2.1.2 Mitosis (M-Phase), Process, phases and significance
 - 2.2.1.3Structure and function of spindle apparatus
- 2.3 Meiosis
 - 2.3.1 Process, phases and significance
 - 2.3.2 Synapsis and synaptonemal complex
 - 2.3.3 Crossing over-mechanism and significance
- 2.4 Deregulation of cell cycle and cancer

UNIT III Structural and numerical changes in chromosomes and their Significance

3.1 Structural changes

3.1.1 Deficiencies/deletions

3.1.2 Duplication

3.1.3 Translocation

3.1.4 Inversions.

3.2 Numerical changes in chromosomes

3.2.1 Aneuploidy

3.2.2 Euploidy

3.2.2. 1 Haploidy

3.2.2.2 Polyploidy

U N I T I V Genetic material and inheritance

4.1 Mendelian law of inheritance; Neomendelism – An elementary idea

4.2 Nature and function of DNA & RNA

4.3 Sex linked inheritance (eye colours in *Drosophila* and hemophilia in man.)

4.4 Cytoplasmic inheritance

4.4.1 Maternal effect on shell coiling in snails (*Lymnaea*).

4.4.2 Kappa particles in *Paramecium*.

4.5 Sex determination system: chromosomal (e.g. Grasshopper), ploidy (e.g. Honey bee) and Environmental (e.g. *Bonelia*)

UNIT V Palaeontology and Evolution

5.1 Palaeontology

5.1.1 Fossil formation and types.

5.1.2 Living fossils with special emphasis on Latimeria and Sphenodon.

5.2. Evolution

5.2.1 Origin of life

5.2.2. Concepts and evidences of organic evolution

5.2.2. 1 Morphological evidences

5.2.2.2 Embryological evidences

5.2.2.3 Palaentological evidences

5.2.2.4 Physiological and biochemical evidences

5.2.2.5Biogeographical evidences

5.3 Neo-darwinism-Modern concept of organic evolution and speciation.

5.3.1 Variations and their types

5.3.2 Mutation -gene mutations.

5.3.3 Isolating mechanisms

Note for Paper Setter

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Books recommended:

1. The Cell- C.P. Swanson. Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Cytology and Cytogenetics -C.P. Swanson. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Fundamental concepts ofCell biology -K.G. Purohit.
4. Gene & Genetic Code -the chemical basis ofLife- J.D.Charayil.
5. Chemical background forbiological Science- E.H.White.
6. Cellular physiology and Biochemistry- W.D Mcelvey.
7. Gene Action -P.E. Hartman, S.R. Suskind
8. Evolution -Lull. Organic Evolution, Richard Swanson, Light & Life Publishers.

9. Genetics-Verma, P.S. & V.K. Agarwal, S: Chand and Co.
10. Biology of Genetics-Lewis, C.D. & Lewin, R. McGraw Hill, Toppan Co. Ltd.
11. Molecular Genetics -Gunther S, StenMcMillian Pub. Co. Inc.
12. Genetics -Goodenough, V .N. Y. Holt, Rinehart & Winston.
13. Principles of Genetics -Gradner, Wiley Eastern (P) Ltd. John Wiley & Sons, Inc.
14. Genetics -Stickberger, Ayala, Stebbins & Valentine (W.H. Freeman). MacMillan Press.
15. Genetics and Origin of species -Dobzhansky (Columbia Univ. Press).
16. Animal cytology and evolution- White, M.J.D. Cambridge Univ. Press. 1973.

LABORATORY COURSE (PRACTICAL)

25 MARKS

1. Study of mitosis from prepared slides
 - 1.1 Prophase
 - 1.2 Metaphase
 - 1.3 Anaphase
 - 1.4 Telophase
 - 1.5 Cytokinesis
2. Study of meiosis from prepared slides meiosis I
 - 2.1 Prophase
 - 2.1.1 Leptotene
 - 2.1.2 Zygotene
 - 2.1.3 Pachytene
 - 2.1.4 Diplotene
 - 2.1.5 Diakinesis
 - 2.2 Metaphase 1
 - 2.3. Anaphase 1
 - 2.4 Telophase I
 - 2.5 Meiosis II
 - 2.5.1 Prophase II
 - 2.5.2 Metaphase II
 - 2.5.3 Telophase II
3. Preparation of different chemicals studied for cytological studies
4. Preparation of slides for study of mitosis from onion root tips
5. Preparation of slides for the study of meiosis from grasshopper
6. Preparation of slides of polytene chromosomes from chironomus larva
7. Ultra structure of cell

8. Study of mendelian and non mendelian ratio through count of bean seeds
9. External morphology of male and female drosophila
10. Study of evolution of horse and man through chart/ model
11. Study of living fossils through specimens (Latemaria)
12. Study of models and their significance of the following
 - 12.1 Archyopterix,
 - 12.2 Dinosaurs
13. Zoogeographic study (through maps)
14. Study of Human Genetic syndromes through charts/photographs

Sericulture

Semester-I

1. Course Title	:	Introduction to Sericulture & Soil Sciences.
2. Total Contact Hours	:	90 hrs.
3. Maximum Marks	:	100
i) External (Univ. Exam.)	:	80
ii) Internal Assessment	:	20
4. Minimum Pass Marks		
i) External (Theory)	:	29
ii) Internal (Theory)	:	07
5. Duration of Univ. Exam.	:	3 Hrs.

OBJECTIVES

The course is designed to introduce the students to the basic theoretical and technological aspects of silkworm rearing and other aspects essential for Sericulture industry. The knowledge thus gained by the students could not only be useful for them as an extension specialist in Sericulture would also be helpful in case they wish to do something for self employment or generating supplementary income in their families.

SYLIABUS

TOTAL PERIODS 90

UNIT-I

18 Periods

- 1.1 Introduction to Sericulture, What is Sericulture-Scope of Sericulture, Origin and history of Sericulture Industry in India and other countries, Silk route.
- 1.2 World output of Silk, other natural fibers-Need for textile fibers-Different types of textile fibers. Present status of silk production. Importance of natural fibers vis-a-vis man made fibers, Role of silk fibers amongst natural fibers.
- 1.3 Silk Industry in World with special reference to China, Japan and India. Silk industry in silk producing states of India viz. Bengal, Karnataka, Tamil Nadu, Andhra Pradesh and Jammu and Kashmir; mulberry areas, sericulture villagers, no. of families, Cocoon and Silk production.
- 1.4 Characteristics of Sericulture Industry, International demand of Silk and constraints in Silk production like labour, land and environmental conditions.

UNIT II

18 Periods

- 2.1 Role of Central Silk Board in research and development of Sericulture in different states of India; Sericulture research and Development in Jammu And Kashmir State.
- 2.2 Introduction to mulberry silkworm and its food plants-what is mulberry sericulture-silk worm races.
- 2.3 Characteristic features. Different varieties of mulberry with special reference to J&K State. Different uses of mulberry
- 2.4 Introduction to non mulberry silkworm and brief account of their food plants. Different species of non-mulberry silkworm, their habit and habitat..Types of Cocoon and silk produced by them.

UNIT -III

18 Periods

- 3.1 Grading of silk and brief account of Silk conditioning and Testing.
- 3.2 Employment potential of Sericulture industry in rural India, with special reference to J&K State.
- 3.3 Introduction to seed organization-What is seed organization. Need for seed organization.
- 3.4 Role of Women in Sericulture-Women participation in mulberry garden and rearing management-Silk reeling-Twisting, weaving and finishing.

UNIT-IV

18 Periods

- 4.1 Definition of soil, Introduction to soil forming factors; soil Classification.
- 4.2 Soil properties: Physical viz. Texture, structure, colour, permeability and air contents; soil water-Importance, moisture content, soil water management for mulberry growth.
- 4.3 Soil properties: Chemical viz. Ion exchange (anions and cations) and its significance, soil organic matter, Carbon-Nitrogen ratio and its significance. Soil management for restoration of proper NPK and S ratios in mulberry gardens.
- 4.4 Important soil types of India viz. alluvial, black, red, laterites and lateritic soils. Acidic and alkaline soils and their problems; reclamation. Importance of soil with reference to mulberry cultivation.

UNIT V

18 Periods

- 5.1 Mulberry growth and nutrition; essential elements, their types; Integrated plant Nutrient management.

- 5.2 Source of nutrient elements in soil and their role in plant growth, including their deficiency and toxicity,
- 5.3 Soil and water conservation including types and causes of soil erosion, soil and water conservation including agronomic and mechanical measure.
- 5.4 Soil micro-organisms, their types and role in plant nutrition. Soil pollution and Waste management

NOTE FOR PAPER SETTING

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

BOOKS RECOMMENDED:

1. Synthesized science of Sericulture by Yokoyama, Published by Central Silk Board-1954.
2. Sericology By Tanaka, Y. Pub., C.S. B-964.
3. Text Book of Tropical Sericulture, Publ. Japan, Overseas Corporation Volunteers-1975.
4. Silk-A Survey of International Trends in Production and Trade (international) Trade Centre UNO TAD/GATT. Developed Countries and Developing Countries.
5. Regional Sericulture Training Centre, Guangzhon, China. ' '.
6. Publications
7. Mulberry Cultivation
8. Silkworm Rearing.
9. 3 Silkworm diseases
10. 4. Silkworm Egg. Production. .
11. 'Silk dyeing printing and finishing, Edited by M.L. Gulrajni, Department of textile Technology, Indian Institute of Technology Hauz Khas, New Delhi-110016
12. Raw Silk Reeling by KIM, Byung-HO.
13. Bibliography of the Technical Literature on silk by F.O. HOWITT.
14. Culture and sericulture by Prof. S.R. Charsnly.

15. Silk Production and Weaving in India by C.C.Bhosh, 1949 (Council of Scientific and Industrial Research)
16. Silkworm Genetics Illustrated by Tada Yokoyama.
17. Sericulture technical Book serial No. 18 Overseas technical Cooperation, March , 1971.
18. An analysis of Demand and Supply Prospects for Right Quality Raw Silk by, Gopal Naik and K.R.Babu, Centre for Management in Agriculture, Indian Institute of Management. Ahmedabad, 1991.
19. Sericulture for Rural Development Edited by M.B.Hanumappa.
20. Silkworm Rearing and Diseases of Silkworms by the Mysore Silk Association; 1956.
21. Eri Silk Industry, Directorate of Sericulture and Weaving, Government of Assam.
22. Tassar culture. Dr. M.S.Jolly *et.al*, CSB, 1974
23. Mysore State seminar on Silk Industry. Report, 1951
24. Hand Book of Silkworm Rearing, Fuzi Publications, 1972.
25. The Development of Indian Silk, Sanjay Sinha, 1990.
26. Sericulture by N.G.Mukerji, 1912.
27. Introduction to Silkworm Rearing, The Japan Silk Association, Inc. Tokyo, Japan.
28. .Silk by H.T.Gaddum and Company Ltd. Macchs Field, Chestern.
29. The Genetics of the Silkworm by Yataro Tazima, 1964.
30. Silk Reeling Techniques in the Tropics by Japan International Cooperation Agency, Tokyo. Japan, 1981.
31. The Silkworm on Important Laboratory Tool. Edit, Y.Tazima, 1970.
32. Silkworm Breeding stock, Dr. P.A.Kovalov, CSB, 1970.
33. Silk Biology, Chemistry Technology by Dr. Paolo Carooni, 1952.
34. Sericulture Technology, By Choel Byong Hee, Seoul Natl. Uni. Press Korea, 1972.
35. Silkworm Rearing Techniques in the Tropics, Dr. S. Omura, Japan International Corporation Agency, 1980
36. The Silk Book. The Silk and Rayon Users Association, London, 1951.
37. Muga Silk Industry by S.N Choudhary, Directorate of Sericulture and Weaving, Government of Assam, 1982.
38. Sericulture Manual-I (Mulberry cultivation) 1972.

39. Text book of Tropical Sericulture-1975, Pub. By Japan Overseas Corporation Volunteers, Sibuya-Ku, Tokyo, Japan. '
40. Jaisawal, P.L.1980, Hand Book of agriculture, India. Indian Council of Agriculture Research New Delhi.
41. Kvamer(Paul J.) 1969; Plant and Soil Water relationship: Modern Synthesis. York McGraw Hill.
42. Krishna Moorthy, H.N., 1975, Gibberellins and Plant Growth, Wiley Eastern, .Delhi.
43. The Nature and Properties of Soils (9t~ edition) N.C.Brady(MacMillan,Publications Co. Inc., New York).
44. Studies on Soils of India, S.V.GovindaRajan and H.G.Gopala Rao (1970), Vikas Publ. House Pvt. Ltd. New Delhi/Bombay.
45. Text Book of Soil Sciences (underprint), T.D.Biswas and S.K.Mukherjee (1990)Tata Mc Graw Hill Publication, Co.Ltd. New Delhi.

Laboratory Practicals

1. Sericulture maps.
 - a. World maps and silk route. .
 - b. India.
2. Organization set up in India General Information.
 - a. Govt. of India.
 - b. Five traditional States with special reference to J&K and Karnataka.
 - i. Karnataka
 - ii. Andhra Pradesh .
 - iii. Tamil Nadu
 - iv. West Bengal
 - v. Jammu and Kashmir.
3. Identification and study of sericulture products
 - a. Cocoon and silk yarn -different types.

- b. Pupae
- c. Silk waste
- d. Spun Yarn
- e. Noil Yarn.
- f. Other by products.

4. Preparation of Histograms on world output

- a. Of silk and other textile fibers
- b. Of silk fiber in different countries.

5. Study of soil profile

- a. Study of different types of soil.
- b. Soil sampling
- c. Preparation of soil sample in the laboratory for analysis
- d. Study of soil colour, designation system (Munsell colour system).
- e. Soil analysis for pH.
- f. Determination of organic carbon by calorimetric method
- g. Determination of available nitrogen by alkaline permanganate method
- h. Determination of available phosphorous and Potassium.

6. Visit to a water shed

7. Visit to a soil testing laboratory,

8. Morphology and anatomy for few important mulberry cultivators.

9. Propagation methods:

- a. Preparation of nursery beds, '
- b. Collection of fruits and separation of viable seeds, seed sowing, seed bed maintenance and raising of seedlings.
- c. Selection of materials for cutting preparation and selection of cuttings, planting and raising of saplings in nursery beds and polythene bags. Selection and grading of saplings.
- d. Preparation of various types of grafts and their maintenance.
- e. Simple air and trench layering techniques

10. Farm implements and Machinery
11. Preparatory practices and mulberry establishment
12. Pit system and row system of planting,
13. Tree planting
14. Different forms of mulberry training and methods of irrigation(demonstration)
15. Identification of different types of fertilizers, calculation of dosages (extensive Preparation of compost
17. Mulching practices and in-situ moisture conservation practices.
18. Identification of common weeds of mulberry and weeding
19. Estimation of leaf yield, moisture contents and harvesting methods.
20. Preparation of various formats for the maintenance of farm records (exercises)
21. Preparation of flow chart of annual schedule of operation for 1.hec. of irrigated mulberry and also of rain fed mulberry (Exercise)
22. Visits to Govt. Silk farm and individual interaction with silkworm growers .
23. Viva-voce.

Semester-II

Theory

1. Course Title : **Biology of mulberry and silkworm & silkworm rearing technology.**
2. Total Contact Hours : 90 hrs.
3. Maximum Marks : 100
 - i) External (Univ. Exam.) : 80
 - ii) Internal Assessment : 20
4. Minimum Pass Marks
 - i) External(Theory) : 29
 - ii) Internal (Theory) : 08
5. Duration of Univ. Exam. : 3 Hrs.

OBJECTIVE

The course is designed to introduce the Students to the basic theoretical and technological aspects of silkworm rearing and other aspects essential for Sericulture industry. The knowledge thus gained by the students could not only be useful for them as an extension specialist in Sericulture but would also be helpful in case the students wish to do something for self employment or for generating supplementary income in their families.

SYLLABUS

TOTAL PERIODS 90

UNIT-I

18 Periods

- 1.1 Taxonomy of mulberry and popular mulberry cultivators; Morphology and anatomy of mulberry stem, root and leaf. An outline of floral biology of mulberry flower, fruit and seed development. Mulberry the "KalpaVriksha" the economical importance.
- 1.2 Propagation of mulberry; seedling methods of raising viable seeds, saplings, preparation and selection of cuttings.

Grafting stem root and bud grafting techniques, layering, raising of nursery, its maintenance and care, use of growth regulators in mulberry propagation.
- 1.3 Establishment of mulberry gardens for high leaf productivity and quality. Mulberry farm; Bush, Middling's and low trees.

- 1.4 Selection and preparation of site, soil testing and soil improvement methods, plot size, orientation and layout, selection of varieties for cultivation, planting system, row system and pot system. Advantages and Disadvantages and recommended system. Spacing for mulberry and its significance in leaf productivity and quality under various field conditions.

UNIT II 18 Periods

- 2.1 Irrigated conditions: Water requirement for mulberry and different field situations and seasons, over irrigation and its effects.

Dry land conditions: Land leveling, budding, moisture conservation practices .and rain H₂O recycling; Mulching its purpose and methods.

- 2.2 Manures and their applications: Vermiculture, organic manures type (FYM and Compost) methods of compost preparation and its use in mulberry fields, advantages and constraints. Fertilizers; types, importance, application methods and limitations.

- 2.3 Chemical fertilizers: Role of major nutrients and trace elements growth. Types (straight, complex and complete fertilizers) important chemical fertilizers in mulberry cultivation, chemical composition of fertilizers, fertilizers doses and schedules of application for irrigation, rain fed gardens, calculation of required doses for given unit area.

Foliar nutrition; foliar nutrients and commercial formulations, Scope and limitations. Common weeds of mulberry, their effect on mulberry productivity and control measures.

- 2.4 Pruning and Training; Objectives. Types and methods of pruning, its importance, utility of mulberry pruning in sericulture management practices.

Harvesting: Effects of harvest on mulberry plant, harvesting methods (leaf and shoot harvest) in relation to cultivation and pruning practices. Time of harvest, transportation and preservation methods. Mulberry Management: Significance of leaf cocoon ratio concept, exclusive mulberry garden for chawki rearing

- 2.5 Mulberry Management: Significance of leaf cocoon ratio concept, exclusive mulberry garden for chawki rearing, concept and methods.

UNIT-III

18 Periods

- 3.1 Systematic position of silkworm and salient features of order Lepidoptera, Silk worm races and Geographical, distribution.
- 3.2 Life history of *Bombyxmori*; morphology of egg, larva, pupa and adult, Morphology and anatomy of organ systems in silkworm mouth parts, digestive system and reproductive system. Silk gland-divisions, spinnert, silk protein and their synthesis.

Moulting; formation and shedding of cuticle, hormonal control.

- 3.3 Metamorphosis and the role of hormones in insect metamorphosis
- 3.4 Structure of egg development and hatching.

Nutrition: Factors influencing Silkworm growth and development.

UNIT IV

18 Periods

- 4.1 Rearing house-Requirement for ideal rearing house- selection of site and size of rearing house. Orientation-Model of rearing house.CSB model-Advantage and disadvantages of different rearing houses.
- 4.2 Disinfections-importance of disinfections, different disinfectants, disinfectants and their concentrations and formulation for application.
- 4.3 Selection of silkworms races/breeds for rearing-advantages and disadvantages of bivoltine, multivoltine and their hybrids.

Estimation of leaf quality and yield-appropriate time for estimation of leaf yield.

- 4.4 Incubation-definition-environmental conditions required for incubation and their influence on egg development-methods of incubation-conventional method, incubator and low cost incubation devices. Preparation or brushing, what is brushing, different brushing methods, egg and sheet eggs-tapping and net method -Selection of leaf for brushing, advantages and disadvantages of different types or brushing.
- 4.5. Preparation or brushing, what is brushing, different brushing methods, egg and sheet eggs-tapping and net method -Selection of leaf for brushing, advantages and disadvantages of different types or brushing.

UNIT-V

18 Periods.

- 5.1 Harvesting of leaf-methods and time of harvesting-transportation and storages of leaf for chawki and late age worms.
- 5.2 Chawki rearing-importance-environment conditions required for chawki rearing- leaf requirement and selection and different chawki rearing methods. Moultng: Symptoms and moulting care during pre-moulting, moulting and post moulting periods. .
- 5.3 Late-age rearing-Spacing and leaf requirement-environmental Conditions required, frequency of feeding, bed cleaning schedules. Different rearing methods-shelf, shoot and floor rearing-Advantages and disadvantages. .
- 5.4 Preparation for mounting-Methods of mounting, types of mountages- Advantages and disadvantages of their use, spinning-environmental conditions required for spinning.Harvesting of Cocoons-time of harvest of seed crop, hybrid crop, sorting of Cocoons; preservation-transportation of Cocoons.
- 5.5 Harvesting of Cocoons-time of harvest of seed crop, hybrid crop, sorting of Cocoons; preservation-transportation of Cocoons.

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

B.OOKS RECOMMENDED

1. P .L.Jaiswal, *et.al* 1980, Hand book of Agriculture, ICAR, New Delhi.
2. R.,F. Daubenmure, 1970. Plants and environment, Wiley Eastee, I.CAR, New Delhi, ;, 1985. -
3. IAEA, 1974, Polyploidy and Induced mutations in plant breedings; international Atomic Energy Agency, Vienna.
4. HURD, 1976, Plant breeding fordrought resistance in: water deficits and plant. growth vol. 4(ed) T.T. Kozlowski, Academic Press, New York.
5. Kiraly, Z. *et. al.* 1974, Methods in Plant pathology with special reference to breeding for disease resistance (eds). Kiraly J. Elsevier Sci. Publ. Co. New Delhi. .
6. Van der Plank, J.E. 1968, Disease resistance in plants Academic Press New York
7. FAOManual-I Mulberry cultivation, Fac, Rome.

- 8 . Boraiah, S. 1986. Mulberry Cultivation.Lectures on Sericulture.
9. Mather, K, and Jinks, J.L. 1977 introduction to Biometrical Genetics, Chapman and Halt
10. Singh B.D, Fundamentals of Genetics: Kalyani Publishers. New Delhi.
11. Swanson, C.P. 1957, Cytology and Cytogenetics. Prentice Hall, Eagle-wood Clifff .New Jersey.
12. Strickberger, M.W. 1976. Genetics, Macmillan Publ. Co. Inc. New York.
13. CSB. .1990. Genes and Genotypes in the Germplasm bank (a report of the committee forthe fixation of norms).
14. Eeltwell, J. The Story of ' Silk.Alan Sutton Pub.Phoenix Mill.Hipivrdyrtjdjotr.1990.
- .15. Dandin~~et.al.~~ 1988 Bibliography on mulberry (1900-1984) CSR &TI, (Central Silk Board) Mysore: .
16. Manual of Sericulture: food and Agriculture Organization Rome I 1976.
17. Appropriate Sericultural Techniques ed. M.S. Jolly, Director, CSR&TI, Mysore
18. Handbook of Practical Sericulture, S.R.Ullal and M.N. Narasimlhanna, CSB, Bangalore, 1987.
19. Text book of Tropical Sericulture, Pub. Japan Overseas Corporation Volunteers, 1975.
20. Handbook on Silkworm Rearing: Agriculture and Technical Manual-I, Fuzi Pub. Co. Ltd. Japan 1972.
21. Manual on Silkworm egg production: M.N Narasimhanna, Pub. By CSB, Bangalore, 1988. ..
22. Silkworm rearing: Vuoang-Chun and Chen Da-Chung; Pub. By FAO, Rome, 1988
23. A guide for bivoltine Sericulture; K.Sengupta, Director, CSR & IT, Mysore, 1989.
24. New technology of Silkworm Rearing: S.Krishnaswamy, Reprinted by CSB, Bangalore 1989. ,
25. Improved method of rearing young age silkworms: S. Kirshnaswamy, Reprinted by CSB Bangalore,
26. The Principles of Insect physiology: V.B. Wigglesworth: Pub. By English Language book Soc., Chapman & Hal, 1972.
27. Economics of sericulture under irrigation conditions: M.S. Jolly, CSR & TI, Mysore- 8,1982.
28. Economics of Sericulture under Rain fed conditions, M.S.Jolly, CSR & TI. Mysore, 1982.
- 29 The Silkworm-an important laboratory tool, ed. By Y.Tazima, Kodansna, Japan.
30. Silk from grub to glamour: Mahesh M.Nanavathy, Pub. In Indian Paramount House, Bombay, 1965
31. Principles of Insect Morphology: R.E.Snodgrass, Tata McGraw Hill Pub. Co. Ltd. : Bombay, 1935.

32. Insect Biology in the future, VBW BO, Ed by Michael Locke, David S. Smith, Academic Press, 1980.
33. Silkworm Biology and Rearing, A.K.Dhole, Project Coordinator, NCERT, New Delhi, 1990.
34. An Introduction to sericulture, Ganga G. and J. Sulochana Shetty-Oxford and IBH .Pub. 1991.
35. China Sericulture, 1972, FAO, Rome.
36. Silkworm Rearing and Diseases of Silkworm, 1956, Ptd. By Director of Ptg. Stn, & Pub. Govt. Press, Bangalore.
37. Choebyong Hone 1972; Sericultural.Technology, Pvt.By Seoul National University Press, Korea.
38. Silkworm Rearing Techniques in Tropics; SeinosukaOmura, 1973, OTCA, Tokyo, .Japan.
39. Sericology, Tanaka, Y. 1964, CSS Pub, Bangalore.
40. Synthesised Science of Sericulture, Yokoyama, 19.54, Pub. With permission of Sugimani -KO, Tokyo.
41. Handbook of Sericulture-I; Yonemua, M and Rama Rao, N.1925. Mysore govt. Ptg. Press. .
42. Cytoplasmic polyhedrosis Virus of the Silkworm, HissaAruga and Tanada, Y, 1971, Univ. of Tokyo Press, Japan.

Laboratory Practicals

1. Morphology of Larva, pupa and moth

- (a) mouthparts of silkworm
- (b) External morphology of larva pupa and moth
- (c) Sex separation of larva, pupa and moth

2. Anatomy -

- a. digestive system, excretory system, and Respiratory system in silkworm
- b. Silk glands in silkworm.
- c) Reproductive system in silk moth

3. Cocoon characters of popular uni, bi, and multi voltine races

4. Model rearing house-types of rearing houses

5. Rearing appliances -estimation of rearing appliances for 100 dfls.

6. Disinfection-Types of disinfectants, effective concentration of disinfectants, preparation of disinfectants. .

7. Incubation of silkworm eggs- black boxing, percentage of hatching, recording of temperature and humidity. .

8. Mulberry leaf estimation -Harvesting and preservation techniques -leaf selection for different instars.

9. Moulting -identification of moulting, larvae, moulting care

10. Mountages and harvesting, cocoon assessment and preparation of harvestreport.

11. Visit to local progressive sericulturists.

12. Rearing of silkworms (Compulsory)

13. Viva-voce.

Industrial Fish & Fisheries

Semester-I

Theory

1.	Course /Paper Title	:	Fish Biology
2.	Total Contact Hours	:	90 hrs.
3.	Maximum Marks	:	100
	i) External (Univ. Exam.)	:	80
	ii) Internal Assessment	:	20
4.	Minimum Pass Marks		
	i) External.	:	29
	ii) Internal	:	07
5.	Duration of Univ. Exam.	:	3 Hrs.

Objectives

The course intends to impart coaching and training to the students regarding various aspects of fisheries with a view to enable them to adopt it as vocation and shall be self-employed.

UNIT I Taxonomy & Fish Biology

- 1.1 General characteristics and classification of fishes upto order level (with examples)
- 1.2 External morphology of commercially important
 - 1.2.1 Elasmobranch (Scoliodon)
 - 1.2.2 Teleosts (Rohu)

- 1.3 Crustacean- General characters and classification
 - 1.3.1 External morphology of Prawn
- 1.4 Mollusks- General characteristics and classification

UNIT II Comparative Anatomy of Fish

- 2.1 Alimentary Canal and associated structure
- 2.2 Heart and circulatory system
- 2.3 Respiratory system- Gill structure
- 2.4 Accessory Respiratory organs in fishes
- 2.5 Reproductive system
- 2.6 Sense organs- Eye, Ear and Lateral line system
- 2.7 Digestive, Respiratory and Excretory system of:
 - 2.7.1 Crustaceans (Prawn)
 - 2.7.2 Mollusks (Unio)

UNIT III Fish Behavior and Adaptation

- 3.1 Excretion and Osmoregulation in Fresh water and Marine Fishes
- 3.2 Feeding habits and adaptation of:
 - 3.2.1 Fishes
 - 3.2.2 Crustaceans
 - 3.2.3 Mollusks
- 3.3 Reproduction and Social Behavior
 - 3.3.1 Courtship behavior
 - 3.3.2 Parental care and Nest building
 - 3.3.3. Aggregation and Shoaling in fishes

UNIT IV Population Dynamics, Age and Growth

- 4.1 Age and growth in fishes- A General Concept.
- 4.2 Age determination through hard parts (Direct and Indirect method)
- 4.3 Length and weight relationship
- 4.4 Population Dynamics:
 - 4.4.1 Structure and Estimation of Population
 - 4.4.2 Factors effecting population

UNIT V Fish Reproduction and Development

- 5.1 Sexuality in fishes- Hermaphroditism, Gonochorism
- 5.2 Types of Reproduction- Oviparity, Viviparity and Ovi-vivaparity
- 5.3 Sexual maturity and maturity stages of gonads
- 5.4 Fecundity in fish:
 - 5.4.1 Definition, types and estimation
 - 5.4.2 Factors effecting fecundity in fish
- 5.5. Spawning habit
 - 5.5.1 Factors effecting spawning
 - 5.5.2 Spawning season
- 5.6 Early embryonic development and fish larva

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Books Recommended

- 1. Jhingran, V.G. (1985). Fish & Fisheries of India
- 2. Beaven, C.R. H/B of the freshwater fishes of India
- 3. Satsnarayanam, V. Fish culture
- 4. Pillay, T.V.R. Aquaculture
- 5. Biswas, K.P. A text book of fish and Fisheries technologies
- 6. Chandy, M. (1970). Fishes national book trust of India , NDL
- 7. Srivastava, C.B.L. (1999). Fish Biology
- 8. Khanna, s.s. and Singh, H.R. A Textbook of Fish Biology and Fisheries

Laboratory Practicals

Industrial Fish & Fisheries

1. Identification of commercially important fishes (Both Freshwater as well as Marine) through morphometric and meristic characteristics
2. General morphological characters and classifications of fin fish and shell fish (Museum survey)
3. Study of fish anatomy (Gut, Heart, Gills, Brain, Gonads) of fin fish and shell fish
4. Study of fish modification with special reference to (Scales, Fins and Mouth)
5. Qualitative and Quantitative studies of fish food through gut analysis.
6. Estimation of growth through hard parts
7. Length weight relationship
8. Study of maturity stage in the male and female fish
9. Study of gonads through prepared slides
10. Identification of larvae of fin fish and shell fish
11. Field visits to collect data for the study species composition, catch/unit effort, age and growth of local aquatic organisms.
12. Study of Axial and appendicular skeleton of fish,

Semester-II

1.	Course /Paper Title	:	Fish Resources and Technology
2.	Total Contact Hours	:	90 hrs.
3.	Maximum Marks	:	100
	i) External (Univ. Exam.)	:	80
	ii) Internal Assessment	:	20
4.	Minimum Pass Marks		
	i) External.	:	29
	ii) Internal	:	07
5.	Duration of Univ. Exam.	:	3 Hrs.

Objectives

The course intends to impart coaching and training to the students regarding various aspects of fisheries with a view to enable them to adopt it as vocation and shall be self-employed

Syllabus

UNIT I Inland Fish Resources

- 1.1 Status and Potential of Inland Fisheries Resources of India
- 1.2 Status and Potential of Warm Water Fisheries Resources of India
 - 1.2.1 Carp Fisheries
 - 1.2.2 Catfish Fisheries
- 1.3 Cold Water Fisheries
 - 1.3.1 Trout
 - 1.3.2 Mahseer

UNIT II Riverine, Lacustrine and Reservoir Fisheries Resources

- 2.1 Riverine fisheries resources of India with special reference to that of Ganga, Bhramputra and Indus river systems
- 2.2 Ecology and potential of rivers and streams
- 2.3 Status, potential and Management of Lacustrine Fisheries of India
- 2.4 Ecology and productive of Lakes
- 2.5 Reservoir Fisheries- Status Potential and Management

UNIT III Marine and Estuarine Fisheries Resources

- 3.1 Status and potential of Marine capture Fisheries Resources of India
- 3.2 Inshore Coastal Fisheries: status, potential and problems
- 3.3 Offshore Fisheries: Status, Potential and Problems
- 3.4 Concept of EE2
- 3.5 Status and Potential of Estuarine Capture Fisheries Resources of India
- 3.6 Ecology, Productivity and Management of Estuaries

UNIT IV Marine Fisheries

- 4.1 Survey of Marine Capture Fisheries of India
 - 4.1.1 Hilsa Fishery, Oil Sardine Fishery, Bombay Duck Fishery and Tuna Fishery
 - 4.1.2 Fisheries of Elasmobranchs (Shark and Ray fin Fishery)
- 4.2 Status and potential of:
 - 4.2.1 Crustacean fisheries (Prawns, Lobsters and Crabs)
 - 4.2.2 Molluscan Fisheries (Mussels and Clams)

UNIT V Fishing technology

- 5.1 Principles of Conservation, Development and Management of Fisheries
- 5.2 Population Dynamics, Concept, Requirement and Yield
- 5.3 Problems of Over Fishing
- 5.4 Fishing Gears:
 - 5.4.1 Gill Net
 - 5.4.2 Cast Net
 - 5.4.3 Drift Net
 - 5.4.4 Traps
- 5.5 Marine Water Bodies:

5.5.1 Trawlers

5.5.2 Purse seines

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

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3. Satsnarayanam, V. Fish culture
4. Pillay, T.V.R. Aquaculture
5. Biswas, K.P. A text book of fish and Fisheries technologies
6. Chandy, M. (1970). Fishes national book trust of India , NDL

Laboratory Practicals

Industrial Fish & Fisheries

1. Methods of collection, handling, identification and preservation of fish for taxonomic purposes.
2. Specific Identification of commercially important fishes (fresh water & marine) prawns, crabs, lobsters, bivalves and cephalopods.
3. Anatomy, digestive, nervous, circulatory & reproductive system of specimens of Fish, Prawn and Crab
4. Preparation of dry and wet mounts, wax and plaster castings of fish; Alizarin preparation.
5. Study of food and feeding habits of fishes viz. plankton feeder, herbivore, carnivore, omnivore and detritus feeder. Structural adaptation for diet variability
6. Qualitative and quantitative methods for stomach content analysis. Food selectivity and ranking methods for food preferences.
7. Estimation of growth rate and aging for direct and indirect method
8. Study of length-weight relationship and ponderal index
9. Classification of maturity stages in male and female fish; gonadosomatic index and fecundity; study of spawning habits based upon diameter polygons.
10. Identification of fish eggs and larvae.
11. Study of larval stages of crustaceans and mollusks
12. Field visits to observe fishing; collect field data regarding species composition, craft gear and problems regarding riverine, reservoir and cold water fisheries.
13. Analysis of data: drawing of graphs, charts histograms and recording of salient features of all fisheries in the practical record book indicating their distribution abundance catch particulars.

Biotechnology

Semester-I

Subject: Biotechnology

Max. Marks: 100

Course Title: Biochemistry and Metabolism

Internal Assessment: 20

External Examinations: 80

Duration: 3hrs

Unit – I

Water and its properties; physico-chemical properties of water; Dissociation and association constants, pH, buffers, pI, pKa, solutions, solubility, criteria for solubility, hydrophobicity and hydrophilicity; Dielectric constant; Thermodynamics; free energy, enthalpy, entropy and redox potential.

Unit – II

Carbohydrates, structure of mono-, di- and polysaccharides, cellulose, glycogen, starch, Glycoproteins, peptidoglycans, lipopolysaccharides; Carbohydrate metabolism- glycolysis, Fate of pyruvate under aerobic and anaerobic conditions, TCA cycle, Amphibolic and anaplerotic nature of TCA cycle, gluconeogenesis; Electron transport chain, oxidative phosphorylation, pentose phosphate pathway: Oxidative and non oxidative phase, glyoxylate cycle.

Unit – III

Structure of amino acids: acidic, basic and neutral amino acids, essential amino acids, Chemical reactions; Structural organization of proteins, primary, secondary: The alpha- helix, beta-pleated sheet structures, tertiary and quaternary structure of proteins and the forces that stabilize the structure, Protein classification, fibrous and globular proteins and functions; Biosynthesis and degradation of amino acids; Reduction and assimilation of atmospheric nitrogen, nitrogen cycle.

Unit – IV

Lipids and fats, classification of lipids and fatty acids, saturated and unsaturated fatty acids, general structure and functions of major subclasses of lipids-acylglycerol, phosphoglycerides, sphingolipids, glycosphingolipids, terpenes, sterols, cholesterol and steroids; prostaglandins; biosynthesis and degradation of fatty acids.

Unit – V

Nucleic acid, DNA: A, B & Z- DNA, RNA: Structure of m-RNA, r-RNA & t-RNA, structure and type of nucleosides and nucleotides, biologically important nucleotides and their functions.

Biosynthesis and degradation of nucleic acids. Vitamins and hormones; types of vitamins and their deficiency symptoms, steroid and peptide hormones.

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Books recommended

1. Lehninger, A.L., Nelson, D.L. and Lox, M.M. (2003). Principles of Biochemistry, CBS Publishers and Distributors, New Delhi.
2. Stryer, L. (2001). Biochemistry: 5th Edition, W.H. Freeman and Company, New York.
3. Zubay, G.L., Parson. W.W. and Vance, D.E. (2006). Principles of Biochemistry: Student Study Art Notebook, Wm. C. Brown Publishers.
4. Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd ed., John Wiley and Sons Inc., New York.

Practical

1. Preparation of physiological buffers.
2. Verification of Beer Lamberts Law for P-nitrophenol or cobalt chloride.
3. Determination of pK_a value of P-nitrophenol.
4. The colorimetric estimation of inorganic phosphate.
5. Estimation of carbohydrate in given solution by anthrone method.
6. Estimation of sugar in biological samples by Dubois method.
7. Protein estimation by Lowry's/ Bradford method.
8. Analysis of urine for urea, glucose, uric acid and choride.
9. Determination of acid value of a fat.
10. Determination of saponification value of a fat.

Books recommended

1. Plummer, D.T. (1990). An Introduction of Practical Biochemistry. 3rd Ed. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
2. Singh, R. and Sawhney, S.K. (2002). Introduction to Practical Biochemistry. Narosa Publications, New Delhi.

Semester-II

Subject: Biotechnology

Max. Marks: 100

**Course Title: General and Applied
Microbiology**

Internal Assessment: 20

External Examinations: 80

Duration: 3hrs

Unit – I

History, development and scope of Microbiology, Principles and applications of microscopy (bright field, darkfield, phase contrast, fluorescence and immunofluorescence, confocal microscopy, electron microscopy). Methods in Microbiology, pure culture techniques, microbial culture media, sterilization, culture collection and maintenance of cultures, Nomenclature and Bergey's manual

Unit – II

Prokaryotic cell structure and function, Flagella and motility, Cell inclusions. Bacterial staining. Microbial growth: batch and continuous culture; Factors affecting growth; Viruses: discovery, classification and structure of viruses (Plant, animal and bacterial viruses), Retroviruses. Metabolic diversity among microorganisms.

Unit – III

Distribution and classification of algae (Fristch) and fungi (Ainsworth). Reproduction and nutrition in algae and fungi. Fungi and ecosystem. Algal ecology and algal biotechnology, Morphology, motility and reproduction in protozoa.

Unit – IV

Industrial products derived from microbes, industrial enzymes, production of antibiotics, vitamins and vaccines; Single cell proteins, biofertilizers, nitrogen fixation, vermiculture, composting, herbicides and biopesticide production, Biotransformation, bioremediation of contaminated soils, biodegradation of organic pollutants and xenobiotics; bioplastics and biomining.

Unit – V

Air borne disease transmission, respiratory diseases caused by bacteria and viruses, Direct contact disease transmission, tuberculosis, sexually transmitted disease including AIDS, diseases transmitted by animals (rabies, plague), Arthropod transmitted disease (rickettsias, malaria, lyme disease), food and waterborne diseases (Cholera, Giardiasis, Typhoid), pathogenic fungi.

Note for paper setters

The question paper will have 2 sections. Section 'I' will be compulsory having ten questions of 2 marks each. The questions will be short answer type having answers not exceeding 20 words. Section II will have long answer type questions of 12 marks each, two from each unit. The candidates will be required to answer one question from each unit.

Books recommended

1. Stainer, R.Y., Ingraham, J.L., Wheelis, M. and Painter, P.R. (2003). General Microbiology. The Mac Millan Press Ltd. London.
2. Pelczar, M.J.J., Chan, E.C.S. and Kreig, N.R (2005). Microbiology. Tata McGraw Hill, New Delhi.
3. Prescott, L.M., Harley, J.P. and Klein, D.A. (2005). Microbiology. McGraw Hill, USA.
4. Mackie and McCartney. (1996). Medical Microbiology. Vol. 1. Microbial Infection. Churchill Livingstone.
5. Cappuccino, J.G. and Sherman, N. (1996). Microbiology – A Laboratory Manual. Addison – Wesley.

Practicals

1. To study different components, use and care of the compound bright field microscope.
2. Culture characteristics of different microorganisms.
3. Different sterilization techniques. Preparation of media for cultivation of bacteria and fungi.
4. Isolation of microorganisms from soil, air and water. Colony purification.
5. Enumeration of microorganisms; total vs viable count.
6. Study morphology of molds and yeast by methylene blue staining.
7. Bacterial staining: simple staining, Negative staining and Gram's staining.
8. Biochemical activities of microorganisms.
9. Standard qualitative analysis of water.
10. Antibiotic sensitivity of microbes.
11. Microbial flora of mouth, teeth and throat.

Books recommended

1. Cappuccino, J.G. and Sherman, N. (1996). Microbiology – A Laboratory Manual. Addison – Wesley.
2. Aneja K.R. (2005). Experiments in Microbiology, Plant Pathology and Biotechnology (4th edition). New Age International (P) Limited, New Delhi.