GOVT. OF KARNATAKA
(DEPARTMENT OF SERICULTURE)

SYLLABUS FOR RECRUITMENT OF SERICULTURE EXTENSION OFFICERS

I. GENERAL :

Introduction to Sericulture-Origin and history of Sericulture– Spread of Sericulture toEurope, South Korea, Japan, India and other Countries. Components of Sericulture; Food plant cultivation, Egg production, Silkworm rearing, Reeling of cocoons and Silk weaving. Sericultural practices in tropical and temperate climate. Textile fibres: Types– Natural and Synthetic fibres, Types of Silk produced in India; Importance of Mulberry silk. Sericulture organization in India and Karnataka; Role of State Department of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development.National and International Silk Organisations, Organisational set up in India. Development of Sericulture through plans, World Bank Projects.Sericulture Organisation at State Level with reference to the planning and quality control, marketing, silk exchange, export–import policy and laws.

II. MORICULTURE :

Salient features, economic importance and affinity of the family Moraceae. Phytogeography and systematics of the genus *Morus* L. and its species.Botanical description of mulberry.

Propagation of mulberry: Sexual & Asexual methods – Significance. Raising of nursery for production of seedlings and saplings. Grafting and layering in mulberry - types and techniques.

Mulberry breeding: Objectives; selection methods; hybridization, polyploidy breeding and mutation breeding; breeding for disease and drought resistance.

Weather elements; influence of climatic factors on growth and productivity of mulberry, agro-climatic zones.

Popular mulberry cultivars of tropical regions, rainfed and irrigated conditions. Assessment of mulberry leaf yield and quality.

Soils for mulberry cultivation: Soil profile and classification; physical, chemical and biological properties.

Concept of soil fertility and productivity: Soil organic matter and humus. Soil sampling and testing; problematic soils and their reclamation.

Irrigation management:Sources, methods and schedules; quality of irrigation water; conservation of soil moisture in dry land farming.

To study advantage of farm mechanization & its limitations.Different agriculture operations which can be mechanized during crop production.

Plant nutrient management:Essential plant nutrients, organic manures, inorganic fertilizers and biofertilizers – importance, classification and application; integrated nutrient management.Tree mulberry method ofcultivation.

Establishment and maintenance of mulberry gardens; package of practices for mulberry gardens under rainfed and irrigated conditions, gardens for rearing of young-age silkworms and silkworm seed crop.

Pruning of mulberry: Objectives and methods, harvesting, transportation and preservation of mulberry.

Weed management in mulberry:Principles, methods and integrated management.

Disease management in mulberry: a) Foliar diseases b) Root diseases.

Pest management in mulberry:a) Sap sucking insects b) Leaf defoliating pests. Integrated pest management.

III. SILKWORM BIOLOGY AND REARING :

SILKWORM BIOLOGY :

Characteristic features of the order Lepidoptera, families- Saturnidae and Bombycidae. Classification of sericigenous insects. Classification of silkworms based on moultinism, voltinism; popular silkworm breeds and hybrids of Karnataka; their economic traits. Life cycle of *Bombyxmori*: morphology of egg, larva, pupa and adult.

Anatomy of digestive, circulatory, excretory, respiratory, nervous and reproductive systems of silkworm larva and silk moth; structure of Silk gland; Integument.

EMBRYOLOGY AND PHYSIOLOGY OF SILKWORM :

Embryology: Morphology and structure of silkworm egg, fertilization, cleavage, blastoderm, germ band formation, blastokinesis, eye spot and blue egg; diapause development.

Physiology: Digestion, Respiration, Excretion, Circulation, Reproduction. Sense organs: Photoreceptors, Chemoreceptors and Mechanoreceptors.Effect of juvenile hormones and JH analogues on moulting, silk secretion and oviposition.

GENETICS AND BREEDING OF SILKWORM :

Genetics: Structure and chromosome numbers in mulberry and non-mulberry silkworms. Linkage groups in *Bombyxmori.*

Gametogenesis- Oogenesis and Spermatogenesis. Genetic basis of voltinism and moultinism in the silkworm, *Bombyxmori.* Hereditary traits of silkworm eggs and larva.

Genetics of cocoon colours- inheritance of cocoon colours. Parthenogenesis in silkworm-types and induction of parthenogenesis.

Sex determination mechanism in silkworm- importance of ZZ and ZW chromosomes-sex-limited races.Silkworm germplasm bank.

Breeding: Introduction to silkworm breeding- inbreeding and outbreeding concepts-objectives of silkworm breeding-techniques- different types of breeding methods- line breeding, cross breeding and mutation breeding. Selection: Methods- individual and mass selection- fixation of characters- qualitative and quantitative traits- evolution of new breeds.

Heterosis and hybrid vigour-exploitation of heterosis in silkworm- concept of single, double and polyhybrids.Race authorisation.

SILKWORM SEED PRODUCTION :

Silkworm Seed Organization: **Seed areas:-** Mysore & Bivoltine Seed Area. Basic seed multiplication centres-P4, P3, P2, P1.

Seed production centres (grainages) – Disinfection and hygiene- types of grainages-organisation and functions of grainages- plan for model grainage- grainagee quipments and their use.

Seed cocoon markets –pupal examination, certification of seed cocoon, price fixation for seed cocoons. Procurement and transportation of seed cocoons.

Moth emergence and synchronisation: sex separation in moth; effect of improper synchronisation on egg hatching and quality-safe duration. 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.

Egg disinfection- handling of multivoltine eggs- preservation of eggs to postpone hatching-ideal embryonic stages for cold storage- maximum duration of cold storage.

Handling of bivoltine eggs for early hatching- physical and chemical methods- hot and cold acid treatment. Postponement of hatching; hibernation schedule for 3, 4, 6 and 10 months duration. Aestivation.Preparation of loose egg- advantages- handling of loose eggs; Incubation of eggs.

SILKWORM REARING :

Rearing house, Rearing appliances and their disinfection.Incubation definition, requirement of environmental conditions.Leaf selection for young and late age silkworms.

Chawki rearing: Preparation; brushing and brushing methods; types of chawki rearing – traditional method, paraffin paper with foam rubber and wrap-up method; optimum environmental conditions; methods and frequency of feeding; methods of bed cleaning; spacing; moulting and care during moult.

Late age silkworm rearing: Different methods of rearing; optimum environmental conditions; feeding quantity and frequency; methods of bed cleaning; spacing; moulting and care during moult. Cocoon spinning and Harvesting.

DISEASES AND PESTS OF SILKWORM:

Diseases of silkworm: Protozoan disease, Bacterial diseases, Viral diseases, Fungal diseases- types and their preventive control measures, disinfection, disinfectants, bed disinfectants.
Pests of silkworm: Indian uzifly, Dermestid beetle, Bio control agents.

SERICULTURE EXTENSION:

Sericulture extension:Extension education- meaning ,objectives and importance. Principles and concepts of extension education. Extension programmes- concepts and principles, role of extension personnel and farmers in programme planning Transfer of technology.
Training- concepts and definition- different methods of training. Extension methods- Individual contact model, Group contact methods, Mass contact methods, Application of extension methods in sericulture. Farmers Produce organization (FPO)
Role of Women in Sericulture activities- Mulberry cultivation, silkworm rearing, Grainage operation, Reeling sector, Role of Sericulture in empowering women through employment and income generation.

COCOON / SILK MARKETING:

Methods of marketing of cocoon and silk. Process involved in cocoon and silk transaction. Brief knowledge of e-auction process in cocoon markets.

IV. SILK TECHNOLOGY :

Silk as a textile fibre :**Classification of textile fibres** – brief note on important properties of different fibres and animal fibres in particular
Cocoon as a raw material for raw silk production. Physical and chemical characteristics of cocoons – colour, shape, grains or wrinkles on the surface, cocoon weight and size, thickness of shell and shell weight, cocoon shell ratio, compactness, filament length, filament size and lousiness. Reelability% of cocoons and raw silk %.
Denier variation of cocoon filament – Denier variation of filament in popular silk worm races.
Factors influencing cocoon quality. Different types of defective cocoons. Cocoon testing - sample size and test reeling. Calculation of filament length, reelability%, raw silk% of cocoons.
Cocoon harvesting, sorting and transportation. Sorting of cocoons – sorting table. Cocoon mixing – objectives and uses

Cocoon stifling – objectives.Steam stifling methods – advantages and disadvantages.
Cocoon drying – objectives, principles of cocoon drying, estimation of drying percentage.
Methods of drying– batch type and conveyor type drying.Factors influencing drying.
Cocoon storage – Storage after steam stifling, storage after cocoon drying
Cocoon cooking – objectives. Sericin softening and degree of cocoon cooking. Cocoon cooking systems – float and sunken systems with reference to permeation of water. Cocoon cooking or boiling in steam medium and hot water medium. Factors influencing cooking-temperature, duration and quality of water. Methods of cocoon boiling – open pan, two pan, circular boiling and continuous boiling machine.
Cocoon brushing – manual brushing and mechanical brushing
Silk Reeling – introduction. Brief history of development of silk reeling machines – Silk reeling machinery and process – Charaka, Cottage basin or filature basin, Multiend reeling machine and Automatic Reeling Machine(ARM). Factors influencing silk reeling – Reeling bath, jettebout, button, croissure, stop motion device, traverse guide and yarn winding speed. Quality control in reeling.
Silk re-reeling – Objectives of re-reeling. Reel permeation – soaking method and vacuum permeation. Re-reeling machine and process. Closed type re-reeling – advantages.
Skein finishing and packing – lacing of skeins.skein conditioning, inspection and packing.
Raw silk testing – Importance of raw silk testing, different type of tests – visual examination, winding; uniformity tests – average size, size deviation, maximum deviation, evenness; cleanness, neatness, tenacity, elongation and cohesion.Raw silk grading BIS and ISA methods
Spun silk – Manufacturing of spun silk, spun silk processing systems, silk waste as raw material for the industry, flow chart of spinning and spinning operations. Brief description about hand spinning of cocoon wastes.
Silk Throwing and Weaving – Objectives of silk throwing, winding, doubling, twisting and setting of twist.Types of twisted yarns – singles, organzine, tram, crepe and georgette.Brief description of weaving preparatory processes – preparation of warp and weft.Weaving machinery – Handloom, Powerloom and shuttleless looms. Fundamental weaves – Plain, Twill and Satin. Different types of fabrics – woven and knitted.
Silk wet processing – Degumming and bleaching processes. Dye classification and brief description of silk dyeing with acid, basic, direct, reactive, vat and metal complex dyes. Silk printing – objectives, printing methods block printing, screen printing and roller printing.

V. NON-MULBERRY SERICULTURE (VANYA SILKS) :

Life cycle of Tasar, Eri and muga silkworms.
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.Disinfection methods.

Seed cocoons – Procurement- cocoons of different ecotypes and their advantages and disadvantages- cocoon preservation-synchronisation of moth emergence- production of disease free eggs. Seed organisation of tasar and muga silkworms.

Diseases of non-mulberry silkworms- protozoan, bacterial, viral and fungal diseases. Symptoms- causative agents-preventive and control measures.

Global production of non-mulberry silks, their scope and impact on the socio-economic conditions of tribal's.Distribution of non-mulberry silk yielding insects and non-insects and their classification.

VI. SERICULTURE ECONOMICS:

Mulberry cultivation (per hectare) –Cost and returns under irrigation and rainfed in comparison with other cash crops.

Economics of silkworm rearing(for 100 Dfls): Investment and returns.

Economics of silk reeling (per kg of raw silk): Cost and returns for different types of reeling establishments

By-products of sericulture industry and their utilization and value addition.

VII. SERI BIOTECHNOLOGY:

Principles and fundamentals of biotechnology; Scope and importance of plant biotechnology. Application of biotechnology in improvement of mulberry strains and silkworm races.

REFERENCES

1. Basavaraja, H.K., Aswath, S.K., Suresh Kumar, N., Mal Reddy, N. and Kalpana, G.V. (2005) *Silkworm Breeding and Genetics.* Central Silk Board, Bangalore.
2. Bongale U.D. and Venkatadsri J.S. (2005) Handbook of sericulture under rainfed condition, KSSRDI Publication.
3. Bongale, U.D (1995) Fertilizers in mulberry cultivation. PushpaSree Publications, Thalaghattapura, Bangalore.
4. Dandin, S.B. and Gupta, V.P. (2002) *Advances in Indian Sericulture Research*. CSR&TI, Mysore.
5. Dilip De Sarkar (1998) *The Silkworm – Biology, Genetics and Breeding*. Vikas Publishing House Pvt. Ltd., New Delhi.
6. Dokuhon, Z.S (1998). Illustrated Textbook on Sericulture. Oxford & IBH publishing Co, Pvt. Ltd, New Delhi, Calcutta.
7. Satish, G. (2015) Pure Mysore Silkworm race protocol for maintenance and multiplication, KSSRDI Technical Publication No.117.

8. Govindaiah, V.P Gupta, D.D Sharma, S. Rajadurai and V. NishithaNaik, (2005). A text Book on Mulberry Crop Protection., Published by Central Silk Board, Bangalore-68, India.
9. Govindan, R.; Narayanaswamy, T.K. and Devaiah, M.C. (1998) *Principles of Silkworm Pathology.* Seri Scientific Publishers, Bangalore.
10. Govindan, R.; Ramakrishna Naika and Sannappa, B. (2004) *Advances in Disease and Pest Management in Sericulture*. Seri Scientific Publishers, Bangalore.
11. Govindan, R.; Ramakrishna Naika and Sannappa, B. (2005) *Objective Sericulture for Competitive Examinations*. Seri Scientific Publishers, Bangalore.
12. Guptta, R.K & Mittal, R.K (1983) Bibliography of Indian Weeds. Associated Pub. Co. New Delhi.
13. HasaoAruga (1994) Principles of Sericulture (Translated from Japanese) Oxford & IBH publishing Co, Pvt. Ltd, New Delhi.
14. Hortmann and Kesler (1993) Plant Propagation, principles and practices. Prentice Hall, HemelNemstead.
15. Jolly, M.S. (1987) *Appropriate Sericulture Techniques.* Published by International Centre for Training and Research in Tropical Sericulture, Mysore.
16. Jolly, M.S.; Sen, S.K.; Ahsan, M.M. (1974) *Tasar culture*. Ambika Publishers, Bombay.
17. Jolly, M.S.; Sen, S.K.; Sonwalkar, T.N. and Prasad, G.K. (1979) *Sericulture Manual - 4 – Non-Mulberry Silks*. Agriculture Service Bulletin, FAO, Rome.
18. Krishnamurthy, N. (1981) Plant growth substances including application in Agriculture. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
19. Krishnaswami, S.; MadhavaRao, N.R.; Suryanarayan, S.K and Sundaramurthy, T.S. (1972) *Sericulture Manual - 3 - Silk Reeling*. Agriculture Service Bulletin, FAO, Rome.
20. Krishnaswami, S.; Narasimhanna, M.N.; Suryanarayan, S.K and Kumararaj, S. (1973) *Sericulture Manual-2 - Silkworm Rearing.* Agriculture Service Bulletin, FAO, Rome.
21. Kumaresan, P. and Srinivasa, G. (2005) *Sericulture Extension Management and Economics.* Central Silk Board, Bangalore.
22. Narasimhanna, M.N. (1998) *Manual on Silkworm Egg Production.* CSB, Bangalore.
23. Narayanaswamy, K.C. and Devaiah, M.C. (1998) *Silkworm Uzi Fly*. Zen Publishers, Bangalore.
24. Nataraju, B., Sathyaprasad, K., Manjunath, D. and Aswani Kumar, C. (2005) *Silkworm Crop Protection.* Central Silk Board, Bangalore.
25. Patil C.S. Silkworm diseases in Tropics and management (2013),KSSRDI Technical Publication, 107.
26. Rajan, R.K. and Himantharaj, H.T. (2005) *Silkworm Rearing Technology.* Central Silk Board, Bangalore.
27. Rajanna L, Das P.K, Ravindra S, Bhogesha K, Mishra R.K, Singhvi N.R, Katigar R.S and Jayaram H. Mulberry Cultivation and Physiology Central Silk Board, Bangalore, Dec.2005.
28. S.B. Dandin and Giridhar K., (2010), Hand book of Sericulture Technologies, Central Silk Board, Madivala, Bangalore.
29. Sengupta, K.; Kumar, P.; Baig, M. and Govindaiah (1990) *Handbook on Pest and Disease Control of Mulberry and Silkworm*. ESCAP, UN, Thailand.
30. Shankar, M.A (1998) Handbook on mulberry Nutrition, Multiplex, Bangalore.
31. Shekarappa., M.B., Gururrja., C.S. Raghuramana., R, Dandin S.B. (1997) Shoot feeding for late age silkworm. KSSRDI Technical bulletin No. 5.

32. Singh, B.D. (1998) *Biotechnology*. Kalyani Publishers, New Delhi.
33. Sreerama Reddy, G. (Ed.) (1998) *Silkworm Breeding*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi and Calcutta.
34. SubbaRao, N.S (1998) Biofertilisers in Agriculture. Oxford & IBH Pub. Co, Pvt. Ltd, New Delhi.
35. Tazima, Y. (1964) *Genetics of Silkworm*. Academic Press, London.
36. Tazima, Y. (1978) *The Silkworm: An Important Laboratory Tool*. Kodansha Ltd., Tokyo.
37. Ullal, S.R. and Narasimhanna, M.N. (1994) *Handbook of Practical Sericulture*. CSB, Bangalore.
38. Veeranna G., Nirmala M.R., Raghuraman., R., U.D. Bongale, (2003) ರೇಷ್ಮೆ ಹುಳು ಸಾಕಾಣಿಕೆಯಲ್ಲಿಊಜಿ ನೊಣ ಹಾವಳಿ ಮತ್ತುಅದರ ನಿಯಂತ್ರಣಕ್ಕೆ ಸಮಗ್ರ ನಿರ್ವಹಣಾ ವಿಧಾನ.KSSRDI Publication no. 44.
39. ಪಾಟೀಲ್.ಎಸ್., ಸುಕುಮಾರ್, ಜೆ. ಕೃಷ್ಣರಾವ್.ಎಸ್. (2013)ಅಧಿಕ ಇಳುವರಿಗಾಗಿ ರೇಷ್ಮೆಕೃಷಿಕರಿಗೆತರಬೇತಿ ಉಪನ್ಯಾಸಗಳು: ಕ.ರಾ.ರೇ.ಸಂ.ಅ.ಸಂಸ್ಥೆ ತಾಂತ್ರಿಕ ಪ್ರಕಟಣೆ ಸಂಖ್ಯೆ102.
40. Manual on Sericulture, Silk Reeling FAO, Agriculture Service Buleetin No. 72/3.
41. Mahadevappa D., Halliyal V.G., Shankar A,G., Bhandiwad R., 2000 Mulberry Silk Reeling Technology, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
42. Byong Ho Kim 1989. Filature Water Engineering. Seoul National University Press, Republic of Korea.
43. Sonwalker T.N. Handbook of Silk Reeling Technology, New Age International Pvt.Ltd.
44. Trotman E.R. 1984. Dyeing and Chemical Technology of Textile fibres. John Wiley and sons, New York.
45. www.ksssrdi.org
46. www.karnataka.gov.in/sericulture1

Additional Director of Sericulture(Tech)
&Chairman Syllabus Committee