

RASHTRASANT TUKADOJI MAJARAJ NAGPUR UNIVERSITY, NAGPUR
SYLLABUS FOR M. Sc. SERICULTURE
(Credit based Semester pattern)

Syllabus for M. Sc. Sericulture (Semester with credit based Pattern) w e f 2012-13 Academic session

The syllabus for M. Sc. Sericulture is based on semester with credit based pattern comprises of four semesters. The examination shall comprise of 16 (Sixteen) theory papers of 100 marks each. Each paper is equivalent to 4 credits hence total credits of 16 theory papers are 64 (16x4=64). There shall be seven practicals and a project work of 100 marks each, equivalent to the total 32 credits (7 practicals x 4 =28 + a project work x 4= 4). The Examination in each theory paper shall be of three hours duration and that of each practical shall be of 6 hours. The seminar shall be conducted during the First, Second, Third and Fourth semester. Each seminar shall be of 25 marks equivalent to 1 credit (4 seminars x1= 4 credits). At the end of Fourth semester candidate has to submit a Project work. The project work shall be of 100 marks. Candidates are expected to pass separately in seminar, theory, project and practical examination. The work load for each theory paper shall be of 4 clock hours per week. Work load for each practical shall be of 8 clock hours per week. Two clock hours per week will be devoted to seminar. Eight (08) clock hours per week will be devoted to project work. In IV semester, project work is compulsory for all the students. The structure of syllabus for M. Sc. Sericulture (Semester with credit based pattern) is also displayed in the following Table 1 and 2.

Table -1

Semester with credit based pattern for M. Sc. Zoology

| Semester | Theory (T) Papers & Marks/ Practical (P) & Marks/ Seminar (S)/Project | Credit | Total Marks/ Credit | Grand total Marks & credit |
|-----------------|--|--|----------------------------|---------------------------------------|
| I | T-4 X 100 = 400 P-2 X 100 = 100 S-1 X 25 = 25 | 4 X 4 = 16 2 X 4 = 08 1 X 1 = 01 | 625/25 | 2500 marks 100 credits |
| II | T-4 X 100 = 400 P-2 X 100 = 100 S-1 X 25 = 25 | 4 X 4 = 16 2 X 4 = 08 1 X 1 = 01 | 625/25 | |
| III | T-4 X 100 = 400 P-2 X 100 = 100 S-1 X 25 = 25 | 4 X 4 = 16 2 X 4 = 08 1 X 1 = 01 | 625/25 | |
| IV | T-4 X 100 = 400 P-1 X 100 = 100 S-1 X 20 = 25 Project = 100 | 4 X 4 = 16 1 X 4 = 04 1 X 1 = 01 1 X 4 = 04 | 625/25 | |

Table -2. M. Sc. Sericulture syllabus, semester with credit based pattern (Theory)

| Semester | Paper | Title of paper | Work load hours/week | Marks |
|----------|-------|---|----------------------|-------|
| I | I | General Sericulture and Biology of Silkworm | 4 | 100 |
| | II | Morphology, Anatomy and Physiology of Silkworm | 4 | 100 |
| | III | Biology of Mulberry and Tasar Silk Host Plants | 4 | 100 |
| | IV | Biology of Muga and Eri Host Plants | 4 | 100 |
| II | V | Pest and Diseases of Mulberry silkworm and Host Plants | 4 | 100 |
| | VI | Pest and Diseases of non- Mulberry silkworm and Host Plants | 4 | 100 |
| | VII | Cell and Molecular Biology | 4 | 100 |
| | VIII | Physiology and Biotechnology | 4 | 100 |
| III | IX | Silkworm Seed and Rearing Technology | 4 | 100 |
| | X | Biology and mulberry silkworm rearing technology | 4 | 100 |
| | XI | Genetics and Breeding of mulberry Silkworms | 4 | 100 |
| | XII | Genetics and breeding of silkworms and host plants | 4 | 100 |
| IV | XIII | Mulberry Silk Technology | 4 | 100 |
| | XIV | Non-Mulberry Silk Technology | 4 | 100 |
| | XV | Economics of Sericulture and Trading of Silk | 4 | 100 |
| | XVI | Extension, Management and Product Analysis | 4 | 100 |

M. Sc. Sericulture syllabus, semester with credit based pattern (Practical)

| Semester | Practical | Hours/Week | Marks |
|----------|---------------|------------|-------|
| I | Seminar-I | 02 | 25 |
| | Practical-I | 08 | 100 |
| | Practical-II | 08 | 100 |
| II | Seminar-II | 02 | 25 |
| | Practical-III | 08 | 100 |
| | Practical-IV | 08 | 100 |
| III | Seminar-III | 02 | 25 |
| | Practical-V | 08 | 100 |
| | Practical-VI | 08 | 100 |
| IV | Seminar-IV | 02 | 25 |
| | Practical-VII | 08 | 100 |
| | *Project work | 08 | 100 |

* The examinee shall be required to produce at the practical examination the following:

The two typed copies of project work signed by supervisor and certified by the Head of the Department/ Principal as a bonafide work of the examinee should be submitted at least one month prior to the commencement of the practical examination. The project shall comprise of Introduction, Materials and Methods, Results, Discussion, Summary and References along with the declaration by the candidate that the work is original and not submitted to any University for the award of the Degree and certified by the supervisor. The evaluation of the project work shall be held on the day of practical by the external and internal examiners and the marks will be submitted to the University as project marks. The subject of project shall be given to a group of not more than four students or to a single student independently on any topic from Life Sciences.

Study tour is to be undertaken in the Semester- I and –III.

SEMESTER- I

PAPER-I : GENERAL SERICULTURE AND BIOLOGY OF SILKWORM

Unit-I : General Sericulture

1. History of Sericulture
2. Geographical distribution of various species and economic races of silkworms.
3. Systematic position of mulberry, tasar, eri and muga silkworm.
4. Distribution of mulberry and non- mulberry silkworms.

Unit-II : Present status & distribution

1. Present status of sericulture industry in India.
2. Morphology of various stages of mulberry silkworm.
3. Morphology of various stages of non-mulberry silkworms
4. Problems and prospects of Sericulture in India.

Unit-III : Morphology of Silk gland of mulberry and non-mulberry silkworms

1. Morphological structure of silk gland of mulberry silkworm
2. Morphological structure of silk gland of non mulberry silkworm
3. Histological structure of silk gland
4. Development of silk gland

Unit- IV: Silk synthesis

1. Biosynthesis of Silk
2. Types of silk protein and constituents of silk
3. Effect of exogenous and endogenous factors on silk synthesis.
4. Role of environmental conditions on silk gland development

PAPER –II: MORPHOLOGY, ANATOMY AND PHYSIOLOGY

Unit-I : Morphology (Digestive, Circulatory, Excretory and Respiratory)

1. Morphology and histology of digestive system
2. Morphology of excretory system.
3. Morphology of respiratory system.
4. Morphology of dorsal vessel, types of haemocytes, composition of haemolymph and mechanism of circulation.

Unit- II: Physiology (Digestion, excretion, respiration and sensory organs)

1. Physiology of digestion.
2. Mechanism of excretion
3. Physiology of respiration
4. Sensory organs : Compound eyes, ocellus and other receptors.

Unit-III : Reproductive system, Embryonic development, silkworm Growth and Metamorphosis

1. Male reproductive system in mulberry and non-mulberry silkworms
2. Female reproductive system in mulberry and non-mulberry silkworms
3. Mechanism of spermatogenesis and oogenesis
4. Embryonic development, Silkworm growth and metamorphosis, Pathogenesis

Unit-IV : Neuroendocrine System

1. Structure of the cephalic neuroendocrine system
(a) Neurosecretory cells (b) Corpora cardiac (c) Corpora allata (d) Ecdycial glands.
2. Other endocrine components—Mid-gut endocrine cells, gonads, ventral ganglia.
3. Types of hormones, structure, control of moulting ,metamorphosis and reproduction
4. Exocrine glands and pheromones.

REFEENCE BOOKS:

1. **Handbook of Practical Sericulture** : Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.
2. **T.B. of Tropical Sericulture** : (1975), Publ., Japan Overseas Corporation Volunteers.
3. **FAO Manuals on Sericulture** : Anonymous (1972), Vol. I-IV

4. **Sericulture for Rural Development** : Hanumappa (1978), Himalaya Publication, Delhi.
5. **The Silkworm, an Important Laboratory Tool** : Tazima, Y. (1978), Kodansha Publications, Tokyo.
6. **Control of Silkworm Reproduction, Development and Sex** : Strunnikov, V.A. (1983), MIR Publications, Moscow.
7. **Tassar Culture** : Joly, M.S. Sen, S.K. and Absan M.M. (1974). CSTRI, Ranchi.
8. **Ericulture in India** Sarkar, D.C. (1988), CSB, Bangalore.
9. **Annual Report** of the Central Sericulture Research and Training Institute, Mysore.
10. **Annual Report** of the Central Silk Technological Research Institute, Bangalore.
11. **Annual Report** of Central Tassar Research Institute, Ranchi.
12. **Annual Report** of Muga Research Institute, Assam.
13. **General Text Book of Entomology** : Imms, A.D. (1961), Edn. 9 Rev. By O.W. Richards & R.G. Davis.
14. **Text Book of Comparative Endocrinology** : Gorman, A. & Bern, H. (1974). Wiley Eastern Pub. Delhi.
15. **Insect Physiology** : Wigglesworth, V.B. (1956) Edn. 5, Rev. Methven, London.
16. **Insect Hormones**: Novak, V.I.A. (1995), Chapman and Hall, London.
17. **Insect Structure and Function** : Chapman, R.R. (1985) ELBS Publ. New Delhi
18. **An Introduction to Sericulture** : Ganga, G. and Chetty, S.J. (1997), 2nd Edition, Oxford and IBH Publishing Co. Ltd., New Delhi.
19. **Principles of Sericulture** : Hisao Aruga, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
20. **Modern Entomology** : Tembhare, D.B. (1997), Himalaya Publishing House, Bombay.
21. **Handbook of Muga Culture** : Thangavelu, K. et. Al. (1988) CSB Publication, Bangalore.
22. **General Entomology** : Mani, M.S. (1994), Oxford & IBH Pub. Co. Pvt. Ltd., Delhi.
23. **General and Applied Entomology** : Nayar, K. et. al., (1995), Tata McGraw-Hill, Pub., New Delhi.
24. **Principles of Insect Morphology** : Snodgrass, R.C. (1970). Tata McGraw-Hill, Pub. Co. Bombay.
25. **A Text Book of Insect Morphology, Physiology and Endocrinology** : Tembhare, D.B. (1984), S. Chand and Co. New Delhi.
26. **Text Book of Applied Entomology** : Vols. I and II. Srivastava, K.P. (1983), Kalyani Publishers, Ludhiana/.

Practical-I : Biology of Silkworms and Host Plants

1. Identification of different types of silkworms.
2. Morphology of egg larva, pupa and adult of different silkworm types.
3. Life history of different silkworm types.
4. Dissection of digestive system of larva, pupa and adult, study of salivary gland.
5. Dissection of circulatory system of the larva, pupa and adult silkworm.
6. Dissection of the nervous system of larva and adult silkworm.
7. Dissection of reproductive system in the adult silkworm types.
8. Study of the silkworm cuticle : Abrasion test and chitosan test.
9. Study of the digestive enzymes; amylase, invertase, trehalase, lipase and protease.
10. Haemocyte types and their counts (Total and differential) in the larva and adult. (Reproductive Biology of Silkworm and Silkworm Biology-II)
11. Anatomy and histology of reproductive organs of silkworm.
12. Gametogenesis; Histological preparation of spermatogenesis and oogenesis.
13. Preparation and mounting of different embryonic stages of silkworm.
14. Study of retrocerebral complex of the silkworm.
15. Histomorphology of endocrine glands of the silkworm.
16. Study of the enzymes during metamorphosis : acid and alkaline phosphatase and beta glucuronidase.

17. Study of the moisture loss during larval and adult stages.
18. Demonstration of the uptake of dyes by the Malpighian tubules of larval stages and adult.
19. Demonstration of the uric acid in the Malpighian tubules.
20. Histological preparations of the various parts of: Digestive system, reproductive system, excretory system and silk glands of the Mulberry silkworm.

DISTRIBUTION OF MARKS

| | | | | | | | |
|--------------------|---|-----|-----|-----|-----|-----|------------|
| 1. | Dissection | ... | ... | ... | ... | ... | 15 |
| 2. | Identification of silkworm cocoons (1-5) | ... | ... | ... | ... | ... | 10 |
| 3. | Identification and comments on given spots (1-10) | ... | ... | ... | ... | ... | 20 |
| 4. | Physiological Experiments | ... | ... | ... | ... | ... | 10 |
| 5. | Permanent stained slide preparations | ... | ... | ... | ... | ... | 05 |
| 6. | Submission of permanent Slides, Tour Diary | ... | ... | ... | ... | ... | 05 |
| 7. | Class Record | ... | ... | ... | ... | ... | 05 |
| 8. | <i>Viva voce</i> | ... | ... | ... | ... | ... | 10 |
| | | | | | | | ----- |
| | | | | | | | 80 |
| 9. | Internal Assessment | ... | ... | ... | ... | ... | 20 |
| | | | | | | | ----- |
| TOTAL MARKS | | | | | | | 100 |

PAPER-III: BIOLOGY OF MULBERRY AND TASAR SILKWORM HOST PLANTS

Unit-I : Moriculture

1. Distribution of mulberry in India
2. Morphology, Taxonomy and its varieties of mulberry; *Morus alba*, *Morus indica*, *Morus cerata*.
3. Anatomy of root, stem, leaf, flower and bud.
4. Selection and preparation of land, climate and soil conditions.

Unit-II: Plantation methods and management

1. Propagation of mulberry,
2. Mulberry planting, asexual and sexual methods ..
3. Inter-cultivation, weeding, pruning, manuring and irrigation harvesting and leaf storage.
4. Physiology of host plants, nutrition, photosynthesis, respiration, growth regulators and transpiration

Unit –III : Arboriculture (Tropical and Temperate Tasar) :

1. Distribution and present status
2. Taxonomy of host plants; Arjun (*Terminalia arjuna*), Asan (*T. tomentosa*), Sal (*Shorea robusta*), Oak (*Quercus serrata*)
3. Morphology of host plants; Arjun (*Terminalia arjuna*), Asan (*T. tomentosa*), Sal (*Shorea robusta*), Oak (*Quercus serrata*)
4. Anatomy of leaf, stem and roots of host plants

Unit –IV: Plantation and management

1. Climate, soil conditions and manuring.
2. Propagation and cultivation
3. Intercultivation and pruning.
4. Physiology of host plants, nutrition, photosynthesis, respiration, growth regulators and transpiration

PAPER-IV: BIOLOGY OF MUGA AND ERI SILKWORM HOST PLANTS

Unit-I : Arboriculture (Muga)

1. Distribution and present status.
2. Morphology of host plants; Som (*Machilus bombyciana*), Soalu (*Litsaea polyantha*).
3. Taxonomy of host plants; Som (*Machilus bombyciana*), Soalu (*Litsaea polyantha*).
4. Anatomy of leaf, stem and roots of host plants

Unit –II: Intercultivation and management

1. Climate, soil conditions and manuring.
2. Types of Propagation methods
3. Intercultivation and pruning and their management.
4. Physiology of Mineral nutrition, Photosynthesis, Respiration, Growth regulators, Photoperiodism, Transpiration

Unit-III : Arboriculture (Eri) :

1. Distribution and present status
2. Morphology of host plants; Castor (*Ricinus communis*), Kessuru (*Heteropanax fragans*).
3. Taxonomy of the plants; Castor (*Ricinus communis*), Kessuru (*Heteropanax fragans*).
4. Anatomy of leaf, stem and roots of host plants

Unit –IV: Intercultivation and management

1. Climate, soil conditions and manuring.
1. Methods of Propagation and cultivation
2. Intercultivation and methods of pruning.
4. Physiology of Mineral nutrition, Photosynthesis, Respiration, Growth regulators, Photoperiodism, Transpiration

REFERENCE BOOKS:

1. **A text book of Sericulture** : Mohan Rao, M.M. (1988), B.S.P. Publications, Sultan Bazar, Hyderabad.
2. **Mulberry Cultivation** : (1988) FAO Pub . By Oxford & IBH Publishing Co. Pvt . Ltd., New Delhi.
3. **T.B. of Soil Science** : Biswas, T.D. and Mukherjee, S.K. (1997). Tata McGraw-Hill Pub., New Delhi.
4. **Nutrient Deficiency Management in Mulberry** : S. Chakrabarti et. al., (1997) Pub. By CSR & T I, Mysore.
5. **Muga Culture** : Choudhary, S.N.
6. **Ericulture** : Choudhary, S.N.
7. **Tasar Culture** : Jolly, M.S. and others, (1974) Ambica Pub, Bombay.
8. **Handbook of Agriculture** : Jaiswal, P.L., et al., (1980) ICAR, New Delhi.
9. **Plants and Environment** : Daubenmure, R.F. (1970), Wiley Eastern, ICAR, New Delhi.
10. **Mulberry Cultivation** : Boraiah, G. (1986) Lectures on Sericulture.
11. **Bibliography on Mulberry** : Dandin et al., 1988), CSR & TI, Mysore.
12. **The Nature and Properties of Soils** : Nyle C. Brady (1984) MacMillan Pub. Co., INC.
13. **Chemistry of the Soil** : Bear, F.E. (1964), Oxford & IBH Pub. Co., New Delhi.
14. **Handbook of Practical Sericulture** : Ullal, S.R. and Narasimhanna, M.N. (1987) CSB Publication, Bangalore.
15. **Ericulture in India** : Sarkar, D.C. (1988), CSB, Bangalore.
16. **Handbook of Muga Culture** : Thangavelu, K. et. Al., (1988), CSB Publication, Bangalore.
17. **An introduction to Sericulture** : Ganga, G. and Chetty, S.J. (1977) 2nd Edition, Oxford and IBH Publishing Co. Ltd., New Delhi.
18. **Polyploidy and Induced Mutations in Plant Breeding** : IAEA (1974) Vienna.
19. **Plant Breeding for Drought Resistance in Water Deficits and Plant Growth** : Hurd, (1976) T.T. Kozlowski, Academic Press, New York.
20. **Cytology and Cytogenetics** : Swanson, C.P. (1975), Prentice Hall, New Jersey.

Practical II

1. Estimation of the enzymes like : Acetylcholinesterase, succinic dehydrogenase, phosphorelase, transaminase, esterase, etc., in the skeletal tissues of the silkworms.
2. Study of the following families Salicaceae, Fagaceae, Moraceae, Magnoliaceae, Lauraceae, Leguminosaceae, Rutaceae, Biurubianaceae, Mellaceae, Dipterocarpaceae, Euphorbiaceae, Celastraceae, Rhamnaceae, Caricaceae, Lythraceae, hexynaceae, Veroinaceae, Rubiaceae, Araliaceae.
2. Preparation of herbarium of the locally available nonmulberry hostplants. Botanical observation to nearby locality to know nonmulberry host plants or the region. Submission of at least 20 herbarium specimen of the locally available nonmulberry host plants.
3. Study of the nitrogen fixation.
4. Kranze anatomy—Hill reaction.
5. Extraction, separation and determination of the absorption spectra of photosynthetic pigments.
6. Study of the growth hormones, dormancy, root formation, stem elongation, senescence and abscission.
7. Study of the external morphology of mulberry species.
8. Study of the locally available varieties of mulberry.
9. Study of embryology of mulberry with the help of permanent slides.
10. Study of the root and stem anatomy of mulberry.
11. Study of pollen morphology and pollen viability of mulberry.
12. Propagation of mulberry through cutting, grafting and laying.
13. Study of the petiole and leaf anatomy of different locally available varieties of mulberry.
14. Pruning methods of mulberry.
15. Study of weeds of mulberry plantation.
16. Study of water potential of plant tissues.
17. Water holding capacity of soil.
18. Soil analysis : pH of the soil, organic contents of the soil and inorganic contents of the soil.

DISTRIBUTION OF MARKS

| | | | | | | |
|--|-----|-----|-----|-----|-----|------------|
| 1. Dissection | ... | ... | ... | ... | ... | 15 |
| 2. Identification of silkworm host plants (1-5) | ... | ... | ... | ... | ... | 10 |
| 3. Identification and comments on given spots (1-10) | ... | ... | ... | ... | ... | 20 |
| 4. Physiological Experiments | ... | ... | ... | ... | ... | 10 |
| 5. Permanent stained slide preparations | ... | ... | ... | ... | ... | 05 |
| 6. Submission of permanent Slides, Herbarium | ... | ... | ... | ... | ... | 05 |
| 7. Class Record | ... | ... | ... | ... | ... | 05 |
| 8. <i>Viva voce</i> | ... | ... | ... | ... | ... | 10 |
| | | | | | | 80 |
| 9. Internal Assessment | ... | ... | ... | ... | ... | 20 |
| | | | | | | 100 |
| TOTAL MARKS | ... | ... | ... | ... | ... | 100 |

SEMESTER- II

PAPER-V : PESTS AND DISEASES OF MULBERRY SILKWORM AND THEIR HOST PLANTS

Unit-I : Pests of Mulberry Silkworm

1. Influence of biotic and a biotic factor on the incidence of diseases.
2. Insect Pests of silkworm, *B. mori*—Identification, classification and life cycle of insect pests—Tachinid fly (Uzifly), Dermestid beetles, Ants, Praying Mantis, Earwig. Other invertebrate Pests—Mites and Nematodes.
3. Vertebrate pests- lizards, Squirrels and Rats.

4. Preventive and control measures of pests of mulberry silkworm.

Unit-II : Diseases of Mulberry Silkworm

1. Diseases of *B. mori*—Etiology, Structure, Symptoms, lesions, Influence of nutrition on the incidence of diseases
2. Pathogenesis and diagnosis of disease—Viral, bacterial
 - a) Viral : Grasserie, CPV, NPV and Infectious flacherie.
 - b) Bacterial : Bacterial septicemia, Bacterial gastroenteric disease, Bacterial toxicosis.
3. Pathogenesis and diagnosis of disease— protozoan and fungal.
 - a) Protozoan : Pebrine
 - b) Fungal : Muscardine—White, Green and Yellow, Aspergillosis
4. Preventive and control measures of disease of mulberry silkworm— chemical control, insecticides.

Unit-III : Pests of Mulberry Silkworm Host Plant

1. Influence of biotic and a biotic factor on the incidence of pests.
2. Pests of mulberry—Identification, classification, life cycle and nature of damage of following insect pests.
 - a) Lepidoptera : Bihar Hairy Caterpillar, Cut down, Morning caterpillar, Leaf roller, Symptomids.
 - b) Hemiptera : Jassids, Scale insects, Mealy Bugs (sucking).
 - c) Thysanoptera : Thrips
 - d) Orthoptera : Grasshoppers
 - e) Isoptera : Termites
 - f) Coleoptera : Stem borers, Weevils.
3. Preventive and control measures of diseases of mulberry.
4. Integrated pest management.

Unit-IV : Diseases of Mulberry Silkworm Host Plant

1. Influence of biotic and a biotic factor on the incidence of diseases.
2. Diseases of mulberry— symptoms, disease cycle
 - a) Bacterial : Bacterial mulberry wilt.
 - b) Fungal : Leaf spot, Powdery Mild Dews, Rust of Mulberry,
3. Other diseases- Root knot, Common mulberry dwarf
4. Preventive and control measures of diseases of mulberry.

PAPER-VI : PESTS AND DISEASES OF NON MULBERRY SILKWORM AND THEIR HOST PLANTS

Unit-I : Pests and Diseases of Tasar Silkworm and Host Plants :

1. Pests of *Antheraea* sp : Uziflies, Red ant, Pentatomid bug, Praying Mantis and Lady bird beetle nature of damage, preventive measures and control.
2. Diseases of *Antheraea* sp : Viral, Bacterial, Protozoan and fungal pathogenesis, preventive and control measures.
3. Pests of tasar silkworm host plants, nature of damage preventive measures and control.
4. Diseases of tasar silkworm host plants: Bacterial and fungal and its Preventive and control measures.

Unit-II: Pests and Diseases of Muga Silkworm and Host plants :

1. Pests of muga silkworm, *A. assamensis* : Uziflies, Red ant, Pantatomid bug, Praying mantis and Lady bird beetle.
2. Diseases of muga silkworm, *A. assamensis* : Viral, Bacterial, Protozoan and Fungal.
3. Pests of muga silkworm host plants preventive measures and control.
4. Diseases of muga silkworm host plants Bacterial and fungal.

Unit-III : Pests and disease of Eri Silkworm

1. Pests of Eri silkworm, *Philosamia ricini* : Invertebrate.
2. Vertebrate Pests of eri silkworm.
3. Diseases of Eri silkworm, *Philosamia ricini* : Viral, bacterial, Progozoan and fungal.
4. Preventive and control measures of pests and diseases of Eri silkworm.

Unit-IV: Pests and disease of eri silkworm host plants :

1. Pests of Eri silkworm host plants.
2. Diseases of Eri silkworm host plants : Bacterial and fungal.
3. Preventive and control measures of pests.
4. Preventive measures and control of diseases of Eri silkworm host plants.

REFERENCE BOOKS : (Paper-I & II)

- 1 **Indian Insect Pests** : Lefroy, H.M. (1971). Today and Tamarroul's Printers and Publishers, New Delhi.
- 2 **Agricultural Insect Pests of India** : Atwal, A.S. (1986), South East Asia, Kalyani Publishers, New Delhi.
- 3 **Agricultural Insect Pest of the Tropics and Their Control** : Hill, D.S. (1975), Cambridge Univ. Press, Cambridge.
- 4 **Silkworm Diseases** : (1988). FAO pub . By Oxford and IBH Pub., Co. Pvt. Ltd., New Delhi.
- 5 **Pesticide—Application and Equipment** : Bindra, O.S. and Singh, H. (1980) Oxford & IBH Co., New Delhi.
- 6 **General Entomology** : Mahi, M.S. (1982), Oxford & IBH Pub. Co. New Delhi.
- 7 **Biological Control of Pest and Weeds** : Samways, M.J. (1981), Edward Arnold Pub. Ltd., London.
- 8 **Agricultural Entomology and Pest Control** : Pradhan, S. (1983), Pub. By ICAR, New Delhi.
- 9 **Handbook of Pests of Diseases of Mulberry and Silkworm** : (19990), Pub. By UNESCAP, Bangkok, Thailand.
- 10 **Diseases and Pests of Mulberry and their Control** : (1991) Pub. by Director, CSR & TI, Mysore.
- 11 **Cytoplasmic Polyhedrosis Virus of the Silkworm** : Hisa /aruga and Tanada, Y. (1971), Univ. of Tokyo Press, Japan.
- 12 **Silkworm Rearing and Disease of Silkworm** : (1956) Ptd. By Director of Ptg. Stn. & Pub. Govt. Press, Bangalore.
- 13 **An Introduction of to Sericulture** : Ganga, G. and Shetty, J.S. (1991), Oxford & IBH Pub. New Delhi.
- 14 **Sericology** : Tanaka, Y. (1964) CSB Pub. Bangalore.
- 15 **Sericultural Technology** : Choe Byong Hoe (1972), Seol National University Press, Korea.
- 16 **Entomology and Pest Management** : Pedigo
- 17 **Integrated Pest Management Apple**, I.L. and Smith, R.E. (1976), Plenum Publ. Corpn . New York.

Practical - I : Pests and Diseases of Silkworm and host plants.

1. A) Pests and Diseases of Silkworm
 - a) **Parasitoid**
 - i) Uziflies : *Exorists bombycis*, *E. sorbillans*, *Trycholyga bombycis*
 - ii) Tasar uzifly : *Blepharipa zebina*.
 - iii) *Xanthopimpla predator*
 - iv) *Apantales glomeriatus*, *A. angaleti*
 - b) **Predators**
 - i) Dermestid beetle (*Dermeantis* sp.)
 - ii) Praying Mantis (*Hierodula bippapilla*)
 - iii) Ladybird beetle
 - iv) Earwig
- Invertebrate Pests :**
- i) Mite *Pediculoides ventricosus*
 - ii) Nematode, *Hexaermis microamphidis*

- c) **Vertebrate Pests** : Lizard (*Hemidactylus flaviviridis*), Squirrel (*Funambulus poalmaram*), Rats (*Rattus rattus*), Cobra (*Naja naja*), Crow (*Corvus splendens*), Indian mynah (*Acridothera tristis*), Bulbul (*Pycnonotus jocosus*).
- d) **Lifecycle studies of the following pests of silkworms** : *Exorista bombycis*, *E. sorbitians*, *Blepharipa zebina*, *Xanthopimpla pedator*, Praying mantis (*H. bipapilla*) Dermestid beetle (*Dermestis* sp.)
- e) Identification of Diseases of mulberry silkworm and non-mulberry silkworms,
i) Flacherie, ii) Pebrine, iii) Grasserie, iv) Muscardine (White & Green)
- f) Isolation, Identification, characterization and preparation of microscopic slides of the casual agents of the following diseases. Pebrine, Flacherie, Grasserie and Muscardine.
- g) **Study of the Biocontrol Agents** : *Nesolynx*, *Thymus* and *Menochilus* sp. / *Illicis* sp.
- h) Pesticide Application Techniques and Appliances.
i) Visits to silkworm rearing houses.
2. Practicals on Pests and Disease of Silkworm Host Plants :
- (A) Collection and preservation of the Pests and casual agents of disease of silkworm host plants.
- (B) Collection and preservation of biocontrol agents of pests of silkworm host plants
- (C) Identification and economic importance of mulberry pests.
i) Defoliators : Bihary Hairy caterpillar, cutworms. Moringa caterpillar. Syntomid worm, grasshopper.
ii) Cell sap suckers : Mealy bug, Jassids, Scales aphids. White fly. Thrips mulberry weevil.
iii) Stem borers : Coleoptera and Termites.
- (D) Life cycle of the following Pests : Mealy bug, Jassid. Bihar hairy caterpillar. Thrips. Termite, Grasshopper, Mulberry stem borer (Coleoptera)
- (E) Identification of damage caused by pests to crops (Silkworm host plants) .
- (F) Identification of mulberry diseases : Powdery mildew leaf spot. Leaf rust stem cranks root rot. Deficiency disease.
- (G) Study of biocontrol agents of pests of silkworm host plants : Parasitoid : Technide, Ichneumonid, Braconid and Tricogrammatid. Predators: Ladybird beetle. Tiger beetle. Lacewings. Reduviid bug. Pentatomid bug, Praying mantis.
- (H) Field visits for the demonstration of damage by the pests.
- (I) Pests of castor, teak, Arjun and Ber : (Identification and economic significance).
- (J) Disease of castor, teak, and Arjun and Ber : (Identification and economic significance).

DISTRIBUTION OF MARKS

| | | |
|--|--------|------------|
| 1. Identification and comments on given spots (1-10) | ... | 20 |
| 2. Identification and comments on given spots (1-10) | ... | 20 |
| 3. Physiological Experiments | | 10 |
| 4. Permanent stained slide preparations | | 05 |
| 5. Submission of permanent Slides, Tour Diary and Herbarium... | ... | 05 |
| 6. Class Record | | 10 |
| 7. <i>Viva voce</i> | | 10 |
| | | ----- |
| | | 80 |
| 8. Internal Assessment | | 20 |
| | | ----- |
| TOTAL MARKS | | 100 |

PAPER-VII : CELL AND MOLECULAR BIOLOGY

Unit-I : Cell Organelles

1. Ultrastructure of Golgi and Secretory mechanism.
2. Ultrastructure of lysosomes, synthesis, segregation and transport.

3. Molecular organization of ribosomes
4. endoplasmic reticulum.

Unit –II: Genetic Organisation

1. Genetic Code
2. Protein synthesis,
3. Mitochondria in energy metabolism.
4. Animal and plant cell, structure and function

Unit-III : Molecular structure and Function

1. Molecular structure of plasma membrane and mechanism of transport.
2. Structure and function of chromosomes
3. Molecular structure of DNA and replication
4. Types of RNA , structure and function.

Unit IV:Enzymetics

- 1 Enzyme kinetic—negative and positive co-operativity, regulation of enzyme activity, activators and inhibitors.
- 2 Receptor—Ligand interaction and signal transduction.
- 3 Lac operation, attenuation, tryptophan operon.

PAPER VIII: PHYSIOLOGY AND BIOTECHNOLOGY

Unit-I : Biochemistry :

1. Primary, secondary, tertiary and quaternary structure of proteins
Protein metabolism.
2. Structure, chemistry and metabolism of carbohydrates.
3. Structure, chemistry and metabolism of lipids.
- 4 Nitrogen metabolism.

Unit- II Nuclie Acids

1. Enzymes—Characteristics, structure, kinetics and regulation of the enzyme activity.
2. Isolation, sequencing of DNA segments, gene amplification, synthesis of gene.
3. Cloning vectors of recombinant DNA—Plasmids, phages, cosmids, binary and shuttle vectors.
4. Gene cloning techniques in bacteria and eukaryotes, molecular probes, labeling, blotting, dot and slot blots.

Unit-III :Gene Manipulation

- 1 Gene transfer, targeted gene transfer and transgenic animals.
- 2 Animal cell and tissue culture : Methods, advantages and disadvantages
- 3 Principles and Applications of compound, phase contrast and fluorescence microscope.
- 4 Principles and Applications of scanning and transmission electron microscope.

Unit- IV:Tools and Techniques

- 1 Principles and applications of spectrophotometer and calorimeter.
- 2 Techniques of Gel electrophoresis.
- 3 Techniques of Thin Layer Chromatography (TLC and HPLC)
- 4 Techniques of Western blot analysis and Immunotechnology : Hybridoma technology and monoclonal antibodies.

REFERENCE BOOKS:

1. **Cell and Molecular Biology** : De Robertis (International Edition), Hongkong.
2. **Harper's Review of Biochemistry** : (1988), Lange Medical Publ. Calif.
3. **Principles of Biochemistry** : Lehinger, A.L. (1993), Publishers N.Y.
4. **Cell Biology** : Powar, C.B. (1991), Himalaya Publishing House, Bombay.
5. **Principles of Biochemistry** : Smith, B.L., et. al., (1983) McGraw-Hill, New York.
6. **The Cell Biology** : Dowben Haper.
7. **Handbook of Molecular Cytology** : Lima-de-Paria
8. **Laboratory Techniques in Biology** : Earle, W.R.

9. **Molecular Biology** : David Freifelder (1989) Narosa Publ. House, Delhi (India).
10. **Molecular Biology of the Cell** : Alberts (1989), Garkani Publication.
11. **Molecular Biology** : Brenner (Academic Press).
12. **Cell and Molecular Biology** : Due Praw.
13. **Biological Membrane, Structure and Function** : Harrison and Lunt.
14. **Essential Techniques in Cell Biology** : Shah et. al., (1987).
15. **The Molecular Basis of Membrane Function** : Tasteson
16. **Fundamentals of Molecular Biology** : Upadhyaya, A. and Upadhyaya, K. (2002), Himalaya Publishing House, Mumbai.
17. **Basics of Molecular Biology** : Upadhyaya, A. and Upadhyaya, K. (2002), Himalaya Publishing House, Mumbai

Practical— : Cell Biology, Physiology and Biotechnology.

Cell and Molecular Biology.

- 1 Study of light and phase microscopy.
- 2 Demonstration of nucleus : Feulgen Technique
- 3 Study of Mitochondria : Ncotetrazolium chloride Technique.
- 4 Study of Lysosomes
- 5 Study of peroxisomes
- 6 Study of the Golgi Complex
- 7 Demonstration of the chromosomes in the silkworm and its host plants.
- 8 Histochemistry of cells and tissues : Proteins, Lipids and Carbohydrates.
 - a) Proteins : MBB Method
 - b) Lipids : Sudan Black B method
 - c) Carbohydrates : PAS reaction. AB pH 1.00 and AB pH 2.5
- 9 Study of pH meter
- 10 Study of the colorimeter
- 11 Study of Centrifuge.

Physiology and Biochemistry :

1. Estimation of glucose in the haemolymph of mulberry silkworm.
2. Estimation of total sugars in the haemolymph of silkworms (Mulberry).
3. Estimation of proteins, Lipids in the mulberry silkworm
4. Separation of protein in the silkworm haemolymph.
5. Separation of proteins in the haemolymph and other tissues by electrophoresis.
6. Estimation of cholesterol in the silkworm haemolymph.
7. Analysis of mulberry leaves for : carbohydrates, Lipids and proteins.
8. Estimation of fibroin and sericin.
9. Ionic composition of plasma of the mulberry silkworms : cat-ions like Ca^{++} and Mg^{++}

DISTRIBUTION OF MARKS

| | | | |
|---|-----|-----|------------|
| 1. Salivary gland chromosome preparation | ... | ... | 05 |
| 2. Histochemical demonstration of DNA and RNA | ... | ... | 10 |
| 3. Estimation of protein in a given sample using Lowry et al., (1951) | . | | 15 |
| 4. Demonstration of SDS-PAGE/TLC | | | 15 |
| 5. Demonstration of Barr Body / Mitochondria | ... | ... | 05 |
| 6. Class record | ... | ... | 10 |
| 7. <i>Viva voce</i> | ... | ... | 10 |
| | | | ----- |
| | | | 80 |
| 8. Internal Assessment | ... | ... | 20 |
| | | | ----- |
| TOTAL MARKS | ... | ... | 100 |

SEMESTER III

PAPER-IX SILKWORM SEED AND REARING TECHNOLOGY

Unit- I : Silkworm Seed Technology

1. General principles of seed technology.
2. Seed organization.
3. Seed cocoons.
4. A plan of grainage and its management.

Unit-II : Silkworm Seed Production : Mulberry Silkworm

1. Management of basic seed farms.
2. Grainage and grainage equipment.
3. Moth emergence, mating and egg laying.
4. Mother moth examination.

Unit-III : Processing of Mulberry Silkworm Seed

1. Disinfection and storage of eggs.
2. Hibernation of bivoltine eggs.
3. Artificial hatching of uni- and bi-voltine eggs.
4. Incubation and transportation of eggs.

Unit-IV : Non Mulberry Silkworm Seed Production

1. Selection, transport and storage of seed cocoons.
2. Grainage of tasar and muga silkworm.
3. Grainage of eri silkworm
4. Artificial hatching, storage and transportation of eggs.

PAPER-X BIOLOGY AND MULBERRY SILKWORM REARING TECHNOLOGY

Unit-I : Life Cycle and Requirement for Rearing of Mulberry Silkworm

1. Life-cycle of mulberry silkworm.
2. Principles of silkworms rearing.
3. Preparation for rearing and model rearing house.
4. Equipment for rearing.

Unit-II : Environment and Rearing Technology

1. Environmental conditions.
2. Rearing of early age silkworm.
3. Rearing of late age silkworm.
4. Mounting, spinning and harvesting of cocoons, precautions for rearing.

Unit-III : Rearing of Tasar and Muga Silkworm

1. Life-cycle of Tasar and Muga silkworm.
2. Rearing house and rearing appliances.
3. Rearing techniques.
4. Spinning harvesting and preservations of cocoons.

Unit-IV : Rearing of Eri Silkworm

1. Life cycle.
2. Rearing techniques and rearing appliances.
3. Rearing methods for Eri silkworm.
4. Spinning process and harvesting of cocoons and storage.

REFERENCE BOOKS : (Paper-I&II)

- 1 **Silkworm Rearing** : Wupang—Chun and Chen Da-Chung (1988), Pub. By FAO, Rome.
- 2 **Handbook of Silkworm Rearing** : Anonymous (1972), Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan.
- 3 **Silkworm Rearing Techniques in Tropics** : (1980), Published by JICA, Tokyo, Japan
- 4 **Silkworm rearing (Translated from Japanese)** : (1977), Oxford & IBH Publ. Co. Pvt. Ltd.
- 5 **Improved Method of Rearing Young age silkworm** : Krishnaswamy (1986), CSB Publication, Bangalore.

- 6 **Manual of Silkworm Egg Production** : Narasimhanna, M.N. (1988), CSB Publication, Bangalore.
- 7 **Cold Acid Treatment for Bivoltine Silkworm Eggs for Tropical Countries** : Manjula A. and Hurakadli, H.K. (1985) Indian Journal of Sericulture, 26 : 25-29.
- 8 **A Scientific method of incubating the Silkworm eggs** : Manjula, A. (1991) Indian Silk 30 (8) : 7-14.
- 9 **Appropriate Sericultural Techniques** : Ed. By M.S. Jolly, Director, CSR & TI, Mysore.
- 10 Manual of Sericulture (1976), Food and Agriculture Organisation, Rome, Vol. II.
- 11 **A guide for Bivoltine Sericulture** : Sengupta, K. (1989), Director, CSR & TI, Mysore.
- 12 **Sericulture Training Manual** : (1990), FAO, Rome.
- 13 **Principles of Seed Certification and Testing** : Nema, N.P. (1985), Allied Publishers Ltd., New Delhi.
- 14 **A Treatise on the Acid Treatment of Silkworm Eggs** : Biram, N.M., et. al., (1990) Pub. by CSR & TI, Mysore.
- 15 **Handbook of Practical Sericulture** : Ullal, Sr. and Narasimhanna, M.N. (1978), CSB Publication, Bangalore.
- 16 **New Technology of Silkworm Rearing** : Krishnaswamy, S. (1986), Reprinted by CSB, Bangalore.

PRACTICALS

Practical- : Silkworm Seed and Rearing technology.

- 1 **Grainage** : Model grainage, planning and distribution of work.
Grainage equipment : Wooden stands, bamboo trays, wooden boxes, ant wells, thermometer, hydrometer, hygrometer, basin stand, cellulose, moth crushing set, microscopes acid treatment equipment, incubators, etc.
- 2 Handling of seed cocoons : spacing, selection and storage (Demonstration only)
- 3 Examination of seed cocoons for pebrine infections.
- 4 Sex separation of pupae and moths.
- 5 Moth emergence : time of emergence, pairing, de-pairing handling and protection of the moth and refrigeration of the male moth.
- 6 Moth-examination : Individual and random moth examination and its purpose.
- 7 Preparation of DFLs—Loose eggs and the sheet eggs surface disinfection of eggs refrigeration of the eggs, cold storage and liberation schedule. Chilling and release of eggs for hatching.
- 8 Acid treatment—Cold and hot acid treatment. Washing of the eggs and storage.
- 9 Identification of eggs—Unfertilized, diapausing non-diapausing dead eggs, hatched eggs, fertilized eggs.
- 10 Counting of eggs : Determination of fecundity, hatching percentage.
- 11 Types of rearing houses : Plan of model rearing house.
- 12 Rearing appliances Chowki rearing stands, wooden boxes and ant wells, metallic stands, bamboo trays, moutage, paraffin paper, foam rubber, feeding stand basin stand chop sticks, feathers, chopping boards, chopping knife, sprayer, hygrometer, wet and dry bulb thermometer (Observations).
- 13 Disinfection : Types of sprayers and methods of their use.
- 14 Incubation of silkworms eggs for uniform hatching.
- 15 Cellular rearing and mass rearing method (Demonstration).
- 16 Brushing method, leaf preservation, young and adult silkworm rearing, chopping of mulberry leaves for feeding, chowki silkworm bed cleaning, feeding, spacing and moulting.
- 17 Leaf harvesting : Method of selection of optimum quality of leaves for different larval stages storage of leaves.
- 18 Spinning and mounting : Picking method, net method, different types of montages, precautions to avoid double and unripened cocoons.
- 19 Cocoon harvesting : Categorisation and separation of different types of cocoons transportation and marketing.

- 20 Maintenance of silkworm rearing record.
 21 Characteristics of basic stocks
 22 Evaluation of Heterosis.
 23 Assessment of cocoon quality for breeding (Selection of best individuals—males and females).

Distribution of Marks :

| | | | | | |
|--------------------|--|-----|-----|-----|------------|
| 1 | Identification and comments on spots (1-10) | ... | ... | ... | 20 |
| 2 | Identification of different races of silkworm cocoons... | ... | ... | ... | 10 |
| 3 | Demonstration of silk moth Examination | ... | ... | ... | 10 |
| 4 | Preparation slide of embryonic stages | ... | ... | ... | 10 |
| 5 | Sex identification of larva/pupa/adult | ... | ... | ... | 05 |
| 6 | Submission of prepared DFLs | ... | ... | ... | 05 |
| 7 | Class Record | ... | ... | ... | 10 |
| 8. | <i>Viva voce</i> | ... | ... | ... | 10 |
| | | | | | ----- |
| | | | | | 80 |
| 9. | Internal Assessment | ... | ... | ... | 20 |
| | | | | | ----- |
| TOTAL MARKS | | | | | 100 |

PAPER-XI : GENETICS AND BREEDING OF MULBERRY SILKWORM

Unit-I : Genetics of Mulberry Silkworm

1. Silkworms races: Genetics and distribution
2. Hereditary traits in *B. mori*
3. Genetics of cocoons colour.
4. Genetics of voltinism and moulting.

Unit-II Breeding Techniques

1. Sex determination in *B. mori*
2. Chromosome polyploidy and parthenogenesis in *B. mori*
3. Mutation, chemical mutagens and their utility.
4. Heterosis.

Unit-III : Breeding of Mulberry Silkworm

1. Silkworm breeding in India—Advantages and disadvantages.
2. Silkworm breeding methods—Aims, advantages, inbreeding, outbreeding.
3. Bio technological approach to improve silk production.
4. Silkworm races—Maintenance of Silkworm stock and large scale multiplication.

Unit-IV : Genetics of Mulberry Silkworm

1. Mendelian principles of genetics.
2. Spontaneous and induced mutation, molecular basis of DNA damage and repair.
3. Biological diversity in mulberry. Germplasm conservation—methods, centre of collection.
4. Genetic control of disease resistance in mulberry.

PAPER-XII: GENETICS AND BREEDING SILKWORMS AND HOST PLANTS

Unit-I : Breeding of Host Plant

1. Principles of plant breeding.
2. Breeding of mulberry for drought resistance.
3. Insect pest resistance.
4. Application of tissue culture in mulberry breeding.

Unit-II : Methods of Breeding

1. Hybridization and selection of mulberry for genetic improvement.
2. Pure line clonal and mass selection—Application, advantages and limitations.
3. Evaluation of mulberry genotype-Primary, secondary and multilocational

traits.

4. Breeding of mulberry for high yielding variety.

Unit-III : Genetics and Breeding of Tasar Silkworm

1. Genetics of tropical tasar silkworm.
2. Breeding of tropical tasar silkworm.
3. Genetics of temperate tasar silkworm.
4. Breeding of temperate tasar silkworm.

Unit-IV : Genetics and Breeding of Muga and Eri Silkworm

1. Genetics of muga silkworm.
2. Breeding of muga silkworm.
3. Genetics of eri silkworm.
4. Breeding of eri silkworm.

REFERENCE BOOKS :

- 1 **Silkworm Genetics Illustrated** : Yokoyama, T. (1959). Japan society for Promotion of Science, Tokyo.
- 2 **Plant Breeding** : Singh, B.D. (1988), Kalyani Publishers, New Delhi.
- 3 **Genetics of Silkworm** : Tazima, Y. (1964), Academic Press, London.
- 4 **Biology of the Gene** : Lavine, L. (1969), Saint Lonis, Mosby.
- 5 **Silkworm Biology, Genetics and Breeding** : Sarkar, D.D. (1998), Vikas Publication, New Delhi.
- 6 **Manual of Bivoltine, Rearing Race Maintenance and Multiplication** : Datta, R.K. et. al., (1996), CSR & TI, Mysore.
- 7 **Principles and Techniques of Silkworm Breeding** : (1993) United Nations, New York.
- 8 **Plant Breeding, Analysis and Exploitation of Variation** : Darbeshwar Roy (2000), Narosa Publishing House, New Delhi.
- 9 **Plant Cell Tissue and Organ Culture** : Gamborg, O.L. and Phillips, G.C. (1996) Narosa Publishing House, New Delhi.
- 10 **Silkworm Breeding** : Reddy, G.S. (19989), Pub. By Oxford and IBH Pub . Co. Pvt. Ltd., New Delhi.
- 11 **The Silkworm : An Important Laboratory Tool** : Tazima, Y. (1978), Kodansha Limited, Tokyo.
- 12 **Introduction to Quantitative Genetics** : Falconer, D.S. (1972), Oliver and Boyd, Edimburgh.
- 13 **Silkworm Breeding Stocks** : Kovalev, P.A. (1970), Published by Bombay.
- 14 **Genetics** : Strikberger, M.W. (1976), McMillan, New York.
- 15 **Text Bok of Tropical Sericulture** : (1975), Pub l. Japan Overseas Corporation Volunteers.
- 16 **Plant Tissue Culture** : Sharma, R (2000), Pub. By Campus Books International, New Delhi.
- 17 **Plant Breeding—Theory and Techniques** : Gupta, S.K. (2000), Agrobios (India), Jodhpur.
- 18 **Gene VI** : Benjamin Lewin (1998), Oxford, New York.
- 19 **Principles of Plant Breeding** : Allard, R.W. (1960), John Wiley and Sons, INC., New York.
- 20 **Plant Breeding and Cytogenetics** : Elliot, F.C. (1958), McGraw-Hill Book Co., Inc., New York.
- 21 **Introduction to Plant Breeding** : Choudhari, R.C. (1982), Oxford & IBH Pub. C., New Delhi.

PRACTICALS : Genetics and Breeding of silkworm and their Host plants.

1. Calculation of inbreeding depression.
2. Identification of mutants of the silkworm.
 - a) Eggs : red eggs, white eggs, giant eggs, ellipsoid eggs.
 - b) Larval : Morie, zebra, plain, stgripped, knobbed, multilunar.

3. Cytological techniques : pretreatment, fixation, staining and squashing.
4. Demonstration of *Eupyrene* and *Apyzone spermatism*
5. Mitotic and Meiotic chromosomes—Preparation of the root tip.
6. Slide preparation of chromosomes of silkworm.
7. Chromosome banding techniques.
8. Salivary gland chromosomes.
9. Maintenance of different varieties of mulberry and other host plants of silkworms.
10. Breeding of mulberry for high productivity
 - a) Section of breeding method.
 - b) Hybridization
 - c) Mutation breeding
 - d) Induction of polyploidy by physical and chemical method
11. Any other practical set by the concerned teachers.

Distribution of Marks :

| | | | | |
|--------------------|---|-----|-----|------------|
| 1 | Identification and comments on spots (1-10) | ... | ... | 30 |
| 2 | Demonstration of meiotic stages in silkworm | ... | ... | 10 |
| 4 | Demonstration of meiotic and mitotic chromosomes of host plants | ... | ... | 10 |
| 5 | Statistical analysis of given data | ... | ... | 05 |
| 6 | Submission of permanent slides (5) | ... | ... | 05 |
| 7 | Class Record | ... | ... | 10 |
| 8 | <i>Viva voce</i> | ... | ... | 10 |
| | | | | ----- |
| | | | | 80 |
| 9. | Internal Assessment | ... | ... | 20 |
| | | | | ----- |
| TOTAL MARKS | | | | 100 |

SEMESTER- IV

PAPER-XIII : MULBERRY SILK TECHNOLOGY

Unit-I : Assessment of Silk Cocoons

1. Collections of cocoons.
2. Types of cocoons.
3. Assessment and selection of cocoons.
4. Gradation of cocoons.

Unit-II : Processing and Storage of Silk Cocoons

1. Transportation of cocoons.
2. Drying and stifling of cocoons.
3. Storage of cocoons.
4. Pests of cocoon and their management.

Unit-III : Reeling Preparations

1. Requirements of silk reeling.
2. Evaluation of silk reeling industry.
3. Reeling appliances.
4. Cocoon processing for reeling.

Unit-IV : Processing and assessment of Silk Yarn

1. Reeling and reeling methods.
2. Silk testing and skeining of silk yarn.
3. Preparation of silk yarn.
4. Bleaching and dyeing of mulberry silkworm.

PAPER XIV: NON MULBERRY SILK TECHNOLOGY

UNIT-I : Processing of Tasar and Muga Silk Cocoons

1. Collections and selection of cocoons for reeling.
2. Reeling appliances of tasar and muga cocoons.

3. Reeling process of tasar and muga cocoons.
4. Testing, preservation of tasar and muga silk.

UNIT-II : Processing of Eri Silk Cocoons

1. Collections, selection and preservation of eri cocoons.
2. Spinning appliances and process of eri cocoons.
3. Testing and preservation of silk yarn.
4. Bleaching and dyeing of silk yarn.

Unit-III : Processing of Silk Yarn

1. Winding machine and process of winding.
2. Doubling machine and process of doubling.
3. Twisting machine and process of twisting.
4. Stiffling and twist reeling machine and process.

Unit-IV : Weaving

1. Warping unit and process of warping.
2. Bobbin filling machine and process of filing for weft.
3. Weaving machine and process of weaving.
4. Testing and storage of silk fabric.

REFERENCE BOOKS: (Paper- I & II)

1. **Silk Dyeing, Printing and Finishing** : Gubrajani, M.L. (1986), New Delhi.
2. **Silk Text Engineering** : Byung Jo. (1987), Halk Publications Seol, Korea.
3. **Silk Throwing and Waste Silk Spinning** : Rayner Hollin (1903), Scott Greenwood and Sons, London.
4. **The Development of Indian Silk** : Sinha, H., Oxford and IBH Publishing Co., Ltd., New Delhi.
5. **Molecular Biotechnology-Principles and Applications of Recombinant DNA** : Bernard, R. Glick and Jack J., Pasternak (1994), ASM Press Washington, DC.
6. **Wearing Calculations** : Sen Gupta (1996), D.B. Taraporevala Sons & Co. Pvt. Ltd.
7. **Global Silk Scenario—2001** : (1994) Proceeding of the International Conference on Sericulture Pub. by CSR & TI, Mysore.
8. **Silk Reeling** : Huang Goo Rui (1998), Oxford & IBH Publishing Co. Pvt Ltd., New Delhi.
9. **Animal Biotechnology** : Ranga, M.M. (2001), Agrobios (India) Jodhpur.
10. **Textile Science** : Gohl, P.G. and Vilensky, L.D. (1987), CBS Publishers & Distributors, Delhi.
11. **Manual of Sericulture** : FAO, Vol. III.
12. **Raw Silk Reeling** : Kim, B.H.
13. **Silk Reeling Techniques Tropics** : Omorh, S.
14. **Silk Production and Weaving in India** : Ghosh, C.C.
15. **Development of Indian Silk** : Sanjay Sinha.
16. **Sericulture and Silk Industry** : Tripurari Sharma
17. **Silk Industry problem and prospects** : Ajas, A. and Lawpper, H.
18. **Biotechnology—Fundamentals and Applications** : Purohit, S.S. (2001), Agrobios (India), Jodhpur.
19. **Biotechnology** : Singh, B .D. (1988), Kalyani Publishers, New Delhi.
20. **Biotechnology** : Current Progress : Paul, N.C. ET. al., (1991) Technological. Publ. Co. Lancaster, USA.
21. **Biotechnology** : Higgins.
22. **Tissue Culture Technique** : 2nd Edition, Cameron, G. Academic Press, New York.
23. **Gene Cloning** : Brown
24. **Tissue Culture Methods and Application** : Kruse, P.F. (1973), Jr. Academic Press, New York.
25. **Invertebrate Tissue Culture Methods** : Mitsuhashi, J. Springer and Verlag Press.
Practical- :Mulberry and Non mulberry silk Technology.
1. Categorisation of types of cocoons :
 - a) Determination of good and defective cocoon percentage based on by number and weight.

- b) Determination of shell ratio percentage and estimated renditta.
 - c) Determination of average filament length, non-breakable filament length and denier.
 - d) Determination of average size, standard size deviation and maximum size deviation.
 - e) Determination of renditta, raw silk percentage and silk waste percentage.
 - f) Determination of establishing percent age of given cocoons.
2. Estimation of fibroin/Sericin in the silk filament.
 3. Processing of cocoons for reeling.
 - a) Cocoon cooking : Open pan, three pan, pressurized.
 - b) Stifling and drying : Different methods.
 4. Reeling techniques
 - a) Single cocoon reeling (Approuvet)
 - b) Charka reeling
 - c) Cottage basin (multi end)
 - d) Filature
 - e) Semi-automatic and automatic machines.
 - a. Estimation of alkalinity of reeling water.
 6. Silk Reeling : lasing, skeining, twisting, booking demonstration.
 7. Determining of degumming.
 8. Bleaching of silk fibre.
 9. Silk dyeing : a) Acid dyes, b) Basic dyes, c) Direct dyes, d) Mordent dyes, e) Vat colours , f) Reactive dyes
 10. After treatment for the dyes silk fibre.
 11. Factors affecting silk dyeing

Distribution of Marks :

| | | | | | |
|--------------------|--|-----|-----|-----|------------|
| 1 | Identification and comments on spots (1-10) | ... | ... | ... | 20 |
| 2 | Identification of different races of silkworm cocoons... | ... | ... | ... | 10 |
| 3 | Demonstration of reeling process | ... | ... | ... | 10 |
| 4 | Preparation slide of twisted/untwisted yarn | ... | ... | ... | 10 |
| 5 | Sex identification of pupa | ... | ... | ... | 05 |
| 6 | Calculate the Shell ratio of given sample | ... | ... | ... | 05 |
| 7 | Class Record | ... | ... | ... | 10 |
| 8. | <i>Viva voce</i> | ... | ... | ... | 10 |
| | | | | | ----- |
| | | | | | 80 |
| 9. | Internal Assessment | ... | ... | ... | 20 |
| | | | | | ----- |
| TOTAL MARKS | | | | | 100 |

PAPER-XV : ECONOMICS OF SERICULTURE AND TRADING OF SILK

Unit-I : Economics of Mulberry Cultivation

1. Economics of mulberry cultivation in tropical climate.
2. Economics of mulberry cultivation temperate climate.
3. Economics of silkworm rearing in tropical climate.
4. Economics of silkworm rearing in temperate climate.

Unit-II : Economics of Silk production

1. Economics of silk production.
2. Economics of silk reeling and processing.
3. Role of silk industry in Indian economy.
4. Economics of non-mulberry silkworm rearing and silk production.

Unit-III : Marketing of Silk products

1. Sericulture marketing organization.
2. Marketing of cocoons of different hybrids, Marketing of raw silk yarn.
3. Silk export : Challenges and growth prospects.
4. Co-operative marketing system in Sericulture.

Unit-IV : Silk Trading Organisation

1. Government Intervention – Legislation and implication in marketing.
2. Traditional land regulated markets.
3. Marketing strategies management.
4. International co-operation in silk trade.

PAPER XVI: EXTENSION MANAGEMENT AND PRODUCT ANALYSIS**Unit-I : Extension Methodology**

1. Principles and importance of extension education in Sericulture.
2. Demonstration farms and training.
3. Research methods in social sciences.
4. Methods of Sericulture extension.

Unit-II : Rearing Management and Networking

1. Management of silkworm rearing.
2. Administration and improvement of sericulture management.
3. Sericulture Service Network.
4. Role of co-operate sectors in development of sericulture.

Unit-III : Sericulture Organisation

1. Central Silk Board, Directorate of Sericulture at State Level.
2. Project Formulation and role of financing agencies in Sericulture.
3. Organisation and present position of sericulture in abroad.
4. Domestic and International silk markets.

Unit-IV : Biostatistics and Bioinformatics

1. Principles and methods of biostatistics. ‘T’ test, simple correlation regression and analysis of variance.
2. Use of computer in biometrics and data processing and introduction to bioinformatics.
3. Introduction to data bases, packages and international networks.
4. Gene bank sequence, molecular biology software, patenting of biological materials.

REFERENCE BOOKS:

1. **Handbook of Practical Sericulture** : Ullal, S.R. and Narasimhanna, M.N . (1987) Central Silk Board Publication, Bangalore.
2. **Advanced Economic Theory** : Ahuja, H.L., S. Chand & Co., Ltd., New Delhi.
3. **Exports and Development** : Koshy, T.D. (1990), Ashish Publication, New Delhi.
4. **Statistical Biannual** : CSB Publication, Bangalore.
5. **Statistical method** : Snedecor, G.W. and Cochran, W.C. (1979), Iowa State Univ. Press, Ames, Iowa.
6. **A Text Book of Economic Theory** : Stonier and Hague.
7. **Sericulture Society and Economy** : Hanumappa, H.G. (1993), Himalaya Publishing House, New Delhi.
8. **Development of Sericulture**: Narasaiah, M.L. and Jaya Raju (1999), Discovery Publishing House, New Delhi.
9. **Sericulture and Rural Development** : G. Sandhya Rani (1998), Discovery Publishing House, New Delhi.
10. **Comprehensive Sericulture Manual** : Mohan Rao, M.M. (1999), B.S. Publications, Hyderabad.
11. **Principles of Biostatistics** : Marcello Pagano Kimberlee Gauvreau, Duxburg, USA.
12. **Economics of Sericulture and Silk Industry in India** : Ramana, D.V. (1987), Deep and Deep Publishers, New Delhi.

13. **Silkman's Companion** : Anonymous (1992), CSB Publication, Bangalore.
14. **The Development of Indian Silk—A Wealth of Opportunities** : Sinha, S. (1960).
15. **An Introduction to Extension Education** : Supe, S.V.
16. **Extension Education** : Advi Reddy.
17. **Agricultural Marketing in India Acharya, S.S. and Agrawal, N.L.** (1999) Pub. By Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
18. **Education and Communication for Development** : Dahama, O.P. and Bhatnagar, O.P. Pub. by Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
19. **Silk Production, processing and marketing** : Nanavaty, M.N.
20. **Biostatistics** : Rama Krishna, P. 1996), Saras Publication, Kanyakumari.
21. **Economics of Sericulture under Irrigated and Rainfed Conditions** : (1982) M.S. Jolly, CSR & TI, Mysore.
22. **An Analysis of Demand and Supply prospectus for High Quality Raw Silk** : Naik, G and Babu, K.R. (1991), Centre for Management in Agriculture, Ahmedabad.
23. **Bioinformatics—Methods and Protocols** : Ed. By Stephen Misener and Stephen, A. Krawetz Humana Press Totowa, New Jersey.

Practicals:

1. Identification of textile fibre by physical and chemical tests : silk, wood, cotton, nylon and rayon.
2. Identification of various types of wastes : a) Filature waste, Grade-I and II; Reuse of Basin waste, b) Charka waste, c) Cottage basin waste.
3. Byproducts and utilization : a) Estimation of pupa oil, b) Estimation of pupal proteins.
4. Demonstration of plant tissue culture experiment : a) Callus culture, b) Micropropagation, c) Protoplast isolation and culture.
5. Any other practical set by the concerned teacher on Economics, Management and Extension methods of Sericulture.
- 6 Preparation of an array and frequency table.
- 7 Preparation of the histograms.
- 8 Description of a sample : Mean, Median, Mode.
- 9 Measures of the description based on the standard deviation.
- 10 Estimation of confidence interval : based on Normal and 't' distribution.
- 11 Use of profit analysis
- 12 Linear correlation.
- 13 Analysis of variance
- 14 Designing of the field experiments and questionnaire preparation for the collection of the field data.
- 15 Use of the computer in the sericulture studies.

Distribution of Marks

1. Practical

| | | | | | |
|----|---|-----|-----|-------|----|
| 1. | Identification and comments on spots (1-10) | ... | ... | ... | 20 |
| 2. | Demonstration of silk reeling/re-reeling | ... | ... | ... | 10 |
| 3. | Estimation of denier/rendita/silk testing of given sample | ... | ... | ... | 10 |
| 4. | Project formulation of mulberry plantation/silkworm rearing | ... | ... | ... | 05 |
| 5. | Submission of cocoon reeling record | ... | ... | ... | 05 |
| 6. | Biostatistical analysis of given sample | ... | ... | ... | 10 |
| 7. | Class Record | ... | ... | ... | 10 |
| 8. | Viva voce | ... | ... | ... | 10 |
| | | | | ----- | |
| | | | | | 80 |
| 9. | Internal Assessment | ... | ... | ... | 20 |

| | | | | | | | |
|-----------|---------------------|-----|-----|-----|-----|-------|------------|
| | | | | | | ----- | |
| | TOTAL MARKS | ... | ... | ... | ... | ... | 100 |
| 2. | Project work | | ... | | | ... | 100 |

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