

UNIVERSITY OF MYSORE
Yuvaraja's College (Autonomous Science College)
Department of Sericulture

I SEMESTER

PAPER- 1. SERICULTURAL BOTANY AND SILKWORM BIOLOGY

3 hrs/week X 15 = 48 hrs.

Part A: General Sericulture.

Unit-1

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| 1. Introduction to Sericulture-Origin and history of Sericulture- Silk road, spread of Sericulture to Europe, South Korea, Japan, India and other countries. | 2 Hrs |
| 2. Sericulture map of India and World: Components of Sericulture. | 3 Hrs. |
| 3. Sericultural practices in tropical and temperate climate; | 2 Hrs. |
| 4. Employment generation in sericulture-Role of women in sericulture | 2 Hrs. |

Unit-2

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| 5. Textile fibres: Types- natural and synthetic fibres- types of silk produced in India; Importance of mulberry silk. | 1Hrs. |
| 6. Sericultural practices in rain-fed and irrigated conditions; traditional and non-traditional areas. | 2Hrs. |
| 7. Sericulture organization in India and Karnataka; role of state departments of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development. | 2Hrs. |

Part-B: Sericultural Botany.

Unit-3

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| 8. Taxonomy of mulberry and food plants of silkworms: Study of salient features of the families-Moraceae. | 3 Hrs |
| 9. Morphology of mulberry: different varieties of mulberry with special reference to Karnataka. | 2 Hrs. |

Unit-4

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| 10. Anatomy of mulberry: internal structure of stem, root and leaf; secondary growth in root and stem | 6 Hrs. |
| 11. Floral biology of mulberry: Sexual behavior, different types of anther and ovule in mulberry; micro- and megasporogenesis; development of male and female gametophytes; pollination, fertilization; development of endosperm, embryo and seed; polyembryony and parthenocarp in mulberry. | 6 Hrs. |
| 12. Weeds of mulberry garden: Classification and characteristics. | 2 Hrs |

Part -C: Silkworm Biology.

Unit-5

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| 13. Characteristic features of the order Lepidoptera; detailed study of the families-Saturnidae and Bombycidae. Classification of sericigenous insects. | 2 Hrs. |
| 14. Classification of silkworms based on moultnism, voltinism and geographical distribution; popular silkworm breeds and hybrids of Karnataka; their economic traits. | 3 Hrs. |
| 15. Life cycle of <i>Bombyx mori</i> ; morphology of egg, larva, pupa and adult. | 3Hrs |

Unit-6

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| 16. Morphology and anatomy of digestive, circulatory, excretory, respiratory, nervous system of silkworm larva. | 4 Hrs |
| 17. Morphology and anatomy of reproductive systems of silk moth. | 2 Hrs |
| 18. Morphology and anatomical structure of Silk gland. | 1 Hrs |

PRACTICAL-1- SERICULTURAL BOTANY AND SILKWORM BIOLOGY. 15 Practicals -3 hrs each

General Sericulture;

1. Sericulture maps: (a) World maps and Silk Road.
(b) Sericulture map of India and Karnataka. 1 Prct.
2. Preparation of histograms and pie charts on:
(a) Production of textile fibers in India.
(b) World silk production.
(c) Pie chart on mulberry and non-mulberry silk production in India. 1 Prct.

Sericultural Botany;

3. Taxonomic description of mulberry. 1Prct.
4. Study of five popular mulberry cultivars of Karnataka(Mysore local, K₂, S₃₆, S₁₃ and V₁) 1Prct.
5. Mounting of Pollen grains, Ovary and Embryo 1 Prct.
6. Anatomy of petiole, leaf lamina, stem and root 2 Prct
7. Weeds of mulberry garden. 1 Prct

Silkworm Biology;

8. Life cycle of *Bombyx mori*- Morphology of egg, larva, pupa and adult of *Bombyx mori*. 1 Prct.
9. Sex separation in larva, pupa and adult of the silkworm *Bombyx mori* 1 Prct.
10. Dissection and display of:
(a) Digestive system of larva.
(b) Silk glands.
(c) Reproductive system of male and female moths.
(d) Mounting of larval mouth parts and spiracle.
(e) Nervous system of silkworm larva. 5 Prct

II SEMESTER

PAPER-2:- MULBERRY CULTIVATION AND SILKWORM REARING 3 hrs/week X 15 = 48 hrs.

Part –A: Mulberry cultivation.

Unit- 1

1. Definition of soil, different types of soils in india 1 Hrs.
2. Importance of soils with reference to mulberry cultivation; soil analysis- soil sampling, soil pH, organic carbon and NPK level. 2 Hrs.
3. Propagation of mulberry- seedling, sapling , grafting and layering. 2 Hrs
4. Raising of commercial nursery. 1 Hrs
5. Application of root inducing hormones. 1 Hrs

Unit –2

6. Establishment of mulberry garden under rain-fed and irrigated conditions:
(a) Planting season.
(b) Selection and preparation of land.
(c) Planting systems
(d) Selection and preparation of planting material
(e) Manuring, intercultivation and irrigation.
(f) Initial harvesting.
(g) Chawki garden; importance and maintenance. 6 Hrs.

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| 7. Manures and fertilizers: Types, dosage, application and schedule; biofertilizers and foliar nutrition; micro nutrients; composting and vermicomposting. | 3 Hrs. |
| 8. Intercultivation practices: Purpose, methods, time and frequency; mulching; Weeding. | 1 Hrs. |

Unit-3

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| 9. Irrigation: Importance, Source, methods, periodicity and quantity of irrigation, over-irrigation and its effects. | 2 Hrs. |
| 10. Leaf harvesting: harvesting methods (leaf and shoot harvests); transportation and preservation of harvested leaf. | 2 Hrs. |
| 11. Estimation of leaf yield in rainfed and irrigated conditions: Importance of leaf quality | 1 Hrs. |
| 12. Integrated weed management | 2 Hrs. |

Part-B: Silkworm rearing.

Unit -4

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| 13. Rearing house: Location, orientation, plan and utilities; model rearing house; low-cost rearing house. | 2 Hrs. |
| 14. Rearing appliances-shelf and shoot rearing; requirements of rearing appliances (per unit rearing of 100dfis). | 2 Hrs. |
| 15. Disinfection of rearing house and rearing appliances; disinfectants (formalin, bleaching powder, chlorine dioxide, slaked lime and iodine compounds); rearing and personal hygiene. | 2 Hrs. |

Unit-5

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| 16. Selection of silkworm races/breeds for rearing- advantages and disadvantages of bivoltine and multivoltine pure races/ breeds and hybrids. | 2 Hrs. |
| 17. Incubation- definition, requirement of environmental conditions, incubation devices; identification of stages of development; black boxing and its importance. | 2 Hrs. |
| 18. Chawki rearing: Preparation; brushing and its methods; types of chawki rearing – traditional and improved method; optimum environmental conditions; methods and frequency of feeding; methods of bed cleaning; spacing; moulting and care during moult. | 5Hrs. |

Unit -6

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| 19. Late age silkworm rearing: Methods; optimum environmental conditions; feeding quantity and frequency; methods of bed cleaning; spacing; moulting and care during moult. | 4 Hrs. |
| 20. Identification of spinning larva; spinning; mounting and mounting density; types of mountages, their advantages and disadvantages; environmental requirements during spinning. | 2 Hrs. |
| 21. Harvesting: Time of harvesting; sorting, storage/ preservation, packaging and transport of cocoons; leaf-cocoon ratio; maintenance of rearing records. | 3Hrs. |

PRACTICAL –2: MULBERRY CULTIVATION AND SILKWORM REARING. 15 Practicals -3 hrs each

Mulberry cultivation;

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| 1. Determination of soil pH and water holding capacity. | 2 Prct. |
| 2. Farm implements. | 1 Prct. |
| 3. Preparation of land, pits and rows; preparation of rooting media (fieldwork). | 1 Prct. |
| 4. Raising of sapling and seedling (field work). | 1 Prct. |
| 5. Intercultivation, mulching, irrigation, pruning and estimation of leaf yield. (demonstration and exercise). | 1 Prct. |
| 6. Grafting and Layering in mulberry. | 1 Prct. |
| 7. Harvesting and preservation techniques; leaf selection for different instars. | 1 Prct |

Silkworm rearing;

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| 8. Rearing houses- model rearing house and low-cost rearing house. | 1 Prct. |
| 9. Rearing appliances. | 1 Prct. |

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| 10. Disinfection- Types of disinfectants- concentration and dosage requirement; preparation of spray formulation of disinfectants. | 1 Prct. |
| 11. Incubation of silkworm eggs- Methods; black boxing; maintenance of temperature and humidity; | 1 Prct. |
| 12. Brushing: Methods; chawki rearing; use of paraffin paper and blue polythene sheet. Bed cleaning: use of bed cleaning net and disposal of bed refuses and silkworm litter. | 1 Prct. |
| 13. Moulting: Identification of moulting larva, care during moulting; mounting and mounting density; harvesting of cocoons; assessment of cocoons; types of mountages; Maintenance of records for silkworm rearing. | 2 Prct. |

III SEMESTER

PAPER –3: PHYSIOLOGY OF MULBERRY AND SILKWORM.

3 hrs/week X 15 = 48 hrs.

Part –A : Physiology of Mulberry.

Unit –1

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| 1. Absorption of water and solutes by roots; effect of external conditions; root pressure; ion exchange and active absorption. | 4 Hrs. |
| 2. Mineral nutrition- macro and micro nutrients; their physiological role. | 3 Hrs |

Unit -2

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| 3. Brief account of photosynthesis: Outline of the process; types of carbon fixation (C3 and C4); brief account of photorespiration and its significance. | 5 Hrs. |
| 4. Role of environmental factors on mulberry growth. | 2 Hrs. |

Unit-3

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| 5. Biochemical composition of mulberry leaf | 2 Hrs. |
| 6. Transpiration: Significance; stomata- mechanism of opening and closing; regulation of water loss by stomata; factors influencing the rate of transpiration. | 2 Hrs. |
| 7. Brief account of biological nitrogen fixation; types- importance in mulberry cultivation. | 2 Hrs. |
| 8. Plant growth regulators: Importance and application in mulberry, agriculture and horticulture. | 2 Hrs. |
| 9. Biofertilizers, types and its significance. | 2 Hrs |

Part-B: Developmental Biology and Physiology of Silkworm.

Unit-4

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| 10. Morphology and structure of silkworm egg, fertilization, cleavage, blastoderm, germ band formation, blastokinesis, eye spot and blue egg; diapause development . | 6Hrs. |
| 11. Digestion: structure and function of digestive system; digestive enzyme; process of digestion. | 2 Hrs. |

Unit-5

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| 12. Respiration: tracheal systems- spiracles, mechanism of respiration, factors affecting respiration. | 2 Hrs. |
| 13. Excretion: structure and function of excretory system and cryptonephrial arrangement and its significance in water regulation. | 2 Hrs. |
| 14. Neuro -endocrine system: Nervous system; Structure and distribution of endocrine glands; role of nervous system in endocrine function. | 4 Hrs |

Unit-6

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| 15. Sense organs: Photoreceptors, Chemoreceptors and Mechanoreceptors. | 2 Hrs. |
| 16. Circulation: heart beat-role of alary muscles; accessory hearts; blood pressure in open circulatory system. Haemolymph. | 2 Hrs. |
| 17. Reproduction: Male and female reproductive systems in insects; role of accessory gland; oviposition. | 2 Hrs. |
| 18. Metamorphosis- types of insect metamorphosis, theories of metamorphosis. | 2 Hrs. |

Physiology of mulberry;

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| 1. Estimation of stomatal index | 1 Prct. |
| 2. Kranz Anatomy in relation to photosynthesis. | 1 Prct. |
| 3. Estimation of leaf protein | 1 Prct |
| 4. Separation of leaf photosynthetic pigments of mulberry through paper chromatography. | 1 prct |
| 5. Extraction of photosynthetic pigments by solvent wash method. | 1 Prct |
| 6. Determination of water potential of potato tubers. | 1 Prct |
| 7. Estimation of moisture percentage and moisture retention capacity of mulberry leaf . | 1 Prct |

Developmental Biology and Physiology of silkworm;

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| 8. Morphology of silkworm egg and mounting of 7 th , 8 th and 9 th day old embryos. | 2 Prct. |
| 9. Estimation of proteins in haemolymph/egg, haemolymph glucose level. | 2 Prct |
| 10. Morphology of haemocytes in silkworm. . | 1 Prct. |
| 11. Estimation of amylase activity in haemolymph of bivoltine and multivoltine races. | 2 Prct. |
| 12. Estimation of SDH activity in the eggs/tissue. | 1 Prct. |

IV SEMESTER

PAPER- IV: MULBERRY AND SILKWORM CROP PROTECTION

3 hrs/week X 15 = 48 hrs.

Part-A: Diseases and pests of Mulberry.

Unit-1

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| 1. Introduction to plant diseases and importance of plant protection. | 1 Hrs. |
| 2. Classification of mulberry diseases. | 1 Hrs. |
| 3. Influence of biotic and abiotic factors on the incidence of plant diseases | 1 Hrs. |
| 4. Mineral deficiency symptoms in mulberry. | 2 Hrs. |
| 5. Pesticides: Forms, formulations, calculation and application. | 3 Hrs |

Unit-2

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| 6. Fungal diseases of mulberry: Occurrence, symptoms, etiology and preventive and control measures of the following diseases : | |
| (a) Powdery mildew. | |
| (b) Leaf spot. | |
| (c) Leaf rust. | |
| (d) Leaf blight. | |
| (e) Root rot. | 5 Hrs. |
| 7. Root-knot disease of mulberry- occurrence, symptoms and preventive and control measures. | 1 Hrs. |
| 8. Viral, bacterial and dwarf diseases of mulberry- their occurrence- symptoms and preventive and control measures. | 2 Hrs. |
| 9. Pest: Definition; pest outbreak; pest forecasting . | 1 Hrs. |

Unit-3

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| 10. Major pests: leaf roller, Bihar hairy caterpillar, mealy bug and thrips – their preventive and control measures | 3 Hrs. |
| 11. Minor pests: girdlers, termites and mites-their preventive and control measures. | 2 Hrs. |
| 12. Biological control of mulberry pests. | 2 Hrs. |

Part B: Diseases and pests of silkworm.

Unit-4

13. Introduction; classification of silkworm diseases. 1 Hrs.
14. Protozoan disease – symptomatology, structure of pebrine spore, life cycle of *Nosema bombycis*, source, mode of infection and transmission, cross infectivity, prevention and control. 2 Hrs.
15. Bacterial diseases - causative agents, symptoms, factors influencing flacherie, source, mode of infection and transmission prevention and control. 3 Hrs.

Unit-5

16. Viral diseases (grasserie, infectious flacherie, cytoplasmic polyhedrosis, denonucleosis and gattine)- causative agents- symptoms – sources, mode of infection and transmission- prevention and control. 4 Hrs.
17. Fungal diseases: white and green muscardine and aspergillosis- causative agents- symptoms - structure and life cycle of fungal pathogen- mode of infection and transmission- prevention and control. 3 Hrs.
18. Integrated management of silkworm diseases. 2 Hrs.

Unit-6

19. Life cycle of Indian uzifly; seasonal occurrence; oviposition and host-age preference; nature and extent of damage; prevention and control; integrated management of Indian uzifly. 3 Hrs.
20. Cocoon pests of silkworm: Dermestid beetle- life cycle; nature and extent of damage; prevention and control measures. 1 Hrs.
21. Predators of silkworm: Cockroaches, ants, lizards and rodents; prevention and control measures. 2 Hrs.
22. Brief account of methods of pest control: Cultural, mechanical, physical, legislative (Quarantine), chemical, genetical / autocidal, biological and IPM. 3 Hrs.

PRACTICAL –4: MULBERRY AND SILKWORM CROP PROTECTION 15 Practicals -3 hrs each

Diseases and pests of Mulberry;

1. Study of powdery mildew, leaf spot and leaf rust through sectioning, staining and temporary mounting 3 Prct.
2. Study of root-knot nematode in mulberry 1 Prct.
3. Collection, mounting/preservation of insect pests of mulberry (field work). 1 Prct.
4. Identification of mulberry pests. Study of nature of damage of the following pests: Leaf roller, Bihar hairy caterpillar, scale insect, mealy bug, thrips, beetles, jassids and grasshoppers. 2 Prct.
5. Identification of fungicides, pesticides- their formulation. Study of various types of insecticide applicators (sprayers and dusters). 1 Prct.

Diseases and pests of silkworm;

6. Identification of different diseased silkworms based on external symptoms (grasserie, flacherie, muscardine and pebrine). Identification of pathogens associated with silkworm diseases: Staining and preparation of temporary slides of bacteria, spores of pebrine, polyhedra of nuclear polyhedrosis virus and mycelial mat of muscardine. 4 Prct.
7. Methods of application of silkworm bed disinfectants for management of silkworm diseases. 1 Prct.
8. Life cycle of Uzi fly; Identification of uzi-infested silkworms and cocoons. 1 Prct.

9. Life cycle of dermestid beetles: Dermestid infested silkworm cocoons and estimation of incidence. 1 Prct.

V SEMESTER

PAPER-5 :- GENETICS AND BREEDING OF MULBERRY AND SILKWORM

3 hrs/week X 15 = 48 hrs.

Part-A: Cytogenetics and breeding of mulberry.

Unit-1

1. Ultra-structure of eukaryotic cell. 2 Hrs.
 2. Ultra-structure of chromosomes; Special types of chromosomes- lampbrush and salivary gland chromosomes. 3 Hrs.
 3. Cell division; Mitosis and Meiosis. 3 Hrs.

Unit-2

4. Brief account of polyploidy in plants- polyploidy in mulberry. 1Hrs.
 5. Chromosomal aberration- Deletion, duplication, inversion and translocation. 2 Hrs.
 6. Mutation- Types; mutagens; physical and chemical mutagenesis. 3 Hrs.
 7. Germplasm bank: Importance; collection, characterization and maintenance. 2 Hrs.

Unit-3

8. Plant introduction and acclimatization; Quarantine. 2 Hrs.
 9. Mulberry breeding: Objectives; selection methods; hybridization, polyploidy breeding and mutation breeding; breeding for disease and drought resistance. 5 Hrs.
 10. Evaluation of selected genotypes and release of improved variety. 1 Hrs.

Part-B: Genetics and breeding of silkworm.

Unit-4

11. Structure and chromosome numbers in mulberry and non-mulberry silkworms- evolutionary significance of chromosomes in *Bombyx mori*. Linkage groups in *Bombyx mori*. 2 Hrs.
 12. Sex determination mechanism in silkworm- importance of ZZ and ZW chromosomes- sex-limited races. 2 Hrs.
 13. Gametogenesis- Oogenesis and Spermatogenesis 2 Hrs.
 14. Genetic basis of voltinism and moulting in the silkworm, *Bombyx mori*. 2 Hrs.

Unit-5

15. Hereditary traits of silkworm egg and larva. 2 Hrs.
 16. Genetics of cocoon colours- inheritance of cocoon colours. 2 Hrs.
 17. Parthenogenesis in silkworm- types and induction of parthenogenesis. 2 Hrs.
 18. Silkworm germplasm bank. 2 Hrs.

Unit-6

19. Introduction to silkworm breeding- inbreeding and out breeding concepts- objectives of silkworm breeding-techniques- different types of breeding methods- line breeding, cross breeding and mutation breeding. 4 Hrs.
 20. Selection: Methods- individual and mass selection- fixation of characters- evolution of new breeds- race authorization. 2 Hrs.
 21. Heterosis and hybrid vigour-exploitation of heterosis in silkworm- concept of single, double and polyhybrids. 2 Hrs.

PRACTICAL -5:- MULBERRY AND SILKWORM BREEDING.

2hours/week x 14 practicals of 28 hrs.

Mulberry breeding;

1. Mulberry germplasm and Mulberry multilocational trials (field visit). 1 Prct.
 2. Evaluation of breeding parameters in different mulberry varieties. 2 Prct.

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| 3. Induction of tetraploidy in mulberry by using colchicin (Demonstration). | 1 Prct. |
| 4. Study of mitosis in onion root tip. | 2 Prct. |
| 5. Mulberry breeding equipments | 1 Prct |

Silkworm breeding;

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| 6. Study of meiosis in grasshopper and silkworm testis. | 2 prct. |
| 7. Identification of different races of silkworm cocoons- NB ₄ D ₂ , KA, PM, C.Nichi, Nistari, CSR ₂ and CSR ₄ race/ breeds characters. | 1 prct. |
| 8. Identification of mutants of silkworm larva- zebra, ursa, knobbed and sex-limited Races. | 2 prct. |
| 9. Comparative assessment of the hybrids and pure race cocoons. | 2 prct. |

PAPER-6:- SILKWORM SEED PRODUCTION AND BIOTECHNOLOGY 3 hrs/week X 15 = 48 hrs.

Part-A: Silkworm seed production.

Unit-1

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| 1. A general account of silkworm seed, grainages, production and demand trends. | 2 Hrs. |
| 2. Silkworm seed organisation, significance of seed organization; Basic seed multiplication centres- P4, P3, P2 and P1; Seed areas- identification, concept of selected seed rearers/ villages- Seed Legislation Act- maintenance of seed crops. Seed cocoon markets- pupal examination, certification of seed cocoon lots- price fixation for seed cocoons. | 6 Hrs. |

Unit-2

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| 3. Disinfection and hygiene in seed production units. | 2 Hrs. |
| 4. Seed production centres (grainages)- types of grainages- organisation and functions of plan for model grainage- grainage equipments and their use - Seed production plan. | 3 Hrs. |
| 5. Procurement and transportation of seed cocoons- processing and preservation of seed cocoons- sex separation in seed cocoons. | 2 Hrs. |

Unit-3

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| 6. Moth emergence and synchronisation; sex separation in moth; effect of improper synchronisation on egg hatching and quality-safe duration. | 2 Hrs. |
| 7. Coupling and decoupling; oviposition; method of egg production; refrigeration of male moths; mother moth examinations- individual and mass methods- dry moth examination; environmental conditions for grainage activity. | 2 Hrs. |
| 8. Egg disinfection- handling of multivoltine eggs- preservation of eggs to postpone hatching- ideal embryonic stages for cold storage- maximum duration of cold storage. | 2 Hrs. |

Unit-4

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| 9. Handling of bivoltine eggs for early hatching- physical and chemical methods- hot and cold acid treatment. | 2 Hrs. |
| 10. Postponement of hatching; hibernation schedule for 3, 4, 6 and 10 month's duration. | 3 Hrs. |
| 11. Preparation of loose egg- advantages- handling of loose eggs; Incubation of eggs. | 2 Hrs. |

Part –B: Biotechnology;

Unit-5

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| 12. Nucleic acids: Introduction- chemical structure of DNA and RNA- Watson and Crick model of DNA- Types of RNA- tRNA, mRNA and rRNA- DNA replication. | 5 Hrs. |
| 13. Protein synthesis: Synthesis of mRNA, RNA polymerase- polyribosomes- translation. Genetic code- salient features. | 4 Hrs. |

Unit-6

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| 14. Introduction to recombinant DNA technology. | 3 Hrs. |
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15. Brief account of tissue culture and morphogenesis; Its applications in crop improvement. 4 Hrs.
 16. Brief account of genetic engineering- concept and technique. Applications in sericulture. 4Hrs.

Practical VI- SILKWORM SEED PRODUCTION. AND BIOTECHNOLOGY

2hours/weekX14 practicals of 28 hrs

Silkworm Seed production;

1. Model grainage plan and Grainage equipments. 1 Prct.
2. Seed cocoon processing/handling- deflossing, sorting and preservation- pupal examination and Sex separation of pupa and moth. Moth emergence- selection of moths-pairing and de-pairing- oviposition- preservation of male moths- preparation of disease free layings- sheet egg and loose egg preparation. Mother moth examination for Pebrine spores- Individual and Mass moth examination- surface disinfection of silkworm eggs. 3 prct.
3. Acid treatment of bivoltine eggs- hot acid and cold acid treatment. & Incubation of eggs-Visit to cold storage to know preservation and handling of hibernated eggs for 3, 4, 6 and 10 month hibernation schedules. 3 Prct.
4. Tissue culture technique (Demonstration and/visit to any research institute). 2 Prct.
5. Extraction of DNA from plant and animal sources 3 Prct.
6. Quantification of DNA by Spectrophotometer/DPA method. 2 Prct.

VI SEMESTER

PAPER-VII: SILK TECHNOLOGY

3 hrs/week X 15 = 48 hrs.

Unit-1

1. Introduction to different textile fibres. 2 Hrs.
2. Physical and commercial characteristics of cocoons: cocoon colour, shape, size, hardness, grain/wrinkle, weight of cocoon, weight of cocoon shell, shell ratio, 2 Hrs.
3. Cocoon marketing- Procedure for procurement of raw material- purchase of cocoon in open auction; grading of cocoons- visual inspection and selection. 2 Hrs.
4. Cocoon sorting: Objectives and procedure; defective cocoons- double, flimsy, melted, urinated, stained, uzi-infested, moth emerged, deformed and flossy. 2 Hrs.

Unit-2

5. Cocoon stifling: Definition, objectives, different methods-conventional and modern techniques- steam stifling. Hot air drying- Batch type and conveyer type; advantages and disadvantages. 3 Hrs.
6. Conditioning and preservation- Methods of storing and preservation of stifled cocoons. 1 Hrs.
7. Cocoon cooking/boiling: Definition and objectives, different methods of cocoon boiling- Mono pan, three pan and pressurized cocoon boiling methods. 2 Hrs.
8. Cocoon brushing: Definition and objectives; methods- stick, hand and mechanical brushing. 2 Hrs.

Unit-3

9. Reeling water; quality required for silk reeling, total and permanent hardness, optimal pH; corrective measures. 3 Hrs.
10. Reeling: Objective and cocoon reeling from various devices-country charaka, cottage basin, multi end reeling machine, auto and semi-automatic, improved CSTR reeling devices; advantages and disadvantages. 3 Hrs.
- 11 Re-reeling and packing: Objectives, process; lacing, skeining, booking and baling. 2 Hrs.

Unit-4

12. Raw silk properties- physical, chemical and biological. Uses of raw silk- Textile and other commercial uses. 2 Hrs.

13. Raw silk testing and grading; Visual inspection. Mechanical tests- winding test, size deviation test, seriplane test, serigraph test and cohesion test.
Supplementary tests- conditioning weight, scouring loss, exfoliation tests. 4 Hrs.
14. Silk throwing: Introduction, objectives of silk throwing, preparation for twisting, soaking, winding, doubling, twisting (high & low), heat/steam setting, rewinding. 3 Hrs.

Unit-5

15. Silk weaving:
Warp preparation- warp, beaming, drawing and denting.
Weft preparation- different pirn winding methods.
Powerloom and handloom weaving.
Flow chart of weaving; weaving defects. 3 Hrs.
16. Chemical processing of silk yarns and fabric:
Introduction and objectives of degumming- Methods.
Silk bleaching- Importance and processing.
Silk dyeing-Acidic and basic dyeing processing. Introduction of different classes of dyes and chemicals used for silk dyeing. 3 Hrs
17. Detailed study of spun silk industry- various steps involved, flow chart, spun silk yarn and noil yarn. 2 Hrs.
18. Printing of silk fabrics: Objectives, methods- hand and screen-printing. 1 Hrs.

Unit-6

19. Silk finishing: Objectives, methods- Mechanical and chemical finishing. 2 Hrs.
20. Introduction to by-products of sericulture industry, by- product utilization in mulberry; types of silk waste and pupal waste-oil extraction and cake preparation. 4 Hrs.

PRACTICAL-VII; SILK TECHNOLOGY.

14 practical of 2 hrs each.

Silk reeling;

1. Categorization of different types of cocoons- good and defective cocoons- calculation of percentage of each type . 1 Prct.
2. Cocoon stifling- different methods and determination of degree of drying. 1 prct.
3. Reeling water: Determination of total and permanent hardness, alkalinity and pH. 1 Pract
4. Determination of commercial characters of cocoon-average cocoon weight, shell weight, shell percentage or shell ratio, average filament length, reelability, raw silk recovery percentage, renditta and denier; reeling on epprouvette. 2 Prct.
5. Identification of silk, cotton, wool and synthetic fibre (viscose/nylon/polyester) by physical method- flame and microscopic test, chemical and confirmatory tests. 2 Prct.
6. Study of charaka, cottage basin, multi-end silk reeling machine, automatic and semi- automatic reeling machine-practical demonstration.
(visit to private reeling unit and filature)
7. Degumming of raw silk by soap & soda wash method and estimation of sericin and fibroin percentage. 2 Prct.
8. Study of silk fabric manufacturing unit- Power & handloom. Identification of Weaving defects (Visit only)
9. Bleaching of silk fibers. 1 Prct
10. Silk dyeing to obtain different shades using acid dye stuff. 2 Prct.
11. Identification of different types of silk waste; floss, cooker, reeler, basin refuse and re-reeling waste, dupion silk. 1Prct
12. Pupal oil extraction (Demonstration). 1 Prct.

PAPER-8: NON-MULBERRY SERICULTURE, SERICULTURE EXTENSION AND ECONOMICS.

3 hrs/week X 15 = 48 hrs.

Part A: Non-mulberry Sericulture.

Unit-1

1. Types of non-mulberry silkworms and their distribution in India and other countries. 1 Hrs.
2. Taxonomy of food plants of non-mulberry silkworms: Study of salient features of the families, Magnoliaceae, Caesalpiniaceae, Euphorbiaceae, Combretaceae, Apocyanaceae, giving more emphasis on the plants of Sericultural importance. 5 Hrs
3. Cultivation of primary food plants of tasar, muga, and eri silkworms- *Terminalia arjuna*, *Machilus bombycina*, *Ricinus communis* and their systematic position. 3 Hrs.

Unit-2

4. Life cycle of Tasar, Eri and muga silkworms. 3 Hrs
5. Brief account of important diseases and pests of primary non-mulberry food plants and their management. 2 Hrs
6. Rearing of non-mulberry silkworms. Ecological conditions that influence rearing of non-mulberry silkworms- improved rearing methods for young and late age tasar, eri and muga silkworms. Mounting methods- different kinds of mountages- rearing of seed and commercial crops- Indoor rearing of tropical tasar and muga silkworms. 5 Hrs.

Unit-3

7. Seed cocoons- Procurement- cocoon preservation-synchronization of moth emergence- production of disease free eggs 2 Hrs.
8. Diseases of non-mulberry silkworms- protozoan, bacterial, viral and fungal diseases. Symptoms- causative agents-preventive and control measures. 4 Hrs.

Part-B : Sericulture extension and economics.

Unit-4

9. Extension education- meaning ,objectives and importance. 1 Hrs.
10. Principles and concepts of extension education 2 Hrs
11. Extension programmes- concepts and principles, role of extension personnel and farmers in programme planning Transfer of technology. 2 Hrs.

Unit-5

12. Communication- definition and planning- types of communication. 2 Hrs.
13. Training- concepts and definition- different methods of training. 2Hrs.
14. TSC's and Co-Operative chawki rearing centers: Role and Importance. 2 Hrs.
15. Farm management; 2 Hrs.

Unit-6

15. Mulberry cultivation (per hectare) –Cost and returns under irrigation and rainfed condition . 2 Hrs.
16. Economics of egg production: Expenditure and income. 2 Hrs.
17. Economics of silkworm rearing: Investment and returns. 2 Hrs.
18. Economics of silk reeling (per kg of rawsilk): Cost and returns for different types of reeling establishments. 2 Hrs.
19. Silk exchange, KSMB and KSIC. 2 Hrs.

Practical VIII: NON-MULBERRY SERICULTURE AND SERICULTURE EXTENSION

14 practical of 2 hrs each.

Non Mulberry sericulture;

1. Rearing appliances used in rearing and seed preparation of non mulberry silkworms (drawing sketches) . 3 Prct

- | | |
|--|---------|
| 2. Taxonomic features of non-mulberry food plants (<i>Terminalia arjuna</i> ,
<i>Terminalia catapa</i> , <i>Ricinus communis</i> , <i>Michilia champaca</i> , <i>Quercus</i> sp., <i>Bauhinea
vareigata</i> and <i>Manihot utilissima</i>). | 4 Prct. |
| 3. Life cycle and morphology of egg, larva, pupa, cocoon and moths of different non-
mulberry silkworms. | 3 Prct. |

Extension;

- | | |
|---|--------|
| 4. Preparation of audio visual aids- Charts, hand outs, pamphlets- film shows – arranging
and conducting of panel discussion with the rearers. | 1 Prct |
| 5. Visit to rearers' house and panel discussion with farmers. | 1 Prct |
| 6. Visit to TSC and CRC. | 1 Prct |
| 7. presentation of statistical data- Bar chart and graph, pie chart of raw silk, cocoon, area
under mulberry cultivation, import And exports. | 1 Prct |

SCHEME OF THEORY EXAMINATION

Sl.No.	Semester	Paper	Marks for theory	Marks for Internal Assessment	Total
1	I	I	60	10	70
2	II	II	60	10	70
3	III	III	60	10	70
4	IV	IV	60	10	70
5	V	V	80	20	100
6	V	VI	80	20	100
7	VI	VII	80	20	100
8	VI	VIII	80	20	100
Total			560	+ 120	680

QUESTION PAPER PATTERN

I-IV SEMESTER

Sl. No	Types of question	Marks /Question	No. of Questions to be asked	No of Questions to be answered	Total
1	Objective	1	05	05	05
2	Short answer	3	07	05	15
3	Medium Type	5	06	04	20
4	Long answer/ Essay	10	03	02	20
Total					60

V- VI SEMESTER

Sl. No	Types of question	Marks /Question	No. of Questions to be asked	No of Questions to be answered	Total
1	objectives	1	6	6	6
2	Short answer	3	10	8	24
3	Medium Type	5	06	04	20
4	Long answer/ Essay	10	05	03	30
Total					80

Distribution of Internal Assessment.

1. Three class test for 10 Marks each will be conducted at the end of each semester.

OR

One class test for 30 Marks will be conducted at the end of each Semester.

Note: Examination question paper pattern will be followed for every class test.

INSTRUCTION TO PRACTICALS:

1. Importance should be given to students participation in the observation of morphological characters. Students should complete the record work before the next practical classes and it has to be signed by the teacher and later submission should be entered in their record.
2. Student who are absent for a particular practical classes, wherever possible be allowed to complete the record only when they make observation in the next practical class.
3. Students should submit the certified practical record at the time of practical examination otherwise they will not be allowed to take the practical examination without the certified record and field report.

Scheme of Practical examination: -

a) Distribution of Marks (Semester wise):

Sl.No.	Semester	Marks for practical	Marks for Internal assessment
1	I	20	10
2	II	20	10
3	III	20	10
4	IV	20	10
5	V	80	20
6	VI	80	20
Total Marks for Practicals =240		+	80 =320

b) Distribution of Marks for Practicals:

Semester	Marks	Type	Marks
I-IV	a) 20 marks for practical	a) One question from Sericultural Botany Part	07
	b) 10 marks for internal assessment	b) One question from Silkworm Biology Part	07
		c) Identification and Commenting (1.5X4)	06
V-VI	a) 40 marks for practical	a) One major question	12
		b) One minor question	20
	b) 10 marks for Internal assessment	c) One minor question	08
		d) Identification and Commenting (5X4)	10

Note: Questions will be covered from all sections

Internal assessment for practicals:

Semester	Distribution	Marks	Duration
I-IV	a) Based on the performance of students at every practical / field work	05	3 Hrs
	b) Submission of practical records, herbarium and rearing / tour report	05	
V-VI	a) Based on the performance of every student in rearing work / mulberry cultivation and reports	15	4 Hrs
	b) Submission of practical records and tour report	05	

Summary of distribution of Mark:

Theory			Practicals	
Semester	Examination proper	Internal assessment	Examination proper	Internal assessment
For each semester for I-IV	60 Marks	10 marks (one class test and one assignment 05+05=10)	20	10 (5 for regular assessment, 5 for submission of records)
For V-VI	80	20 (one class test for 15 marks and one assignment for 05 marks) +	40	20
	80	20 (one class test for 15 marks and one assignment for 05 marks).	40	20

SCHEME OF PRACTICAL EXAMINATION

Practical I

Max. Marks - 20

Q 1. Taxonomic description of any one of the food plants of mulberry/non-mulberry silkworms. - 07 marks

Note: Distribution of marks

- a) Identification of family / classification - 1.5
- b) Diagnostic features - 4.0
- c) Sericultural importance - 1.5

OR

Sectioning and Mounting of petiole, leaf lamina, stem and root.

Note: Distribution of marks

- a) Preparation - 2.0
- b) Identification - 03
- c) Procedure - 02

Q 2. Any one of the following: - 07 marks

Male/ female reproductive system/ silk glands/ digestive system / nervous system/sex separation at larval/ pupal / moth stage.

Note: Distribution of marks

- a) Dissection/ sex separation - 4.0
- b) Labeled diagram - 3.0

Q 3. Identification: 06 marks ---1.5 marks each.
Any FOUR from the practical syllabus

Practical II

Max. Marks - 20

Q 1. Determination of soil pH/ grafting/ layering/ water holding capacity. -- 07 marks

Note: Distribution of marks

- a) Procedure - 2.0
- b) Diagramme - 1.0
- c) Experiment - 4.0

Q 2. Calculations and procedure about disinfection/ brushing/ bed cleaning/ hatching Percentage -- 07 marks

Note: Distribution of marks

- a) Procedure - 2.0
- b) Experiment - 5.0

Q 3. Identification: 06 marks ---1.5 marks each.
Any FOUR from the practical syllabus.

Practical III

Max. Marks - 20

Q 1. Separation of photosynthetic pigments/ water holding capacity of potato tubers / Stomatal index
-- 07 marks

Note: Distribution of marks

- a) Procedure - 2.0
- b) Diagramme - 1.0
- c) Experiment - 4.0

Q 2. Mounting of silkworm embryo (7th/ 8th/ 9th day) -- 07 marks

Note: Distribution of marks

- a) Procedure - 2.0
- b) Experiment - 5.0

Q 3. Identification:

Any FOUR from the practical syllabus 06 marks ---1.5 marks each.

Practical IV

Max. Marks – 20

Q 1. Temporary mounting of any one of the following -- 07 marks
Leaf spot/ leaf rust/ powdery mildew/ root knot nematode of mulberry.

Note: Distribution of marks

- a) Identification - 1.5
- b) Sectioning, staining and mounting -4.0
- c) Labelled diagram - 1.5

Q 2. Temporary mounting of any one of the following. -- 07 marks
Pebrine spore/ nuclear polyhedral bodies/ mycelia and conidial spores.

Note: Distribution of marks

- a) Identification - 1.0
- b) Staining and mounting -4.0
- c) Procedure - 2.0

Q 3. Identification:

Any FOUR from the practical syllabus. 06 marks —1.5 marks each.

Practical V**Max. Marks - 40****Q 1.** Temporary squash preparation of mitotic/ meiotic chromosomes

Onion root tip/ grasshopper testis/ silkworm testis.

-- 12 marks

Note: Distribution of marks

- a) Procedure - 2.0
- b) Staining and preparation of chromosomes - 6.0
- c) Identification of stages - 2.0
- d) Labelled diagram -2.0

Q 2. Any one of the following:

-- 10 marks

Mother moth examination/assessment of cocoons of pure races for cocoon weight, shell weight and other racial characters.

Note: Distribution of marks

- a) Procedure - 04.0
- b) Experiment - 06.0

Q 3. Any one of the following:

Evaluation of breeding parameters of different mulberry varieties/ mulberry hybridization experiments.

-- 8 marks

Note: Distribution of marks

- a) Procedure - 03.0
- b) Experiment - 05.0

Q 4. Identification:

Any FIVE from the practical syllabus.

--10 marks –2.5 marks each

Practical VI**Max. Marks - 40****Q 1.** Cold/Hot acid treatment of silkworm eggs.

-- 12 marks

Note: Distribution of marks

- a) Procedure - 4.0
- b) Experiment - 8.0

Q 2. Any one of the following

Pupa/Mother moth examination

-- 10 marks

Note: Distribution of marks

- a) Procedure - 04.0
- b) Experiment - 06.0

Q 3. Any one of the following:

-- 8 marks

Sex separation of pupal or moth stage/loose eggs or laying preparation demonstration/hatching percentage

Note: Distribution of marks

- a) Procedure - 03.0
- b) Experiment - 05.0

Q 4. Identification:

Any FIVE from the practical syllabus.

--10 marks –2.5 marks each

Practical VII**Max. Marks - 40**

- Q 1.** Estimation of filament length/ reelability/ raw silk % recovery/ renditta/denier (any two)
From the given cocoons. -- 12 marks

Note: Distribution of marks

- a) Procedure - 5.0
b) Experiment - 7.0

- Q 2.** Estimation of fibroin and sericin % from the cocoon shell/identification of textile fibers by
physical and chemical Tests. -- 10 marks

Note: Distribution of marks

- a) Procedure - 04.0
b) Experiment - 06.0

- Q 3.** Any one of the following: -- 8 marks
Identification, sorting and percentage determination of different types of cocoons/
Estimation of shell weight, shell %/ Determination of total alkalinity/ Water pH.

Note: Distribution of marks

- a) Procedure - 03.0
b) Experiment - 05.0

- Q 4.** Identification: --10 marks (2.5 marks each).
Any FIVE from the practical syllabus.
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Practical VIII**Max. Marks - 40**

- Q 1.** Taxonomy of non-mulberry food plants/dissection of any non-mulberry silkworms
-12 mark

Note: Distribution of marks

- a) identification -1.0
b) classification - 2.0
c) diagnostic features - 7.0
d) sericultural importance - 2.0

- Q 2.** Preparation of bar charts/graphs/pie charts - 10 marks

- a) calculation - 04.0
b) preparation - 06.0

- Q 3.** Any one of the following: - 8 marks
Preparation of charts/handouts/pamphlets
Note: Distribution of marks
a) Preparation - 08.0

- Q 4.** Identification --10 marks -2.5 marks each
Any FIVE from the practical syllabus.
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