

APRCET 2023-24

49-SERICULTURE

MULBERRY PRODUCTION TECHNOLOGY

Principles and practices of plant propagation techniques with special reference to mulberry.

Seedlings: Collection of seeds, growing seedlings in field nurseries.

Techniques of propagation by cuttings and saplings their merits and demerits.

Grafting : Selection of stock and scion materials. Stem root and bud grafting techniques.

Ground, air and Trench layering methods.

Preparation of nursery bed. Layout, size, composition, maintenance and care.

Mulberry cultivation practices (Under irrigated and dry land conditions)

Selection and preparation of land, implements and machinery employed in mulberry cultivation.

Selection of elite varieties for cultivation.

Planting materials (cuttings, saplings, grafts, layers) and their practical utility.

Planting systems: Row system, pit system and paired row system , leaf yield estimation and their importance in leaf productivity under different field conditions.

Inter-cultivation, weeds and weeding. Its types, objectives, methods and periodicity.

Organic manure (FYM, compost, tank silt, night-soil, sewage sludge, oil cakes, vermicompost,)

Green manure, Bio-fertilizers, Chemical fertilizers – Types, application methods and schedules for irrigated and rain fed mulberry gardens.

Irrigation: Water requirement of mulberry, water resources, water quality, irrigation systems.

Pruning types, objectives, methods, advantages and practical relevance.

Leaf harvesting methods in relation to cultivation and rearing practices. Storage, transportation and preservation methods.

Mulching, Intercropping and their uses..

Foliar nutrition, formulations – Mode of application merits and demerits.

Package of practices of mulberry cultivation under rain-fed and irrigated conditions.

Watershed area concept and water management practices in dry land and mulberry cultivation.

Influence of agro-climatic factors on growth and development of mulberry.

Edaphic factors :

Soils formation- weathering, types of weathering, factors influencing the weathering. types, profile, structure, topography, porosity, aeration, soil water, organic matter, soil micro-organisms.

Soil chemical characters, Soil reaction, Salinity, acidity and alkalinity. Soil amendments, soil and water conservation. Soils of mulberry.

Climatic factors :

Role of light, temperature, wind velocity, attitude, rainfall and relative humidity in mulberry growth and development.

Mineral deficiency, diagnostic techniques, correction measures and mineral toxicity.

Entrepreneurship development programme (EDP): Emergence and objectives of EDP - essential qualities to become an entrepreneur - selection of a potential entrepreneur.

Planning for EDP: Objectives, selection of a centre, purpose of pre-training promotional work.

EDP in raising mulberry saplings (Kisan nursery) and vermicomposting.

BIOCHEMISTRY

Carbohydrates – Structure, properties and Classification.

Glycolysis, Tricarboxylic acid cycle and Oxidative Phosphorylation.

Proteins –structure, Classification, properties and synthesis.

Amino acids –, structures and Classification

Amino acids of mulberry leaf and silk proteins (Fibroin and Sericin)

Role of amino acids and proteins in silkworm nutrition

Phytochemical constituents of mulberry with special reference to silkworm nutrition.

Lipids: Structure, classification and functions.

Properties of fatty acids –Tri acylglycerols, Phospholipids , Sterols, glycolipids, lipoproteins, cholesterol,

Amphipathic lipids.

Enzymes – History, classification, nomenclature and properties

Factors affecting enzyme activity – Cofactors, coenzymes, isoenzymes – Michael's Menten equations –

Significance of Km and Vmax. Mechanism of enzyme action – Lock and key hypothesis, Induced fit

theory and substrate strain theory. Bisubstrate reactions – Enzyme inhibition – Reversible(Competitive and non-competitive), Irreversible and Allosteric inhibitions –

Thermodynamics of enzymatic reactions- Role of inhibitors in enzyme regulation – Feedback inhibition.

Biostatistics

Principles of Biometry – Frequency distribution – Diagrammatic representation of data.

Measures of central tendency.

Linear correlation and regression.

Sampling theory – Tests of significance – Student's 't' test, 'Chi -square' test – Analysis of variance – 'F' test – Levels of significance.

SILKWORM BIOLOGY, PHYSIOLOGY AND ENDOCRINOLOGY THEORY

1. Origin and distribution of silkworm

2. Taxonomic classification of silkworm and Kinds of silkworms

3. Moulting and voltinism of silkworm- temperature, Photoperiod and humidity

4. Morphology of Silkworm larva, pupa, moth and metamorphosis.

1. Body wall and its derivatives- structure and function of integument- Larval integument- Pupal and Adult.

2. Structure and Physiology of

a. Digestive system – Larval digestive system, Digestive organs of adult , Food ingestion and digestion and Feces and fecal elimination

b. Respiratory system- Micro structure of trachea, Mechanism of the respiration- gaseous diffusion, Tracheal ventilation, , Excretory system, Circulatory system, Silk gland, Muscular system and Reproductive system

c. Artificial diets for the silkworm

DEVELOPMENTAL PHYSIOLOGY OF SILKWORM

1. Growth and development of silkworm

2. Physiology and biochemistry of moulting and metamorphosis

3. Physiology and biochemistry of diapauses
4. Hormone regulation of growth and development

APPLICATION OF INSECT HORMONES IN SERICULTURE

1. Application of juvenile hormone in sericulture
2. Application of moulting hormone in sericulture

PATHOLOGY OF MULBERRY AND SILKWORM THEORY

DISEASES OF MULBERRY AND THEIR CONTROL

1. Fungal diseases : Leaf spot, Powdery mildew, Rust disease, Root rot, and Twig blight
2. Bacterial disease: Bacterial blight
3. Mycoplasma diseases : Dwarf diseases
4. Viral diseases : Mosaic diseases
5. Nematode diseases : Root knot disease

6. Deficiency diseases : Mineral deficiency and its control.

PESTS OF MULBERRY AND THEIR CONTROL

1. Lepidoptera : Behar hairy caterpillar, Cutworm, Moringa hairy caterpillar, Tussock hairy caterpillar,

Leaf –roller

2. Hemiptera : Mulberry mealy bug, Jassid, Scale insects,

3. Coleoptera : Stem girdler beetle and Stem borer

4. Orthoptera : Grass hopper

5. Thysanoptera: Thrips

6. Isoptera: Termites

7. Acarina: Mites

8. **Integrated Pest and Disease Management (IDPM) in Mulberry**

DISEASES OF SILKWORM AND THEIR CONTROL

1. Viral diseases : Nuclear polyhedrosis, Cytoplasmic polyhedrosis, Infectious flacherie and

Densonucleosis

2. **Bacterial diseases : Septecemia, Bacterial disease of digestive tract and Sotto (Bacterial Taxicosis)**

3. Fungal diseases: Muscarding and Aspergillosis

4. Protozoan disease: Pebrine

PESTS OF SILKWORM AND THEIR CONTROL

1. **Major pest : Uzi fly**

2. **Minor pests : Dermestid beetles and other pests of silkworm**

3. **Forms and formulations and applications of pesticides.**

4. **Integrated Disease and Pest Management (IDPM) in Silkworm.**

TAXONOMY AND ANATOMY

Distribution, morphology and taxonomic status of the genus *Morus*.

Popular mulberry cultivars of tropical and temperate regions and their yield potentiality.

Anatomy of mulberry leaf, stem and root

PHYSIOLOGY

Photosynthesis, photosynthetic pigments their characteristic, carbon fixation mechanism (C₃, C₄ and CAM) photorespiration and productivity.

Evapo-transpiration, stomatal frequency and dynamics, anti-transpirants.

Water stress and its effect on growth and development of mulberry:

- (a) Biochemical and physiological adaptations, drought resistance
- (b) Response of mulberry to salt stress and water logging
- (c) Symptoms of water logging injury in plants, physiological and biochemical response of plants to water logging. Photoperiodism, Mulberry growth regulators, flowering and fruit development,

senescence and abscission. Biological nitrogen fixation: Symbiotic and A symbiotic biological nitrogen fixation mechanism.

ENVIRONMENTAL BIOLOGY

1. Introduction to environmental biology
2. Basics of Atmosphere, ocean, lithosphere, hydrosphere and biosphere
3. Biogeochemical cycles
4. Ecosystems- Structure and functions of mulberry ecosystem, biotic and abiotic factors, ecological pyramids
5. Energy flow in mulberry ecosystem.
6. Food-chains, ecotone, ecological niche, ecosystem stability.

BIODIVERSITY

1. Biodiversity Bio-Resources conservation
2. Pollution- air, water and soil
3. Environmental biotechnology; Role of biotechnology in conservation of species, *in-situ* and *ex-situ* conservation.

COCOON PRODUCTION TECHNOLOGY

Different races in mulberry silkworm-classification based on voltinism, moultinism and geographic origin. Popular silkworm breeds and hybrids for commercial rearing, their adaptability, productivity etc.

Silkworm rearing technology: prerequisite planning for rearing and programme of mulberry leaf production. Importance of Types of rearing, seed crop rearing and commercial rearing, pre-requisites for rearing. Rearing house, model rearing house, construction of different types of rearing houses, modification to control Uzi fly infestation, sanitation, disinfectants and their effects, and their role in disease management, importance of disinfection-physical, chemical, and gaseous types- formalin requirements for effective disinfection. Rearing equipments for shelf rearing and shoot rearing methods. Methods and importance of incubation, black boxing techniques, brushing of silkworm, - 13 hrs

Mulberry leaf quality: Various factors affecting leaf quality (tender, medium and coarse leaves) nutritional requirements, harvesting and transportation- preservation of mulberry leaf, chopping of mulberry leaves, requirements at different instars-artificial diet, their advantage and limitations role of hormones and the chemicals on rearing performance. Environmental factors for rearing, measurements, and regulation of environmental factors such as photoperiods, temperature, and humidity. Effect of temperature and humidity on young and late age silkworm-control of temperature and humidity, controlling devices, effect of air and light on rearing. - 11hrs

Young age silkworm rearing: Characteristics of young age larvae (chawki), different methods adopted including isolation chamber method, co-operative chawki rearing, and importance of chawki rearing centers. Method adopted in sericulturally advanced countries.

Late age silkworm rearing: Characteristics-different methods (shoot and tray rearing), their merits, and demerits-importance in sericulture economics.

Cleaning and Spacing: Objectives and methods of cleaning. Time and frequency of cleaning for different instars, objectives of spacing, optimum spacing for different ages, molting, care during molting.

Recent/Modern concepts in chawki and late age silkworm rearing (Isolation chamber, single feeding shoot, and floor rearing), merits and demerits. Improved techniques of rearing over traditional practices.

Spinning: Characteristics of spinning larvae, mechanism of silk formation, cocoon formation, mounting-different methods-merits and limitations, care during mounting, environmental conditions during spinning. Harvesting of Cocoons: Time of harvesting of Cocoons, defective cocoons- double, flimsy, deformed, stained and melted cocoons-characteristics and their impact on cocoon quality, remedial measures to avoid defective cocoons. cocoon assessment-transportation and marketing of cocoons-leaf cocoon ratio. Rearing technology for non-mulberry silkworms Tasar, Oak tasar Muga, Eri and silkworm varieties.-11 hours

SEED TECHNOLOGY

1. Management of Basic seed Farms **(P3)**
2. Seed multiplication farms **(P2)**.
3. Parent seed cocoon production **(P1)**

MANAGEMENT OF GRAINAGE

1. Location of the Grainage, capacity of a Grainage, Grainage building, Grainage Equipment .
2. Programme of Production
3. P1 Seed Cocoon Production and supply
4. Synchronization of moths
5. Transportation of Seed Cocoons
6. Staff of the Grainage, Day duty batch, Night duty batch and Moth examination batch
7. Transportation of Silkworm eggs

8. Cordial relation with Farmers.

PROCESS OF EGG PRODUCTION

1. Disinfection of Grainage equipment and building
2. Hybrid Disease Free Layings
3. P1 Seed Cocoons : Cocoon arrangements, Sorting of Cocoons, Arrangement of Cocoons, Sex separation, Emergence of moths, Pairing, Fertilization, Moth Examination, Sample testing, Individual and Mass moth examination, Washing of Eggs, Preparation of Sheet eggs and loose eggs and disposal of Dfls

PRESERVATION AND HANDLING OF EGGS

1. Embryology and hibernation of Silkworm eggs
2. Preservation of multivoltine eggs.
3. Preservation of Bivoltine eggs.
4. Acid treatment of Bivoltine eggs
5. Hot acid and Room temperature acid treatment of silkworm eggs
6. Acid treatment after a long duration of chilling – Chilling for a shorter duration and acid treatment and cold storage of Acid treated eggs.

SILK TECHNOLOGY AND ENTREPRENEURSHIP DEVELOPMENT

Physical and commercial characteristics of multivoltine and bivoltine cocoons: Cocoon markets – organization and functions - cocoon sorting – objectives and procedure - defective cocoons.

Cocoon stifling: Objectives and methods – sun drying, steam stifling, hot air drying, - advantages and disadvantages - Preservation of cocoons.

Cocoon cooking: Objectives and methods - open pan - three-pan – pressurized - floating and sunken systems - merits and demerits.

Reeling water: Sources and quality, importance in cocoon cooking and raw silk quality; factors influencing water quality; corrective measures.

Silk reeling: Evolution of silk reeling. Reeling units – charaka - cottage basin - multi-end and automatic reeling devices - Comparative account on the performance of different reeling units - components and their functions in silk reeling devices.

Re-reeling and packing: Objectives - grant reeling - hank preparation – lacing – skeining – booking - bale making and bundling.

Raw silk properties – physical - chemical and microscopic - Factors influencing the properties of raw silk - Silk exchanges – structure and function.

Raw silk testing and grading – objectives: Raw silk testing – conditioned weight - visual and mechanical tests - Raw silk grading - international standards (ISA) and Bureau of Indian Standards (BIS).

Degumming - bleaching and silk dyeing – objectives and methods.

Silk throwing: silk weaving - hand and power loom; fabric examination.

Byproducts of silk reeling industry and their utilization.

Entrepreneurship development programme (EDP): Emergence and objectives of EDP - essential qualities to become an entrepreneur - selection of a potential entrepreneur.

Planning for EDP: Objectives, selection of a centre, purpose of pre-training promotional work.

EDP in raising mulberry saplings (Kisan nursery) and vermicomposting.

EDP in organization of chawki rearing centres.

EDP in silkworm egg production and rearing.

EDP in silk reeling – charaka, cottage basin and multi-end reeling units.

EDP in mass production of parasitoids and predators.

CELL BIOLOGY, MOLECULAR BIOLOGY AND IMMUNOLOGY

Techniques in Cell Biology – Various types of microscopy – Light microscopy and electron microscopy – Fixation and staining – Cytochemical methods – detection of aldehydes, lipids and enzymes, cell culture – autoradiography – micro manipulation techniques, cell fractionation, cell centrifugation and sedimentation – ultracentrifugation.

Structure, organization and functions of plasma membrane models.

Ultra structure organization of the following organelles –

Golgi complex, Endoplasmic reticulum, Nucleus and nuclear envelop, Mitochondria

Chloroplast, Lysosomes and Ribosomes

Structure and functions of cytoskeleton – microfilaments, microtubules – Intermediate filaments – organization of cytoskeleton.

Eukaryotic chromosomes – Types of chromosomes – Structures and organization of chromatin – Synaptemal complex – Polythene and lampbrush chromosomes.

MOLECULAR BIOLOGY AND IMMUNOLOGY

Introduction to nucleic acids – Chemistry and Physics of DNA and RNA – Watson and Crick model of DNA. Structure of RNA - Different types of RNA – tRNA, mRNA and rRNA – DNA organization in chromosomes.

Mechanism of DNA replication – semiconservative synthesis of DNA – DNA replication in prokaryotes and eukaryotes – DNA polymerase – Inhibitors of DNA synthesis.

Transcription : Biosynthesis of RNA and DNA – RNA Polymerase – Initiation, elongation and termination of transcription – RNA.

Translation : Factors and enzymes involved in protein synthesis – initiation, elongation and termination of translation. Wobble hypothesis – a special note on amino acylation of t-RNA – inhibitors of protein synthesis.

Types of immunity : Passive, active and acquired immunological action.

Classes and structure of antibodies – Functions of antibodies and generation of antibody diversity – antigen-antibody reaction – blood group antigens – monoclonal antibodies.

Cellular basis of immunity – Immune system – Primary and secondary response – T & B lymphocyte antigen processing and presentation – Immunoglobulin gene

POST-COCOON TECHNOLOGY

Textile Fibres : Brief introduction to natural and man-made fibres – Cotton – Wool – Silk and Nylons – Polyester – Acrylic.

Physical and chemical properties of silk.

Identification of textile fibres – Burning, microscopic and solubility tests.

Cocoon properties – assessment – Cocoon testing – methods followed in Japan and its practicability to Indian conditions – Cocoon shape, colour, wrinkles or grain

Defective cocoons – Types defective cocoons and percentage.

Commercial characters: Assessment of Cocoon by Size, Filament length – Filament denier, average Denier– Estimated Renditta Shell ratio its percentage and Raw Silk percentage.

Cocoon stifling /drying – Objectives – different methods – Suitable stifling methods according to cocoon varieties and reeling devices. Merits and demerits of each method.

Cocoon storage and preservation of cocoons in silk reeling units – Factors to be considered for ideal storage – Faulty storage – Fungus and insect attack.

Cocoon boiling / cooking – objectives – different methods – open pan, three pan, pressurized cocoon boiling systems – Floating and sunken systems – Merits and Demerits of each method – Appropriate cocoon cooking systems to be followed according to cocoon variety and reeling devices.

Silk reeling : System of reeling – Direct and indirect type – Floating and sunken type.

Reeling method on country Charkha – Improved Charkha – Cottage basin – Multiend and automatic reeling machines.

Passage of thread in various reeling machines.

Functions in reeling machines components – Reeling basin – Jettebout – Porcelain button – Croissure – Chambon and tavellette type – Guide pulleys – Tension pulley Traverse mechanisms – Reel or swift – Reel stop motion – Denier control device Production Calculations.

Non- mulberry silk reeling – Tasar – Muga and Eri Reeling appliances.

Cooking methods – Reeling process for non-mulberry cocoons.

Re-reeling – Objectives – Standard sized hank – Grant reeling – Lacing – Skeining – Book making – Standard weight of skein, Book, Bale.

SERICULTURE ORGANIZATION EXTENSION AND ECONOMICS

Present Status of Sericulture in the world : India's position : Distribution of Sericulture in India.

Organizational setup in Sericulture. Central Silk Board and its role in promoting Sericulture. Role of State

Extension education: Extension education Meaning Principles Philosophy

Communication Definition and meaning Role of communication in extension education

Extension methods Individual contact model Group contact methods Mass contact methods Application of extension methods in sericulture

Economics of mulberry cultivation:

i) Under irrigated conditions

- ii) Under rainfed conditions
- iii) Raising of nursery
- iv) Cost and returns
- v) Yield and productivity trend

Economics of cocoon production:

- i) Cost of production of cocoons under irrigated conditions
- ii) Cost of production of cocoons under rainfed conditions
- iii) Cost and returns
- iv) Yield and productivity trend

Economics of Silk Production:

- i. Cost of production of silk charkha
- ii. Cost of production of silk on Cottage basin
- iii. Cost of production of silk on Multi end reeling units

Economics of Seed Production:

- i. Cost of seed cocoons
- ii. Cocoon-DFL ratio

Economics of non-mulberry cocoon production

Economics of hoisting and Matka yarn.

VANYA SERICULTURE

1. Insect and non-insect fauna producing silk and their distribution in world and India.
2. Status of vanya silks in India – characteristic features, advantages, income and employment, production and demand.
3. Host plants of vanya silkworms: State-wise distribution in India, area and economic importance.
4. Botanical description of primary host plants of vanya silkworms.
5. Establishment of primary host plants of vanya silkworms and package of practices for their cultivation.
6. Pests and diseases of primary host plants of vanya silkworms and their management.
7. Planning for vanya silkworm egg production and rearing; grainage and rearing equipments.
8. Disinfection and hygiene practices in grainages and silkworm rearing houses / premises.

1. Breeding, eco-races / races, morphology and life cycle of vanya silkworms.
2. Egg production technology of vanya silkworms.
3. Rearing technology of young and late-age vanya silkworms.
4. Pests and diseases of vanya silkworms and their management

1. Tasar and muga cocoon reeling: Selection, cooking and reeling; eri cocoon spinning.
2. Economics of tasar, eri and mugaculture.
3. Byproducts of vanya sericulture and their utilization.
4. Constraints (inherent and man-made) in vanya silk production; strategies for improvement of vanya sericulture (host plants and vanya silkworms) in India.

MULBERRY GENETICS AND BREEDING

Chromosome number karyotypes meiotic behavior in Morus species/varieties -Brief account of micro and mega sprogenesis - development of male and female gametophytes - pollen structure – pollination – fertilization – endosperm – embryo – polyembryony - parthenocarpy with reference to mulberry.

General introduction to plant breeding: History - scope and objectives - Method of evaluation of mulberry genotypes - Agro-botanical parameters (Sprouting, rooting survivability, yield) - Chemoassay and Bioassay.

Stress parameters: Plant exploration - collection and establishment of mulberry germplasm bank - Field maintenance - Significance of mulberry germplasm conservations - Mulberry germplasm systems.

Plant introduction and acclimatization – Scope, objectives and limitations – Plant quarantine – Plant introduction agencies - National and International agencies.

Selection: Mass Selection - pure-line selection and clonal selection – definition - methods procedures followed - Applications and significance in mulberry breeding – Achievements made.

Hybridization: History – definition - objectives and application - Hybridization strategies in mulberry breeding (single cross - double cross - back cross - three-way cross - reciprocal cross) - advantages and constraints - Bulk and pedigree methods of segregating population - Heterosis and crop improvement.

Polyploidy: Definition – types - induction on polyploidy - Polyploidy in mulberry species/varieties - Characters associated with polyploids - Significance of polyploidy in evolving popular mulberry varieties. Mutation breeding : Definition – types - Artificial induction of mutations – Mutagens -Mulberry mutants - Role of physical and chemical mutants in inducing beneficial mulberry genotypes.

Breeding for drought resistance: Definition - Mechanism of drought escape - Tolerance - endurance and resistance - Characteristic features of drought resistance in crop plants - Methods of breeding for drought resistance.

Breeding for disease resistance: Definition – scope - and limitations - Nature and causes of disease resistance - Methods of breeding for disease resistance in mulberry.

Distribution morphology and cultivation strategies of non-mulberry silkworm food plants. (Tropical temperate Tasar - Muga and Eri food plants).

BIOTECHNOLOGY

Scope – Importance – Different branches of Biotechnology.

GENETIC ENGINEERING :Molecular vectors – Cloning – shuttle – expression - binary vectors – plasmids – virus - Enzymes – Restriction endonucleases - types and utility in gene cloning and mapping.

MOLECULAR CLONNING TECHNIQUES

cDNA synthesis - Joining of DNA fragments to vectors - Introducing of recombinant molecules into selected host cells (transformation) - Screening techniques – Western – Northern - Southern Blotting - Genomic and c DNA Libraries.

RECOMBINANT DNA TECHNOLOGY

Polymer chain reaction technology - PCR techniques in biotechnology and genetic engineering – Gene tagging and DNA finger printing

RESTRICTION ENZYMES ANALYSIS – RFLP and RAPD profiles for identification of DNA genetic material.

IMMUNITY – Mechanism of antigen – antibody reactions – defense mechanisms.

Cell mediated immunity in silkworms – phagocytosis - Anti bacterial – anti viral factors and induced resistance.

SEROLOGICAL TECHNIQUES – Principles and application of serological tests used in identification of Pathogenic agents - Precipitation tests – Ring test – Single and double diffusion test – Agglutination tests – Immuno fluorescence test - Enzyme linked Immunosorbent Assay (ELISA) – Western blotting method - Bio-insecticides – Engineered Baculaviruses – Molecular tools of lepidopteron development biology and physiology - Potential agents for insect control - bacillus thurengiensis gene.

BIOFERTILIZERS – Nitrogen fixation and Mass production of bio fertilizers - diazotrophic microorganisms blue green algae and Azolla - Micorhizae.

TISSUE CULTURE – Tissue culture techniques in mulberry anther/ pollen culture - callus culture - somoclonal variants – somatic - hybrid in *vitro* screening - cryopreservation.

SILK FIBRE TECHNOLOGY

Raw silk testing and Grading: - Visual and mechanical tests – Winding test – Size test Tenacity and elongation test – Evenness – Cleanness – Neatness tests – Cohesion test – Condition weight test- Testing and grading on the basis of BIS and ISI Standards.

Spun silk yarn technology: Difference between reeling and spinning – Types of silk wastes:– Cocoon waste – reeling waste – Cookers waste – Reeler’s waste – Basin Thrower’s waste – Various processes involved in spun silk processing – Degumming – Combing – Drawing and Drafting – Rowing – Spinning- Doubling – Twisting – Gassing – Re-reeling.

Utilization of pupae – Oil extraction – Protein extraction

Silk exchange – Functions – Factors influencing price of raw silk stabilization – Role of government agencies in price stabilization.

Reeling water : Consumption of water in silk industry water quality – Suitable water for cocoon cooking and reeling – Influence of water quality on raw silk - Treatment of water for reeling purpose .

Silk weaving: Silk Throwing / Preparatory processes – Winding – Doubling – Twisting – Rewinding - Warping – Pirn winding – Weaving – Handloom weaving - Types of power looms - Fabric defects - Silk knitting.

Wet processing : Degumming – Bleaching – Dyeing – Eco-friendly dyes - Printing – Hand block printing- screen printing – Fabric finishing

Principles of silk industry: Basic principles – Uses in silk industry - Silk care- stain and its removal-Tips on handling and storage of silk cloths – zari - Textile designing – computer aided textile designing (CATD)

SILKWORM GENETICS & BREEDING

Heridity and Environment - Effect of temperature, light, food and hormones – genetics of voltinism and moultinism.

Linkage and crossing over of *Bombyx mori* – Linkage maps, marker genes, crossing over.

Chromosomal aberrations – Translocation, Recombination, centromere, splitting of chromosomes.

Genetics of cocoon colours – carotinoids and flavonoids

Hereditary traits : Hereditary traits in Egg, Larva, Pupa, Cocoon and Moth of the silkworm *Bombyx mori* L.

Sex determination: Sex chromosomes- Role of 'W' and 'Z' chromosome, Ratio of chromosomes, Super males, Super females and Gynandromorphs

Mosaicism – Types of mosaics, induction of mosaics in silk worm.

Pleiotropism – E-group alleles, mechanism of pleiotropic action

Background and present status of silkworm breeding: Background, Present status and Aims and Achievements of silkworm breeding. Establishing a silkworm breeding programme: Major Principles and Techniques. Introduction, Establishment and maintenance of germplasm bank, Heterosis or hybrid vigour, Inbreeding, cross breeding, Polyploidy breeding, and Mutation breeding (practical application in silkworm breeding) Breeding for resistance to disease and adverse physical conditions Local adaptability test and authorization of commercial hybrids and their abolition. Management of parental inbred stocks of commercial hybrids.