



UNIVERSITY OF MYSORE

M.Sc. in Sericulture & Seribiotechnology

Credit Based, Choice Based Continuous Evaluation Pattern System

[76 credits course]

[2019-2020]

**DEPARTMENT OF STUDIES IN SERICULTURE SCIENCE
MANASAGANGOTRI
MYSURU – 570 006**

UNIVERSITY OF MYSORE
DEPARTMENT OF STUDIES IN SERICULTURE SCIENCE
Manasagangotri, Mysuru

Course: M.Sc. degree in Sericulture & Seribiotechnology

[Credit Based Choice Based Continuous Evaluation Pattern System]

Eligibility Criteria for Admission:

- (1) The candidates having B.Sc. degree with sericulture as one the cognate subjects of the study or any Life Science/Biological Science/Agricultural Science subjects.
- (2) The candidate must have scored a minimum of 45% marks in aggregate at graduation. (Relaxable to 40% for SC & ST candidates or as per University Rules and Regulations)
- 3) Admission: As per University Rules & Regulations.

Credit Matrix for M.Sc in Sericulture & Seribiotechnology

	Type of Course	M.Sc.				Total
		I	II	III	IV	
1.	Hard Core	16	12	12	12	52
2.	Soft Core	8	8	8	8	32
3.	Open Elective	-	4	4	4	12
	Total	24	24	24	24	96
Grand Total						96

UNIVERSITY OF MYSORE
DEPARTMENT OF STUDIES IN SERICULTURE SCIENCE

M.Sc. in Sericulture & Seribiotechnology

(Credit Based, Choice Based Continuous Evaluation Pattern System)

70: 30 Pattern

Sl. No.	Course Code	Title of the Course	Type	Credit pattern (L:T:P)	Credit value
I Semester					
1	SERBT -1.1	Mulberry Biology and Production	HC	3:0:1	4
2	SERBT -1.2	Silkworm Biology and Egg Production	HC	3:0:1	4
3	SERBT -1.3	Silkworm Physiology and Biochemistry	HC	3:0:1	4
4	SERBT -1.4	Silkworm Genetics and Breeding	HC	3:0:1	4
5	SERBT -1.5	Science of Sericulture	SC	3:1:0	4
6	SERBT -1.6	Applications of Computer and Biostatistics	SC	3:1:0	4
II Semester					
1	SERBT -2.1	Mulberry Physiology, Genetics and Breeding	HC	3:0:1	4
2	SERBT -2.2	Silkworm Cocoon Production Technology	HC	3:0:1	4
3	SERBT -2.3	Silk Technology, Sericulture Extension and Economics	HC	3:0:1	4
4	SERBT -2.4	Cell Biology and Genetics	SC	3:1:0	4
5	SERBT -2.5	Molecular Biology	SC	3:1:0	4
III Semester					
1	SERBT -3.1	Mulberry and Silkworm Crop Protection	HC	3:0:1	4
2	SERBT -3.2	OMICS : Genomics, Transcriptomics, Proteomics and Bioinformatics	HC	3:0:1	4
3	SERBT -3.3	Skill Development in Sericulture	HC	0:1:3	4
4	SERBT -3.4	Vanya Sericulture	SC	3:1:0	4
5	SERBT -3.5	Entrepreneurship Development in Sericulture	SC	3:1:0	4
IV Semester					
1	SERBT -4.1	Seri –Biotechnology	HC	3:0:1	4
2	SERBT -4.2	Project Work	HC	0:2:6	8
3	SERBT -4.3	Biomaterials and Applications	SC	3:1:0	4
4	SERBT -4.4	Economic Entomology	SC	3:1:0	4
Open Elective - II, III and IV Semesters					
		Sericulture Technology and Entrepreneurship Development	OE	3:1:0	4

- Note:** 1. L = Lecture (1 Credit = 1 hr.); T = Tutorial (1 Credit = 2 hrs.); P = Practical (1 Credit = 2 hrs.).
2. A duration of two hours per week for each Hard core course will be allocated towards Field Work in addition to the credits (hours) assigned.

Sd/-
(Prof. H.B. MANJUNATHA)
Chairman – BOS in Sericulture

PROGRAMME OUTCOMES

On successful completion of the programme, student will be able to

1. Acquire sound knowledge on the basics and advances in various aspects of sericulture and seri-biotechnology.
2. Gain confidence with the practical training obtained during the course to undertake sericulture as an entrepreneur and/or guide farmers.
3. Get acquainted with the allied aspects of biological/agricultural sciences to prepare for competitive examinations.
4. Get exposed to various scientific equipments and learn their usage that was quite useful towards research.
5. Know through the project work undertaken - how to choose research topic of current interest and way to execute and compile it.

I SEMESTER

SERBT - 1.1: MULBERRY BIOLOGY AND PRODUCTION

Course Outcomes

On successful completion of this course, students will be able to

1. Gain knowledge on various aspects of growth and development of mulberry.
2. Know the climatic and soil conditions required for the cultivation of mulberry.
3. Acquire practical knowledge on production of mulberry leaves under different systems of cultivation.

Pedagogy

1. Presentation through power point slides, display of photos, charts, etc.
2. Field work: Preparation of mulberry nursery, grafting and layering.
3. Field work: Soil sampling and analysis, application of manures and fertilizers, irrigation, cultural operations, pruning and harvesting of mulberry leaves.

Theory

3 Credits

Unit – I		
1	Salient features and economic importance of the family Moraceae. Phytogeography and systematics of the genus <i>Morus</i> L. and its species. Botanical description of mulberry.	4hrs.
2	Reproductive biology of mulberry: Development of anther, pollen and male gametophyte, development of ovary, megaspore and female gametophyte, pollination, fertilization, embryo and seed development; polyembryony, parthenocarpy and apomixis.	5hrs.
3	Anatomy of mulberry leaf, stem and root; secondary growth: structure and organization of shoot and root meristems.	3hrs.
Unit-II		
4	Botanical nomenclature; centers of origin of crop plants. Weeds of mulberry garden: Taxonomy and their characteristics.	2hrs.
5	Propagation of mulberry: Sexual and asexual methods – significance. Raising of nursery for production of seedlings and saplings.	3hrs.
6	Grafting and layering in mulberry - types and techniques.	2hrs.
7	Weather elements; Role of climatic factors on growth and productivity of mulberry, agro-climatic zones, agricultural applications of remote sensing.	3hrs.
8	Popular mulberry cultivars of tropical and temperate regions, rainfed and irrigated conditions. Assessment of mulberry leaf yield and quality.	2hrs.
Unit – III		

9	Basic principles of crop production; classification of crops; methods of crop production; farming systems; planting seasons.	2hrs.
10	Soils for mulberry cultivation: Soil profile and classification; physical, chemical and biological properties.	2hrs.
11	Concept of soil fertility and productivity: Soil organic matter and humus. Soil sampling and testing; problematic soils and their reclamation.	2hrs.
12	Plant nutrient management: Essential plant nutrients, organic manures, inorganic fertilizers and biofertilizers – importance, classification and application; integrated nutrient management.	3hrs.
13	Irrigation management: Sources, methods and schedules; quality of irrigation water; conservation of soil moisture in dry land farming.	3hrs.
Unit-IV		
14	Establishment, maintenance and package of practices for mulberry gardens under rainfed and irrigated conditions. Gardens for rearing of young-age silkworms and silkworm seed crop.	4hrs.
15	Pruning of mulberry: Objectives and methods. Harvesting, transportation and preservation of mulberry leaves.	2hrs.
16	Weed management in mulberry: Principles, methods and integrated management.	2hrs.
17	Farm management: Objectives, basic farm management decisions, cost computation procedures and maintenance of farm records.	3hrs.
18	Mechanization in mulberry cultivation. By-products of mulberry and their utilization.	1hr.

Practical

1 Credit

1	Morphology of mulberry.
2	Anatomy of leaf blade of mulberry.
3	Anatomy of stem and root of mulberry.
4	Salient features of popular mulberry cultivars.
5	Raising of saplings - cutting preparation, planting and maintenance of nursery.
6	Grafting (bud, stem and root) and layering in mulberry.
7	Planting methods – row and pit systems and tree planting.
8	Characteristic features of important weeds of mulberry garden.
9	Soil sampling and preparation of soil samples for analysis.
10	Preparation of FYM, compost and vermicompost.
11	Application of organic manures and chemical fertilizers for mulberry.
12	Irrigation methods (surface, sprinkler and drip irrigation) for mulberry.
13	Estimation of leaf yield, leaf-shoot ratio and leaf area in mulberry.
14	Methods of pruning and harvesting of mulberry.

SERBT - 1.2: SILKWORM BIOLOGY AND EGG PRODUCTION

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire knowledge on various aspects of silkworm biology and development.
2. Understand the silkworm seed organization and grainage operations.
3. Gain scientific procedure involved in production of disease free layings.

Pedagogy

1. Presentation through power point slides, charts, etc.
2. Dissect and display of silkworm larvae, pupae and moths.
3. Visit to silkworm egg production centres.

Theory

3 Credits

Unit-I		
1	Classification of insects; general characteristic features of insects; classification of sericigenous insects; characteristic features of order Lepidoptera and families – Bombycidae and Saturniidae.	3hrs.
2	Metamorphosis in insects: Definition, types and hormonal regulation.	3hrs.
3	Life cycle of the silkworm, <i>Bombyx mori</i> ; Morphology of Egg, larva, pupa and adult.	3hrs.
4	Classification of silkworms: Geographical distribution, moulting, voltinism, cocoon colour and shape.	3hrs.
Unit-II		
6	Spermatogenesis, oogenesis in <i>Bombyx mori</i>	3hrs.
7	Fertilization and embryonic development in the silkworm <i>Bombyx mori</i> .	3hrs.
8	Anatomical features : Digestive, circulatory, excretory, nervous, and respiratory systems; silk glands of silkworm <i>Bombyx mori</i> .	4hrs.
9	Reproductive systems of silkworm larvae and silk moths.	2hrs.
Unit-III		
10	General account of silkworm egg production, demand and supply.	1hr.
11	Silkworm seed organization: Importance of quality seed cocoon production; norms and procedure followed in P ₃ , P ₂ and P ₁ multiplication levels; seed areas and selected seed rearers; seed legislation act.	4hrs.
12	Grainage: Location and capacity; model grainage; grainage equipments and their uses; disinfection and hygiene practices.	3hrs.
13	Planning for pure and hybrid silkworm egg production. Seed cocoon markets, norms for purchase of bivoltine and multivoltine seed cocoons, procurement and	3hrs.

	transportation of seed cocoons.	
14	Environmental requirements during silkworm egg production;	1hr.
Unit-IV		
15	Grainage operations : Cocoon sorting, selection and preservation of seed cocoons, sex separation at pupal stage, preliminary examination of pupae, synchronization and emergence of moths, pairing and de-pairing, refrigeration of moths, oviposition – preparation of loose and sheet eggs, surface sterilization, mother moth examination, packing and sale of eggs.	6hrs.
16	Preservation of silkworm eggs: Short and long term chilling and hibernation schedules. Artificial hatching of hibernating eggs – hot and cold acid treatment, washing and drying of eggs.	4hrs.
17	Byproducts of grainage and their utilization.	2hrs.

Practical

1 Credit

1	Life cycle of the silkworm, <i>Bombyx mori</i>
2	Morphology of different stages of <i>Bombyx mori</i> .
3	Characteristic features of popular bivoltine and multivoltine races/breeds/hybrids of silkworm, <i>Bombyx mori</i> .
4	Dissect and display the digestive and excretory systems in silkworm.
5	Dissect and display of nervous system and silk glands in silkworm.
6	Dissect and display of reproductive systems of silkworm larvae and moths.
7	Ground plan of grainage building and equipments.
8	Disinfection and hygiene practices in grainage.
9	Sorting and processing of seed cocoons for egg production.
10	Sexing of pupae and moths.
12	Preparation of loose and sheet eggs.
12	Acid treatment (hot and cold) of hibernating silkworm eggs and mother moth examination.
13	Identification of different types of eggs and incubation of eggs.
14	Mounting of embryo – 6 th , 7 th , 8 th and 9 th day egg stages.
15	Visit to cold storage and egg production centres.

SERBT - 1.3: SILKWORM PHYSIOLOGY AND BIOCHEMISTRY

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire knowledge on basics of biochemistry and physiological aspects of silkworm.
2. Know the nutritional requirements and preparation of artificial diet for silkworm.
3. Understand the role of bio-molecules and their metabolism in silkworm.

Pedagogy

1. Presentation through power point slides, display of charts, etc.
2. Hands on training in collection of silkworm tissues for bio-chemical analysis.
3. Analysis of bio-molecules in different tissues of silkworm strains.

Theory

3 Credits

Unit-I		
1	Muscle Physiology: Types, ultra structure of skeletal muscle, mechanism of muscle contraction, muscle protein, flight muscles in insects-behavior-fuels for flight muscles.	4hrs.
2	Neurophysiology: Insect nervous system, structure of the neuron, conduction of nerve impulse in myelinated and non-myelinated nerve fibre, neurotransmitters-synaptic conduction of nerve impulse.	3hrs.
3	Endocrinology: Organisation of neuroendocrine system in insects, structure of endocrine glands- chemistry and role of insect hormones.	3hrs
4	Integument: Ultra structure, formation of the new cuticle and chitin, physical properties of cuticle, moulting process.	2hrs
Unit-II		
5	Nutritional physiology: Feeding behaviour – phagostimulants - feeding deterrents - nutritive requirements of the silkworm- artificial diets and compositions.	4hrs.
6	Respiratory physiology: Insect respiratory system- tracheal system –Structure of spiracles, classification - tracheal ventilation - tracheal diffusion.	4hrs.
7	Excretory physiology: Malpighian tubules –Types, structure and functions; modification of primary urine; problems of urination- role of hind gut in water regulation – water balance in silkworm.	4hrs.
Unit-III		
8	Carbohydrates: Structure and classification; properties of different classes of sugars and aminosugars. Isomerism - optical and stereoisomerism in sugars.	3hrs.
9	Metabolism of carbohydrates: Glycolysis, Glycogenolysis and Gluconeogenesis -	4hrs.

	pathways and regulation of energy budget.	
10	Bioenergetics: First and second laws of thermodynamics. Concepts of entropy and free energy change in cellular reaction. Biological oxidation: Respiratory chain reaction, mechanisms of oxidative phosphorylation. Alternate pathways of carbohydrate metabolism - HMP / PPP.	5hrs.
	Unit-IV	
11	Proteins and amino acids: Classification, structure and properties - primary, secondary, tertiary and quaternary and other classifications.	3hrs.
12	Biosynthesis of silk protein - mechanism and regulation of silk protein synthesis. X- ray diffraction studies, alpha keratin, collagen and fibroin.	3hrs.
13	Amino acids - chemical structure and functions; essential and non essential amino acids; ketogenic and glucogenic amino acids; inborn errors of amino acid metabolism – phenylketoneuria, alkaptonuria and albinism; oxidative deamination and transaminations; biosynthesis of urea and uric acid in silkworm.	6hrs.

Practical

1 Credit

1	Estimation of amylase activity in silkworm gut fluid and haemolymph.
2	Estimation of protease activity in the silkworm haemolymph
3	Determination of effect of adrenalin and atropine on the heart beat of silkworm.
4	Estimation of glycogen in fat body and ovary of <i>Bombyx mori</i> .
5	Estimation of succinate dehydrogenase activity level in the haemolymph of multivoltine and bivoltine silkworm races / breeds.
6	Estimation of aminotransferase activity levels in haemolymph of silkworm races / breeds.
7	Estimation of glucose level in haemolymph in different instars of silkworm.
8	Estimation of protein content in fat body / midgut tissue of silkworm.
9	Estimation of total carbohydrates in fat body and mid gut tissue of silkworm.
10	Estimation of haemolymph trehalose content in silkworm.
11	Estimation of cholesterol content in haemolymph of silkworm.
12	Estimation of uric acid content in silkworm litter.
13	Estimation of lactic acid content in hibernated and non-hibernated eggs of silkworm.

SERBT 1.4 - SILKWORM GENETICS AND BREEDING

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the concepts of genetics and racial characteristics of silkworm breeds.
2. Understand the genetical intricacies in silkworm.
3. Learn different methods and procedure involved in breeding of silkworm.

Pedagogy

1. Presentation through power point slides.
2. Display of charts, photos, etc.
3. Conduct of laboratory experiments.

Theory

3 Credits

Unit – I		
1	Hereditary traits of <i>Bombyx mori</i> - egg, larva, pupa and moth.	3hrs.
2	Genetics of cocoon colour: Inheritance of cocoon colour - white, flesh, green, pink and yellow.	3hrs.
3	Linkage groups and linkage maps of the silkworm, <i>Bombyx mori</i> .	3hrs.
4	Genetics of voltinism, moultnism and maturity genes - maternal inheritance - voltinism studies.	3hrs.
Unit – II		
5	Mosaicism - types and induction of mosaics in silkworm, <i>Bombyx mori</i>	2hrs.
6	Parthenogenesis - types and induction in silkworm, <i>Bombyx mori</i>	2hrs.
7	Radiation and chemical mutagenesis in silkworm, measurement of mutation through specific locus test; dominant and autosomal recessive lethal; strain and stage sensitivity. Mutants of silkworm, <i>Bombyx mori</i> .	3hrs.
8	Introduction to toxicology of silkworm. Procedures used in toxicology studies, methods of administration of pesticides, toxic symptoms in silkworm, LC-50 and LD-50 values.	3hrs.
9	Silkworm breeding organization in India and China.	2hrs.
Unit – III		
10	Silkworm races: Distinct characters, classification based on voltinism, moultnism and geographical distribution. Characteristic features of temperate and tropical races. Germplasm and its importance in silkworm breeding.	3hrs.
11	Genotype - environmental interactions. Heritability studies in <i>Bombyx mori</i> - broad and narrow range of heritability for various economic traits in silkworm.	2hrs.
12	Silkworm breeding - scope and objectives; methods – inbreeding, out-breeding, mutation breeding - their merits and demerits; breeding plans.	3hrs.

13	New concepts of silkworm breeding: Biochemical genetics and breeding; inheritance of genes for amylases, esterases and phosphatases; breeding for thermotolerance, disease resistance, higher productivity, shorter larval duration and fine denier; voltinism breeding.	3hrs.
14	Quantitative genetics – Quantitative Trait Loci (QTL).	1hr.
Unit – IV		
15	Selection: Criteria, index and parameters - methods of selection for qualitative and quantitative traits, fixation of characters, inbreeding depression and evaluation index.	3hrs.
16	Hybridization: Heterosis and hybrid vigour; theories of heterosis; combining ability - general and specific; line x tester and diallele analysis. Exploitation of heterosis in Indian sericulture.	3hrs.
17	Sex limited breeds - role of translocation in silkworm breeding, methods of evolving sex-limited breeds; sex limited breeds of India.	3hrs.
18	Race authorization system of India - a comparative analysis; release of races for commercial exploitation; authorized races / hybrids of India.	3hrs.

Practical

1 Credit

1	Racial characters of the silkworm, <i>Bombyx mori</i> : Egg, larva, cocoon (pupa) and adult stages (univoltine, bivoltine and multivoltine).
2	Estimation of fecundity and hatching percentage in bivoltine and multivoltine races/breeds/hybrids.
3	Mutants of <i>Bombyx mori</i> : Larval (Lemon, Moricaud, Ursa, Zebra and Knobbed), egg colour (pere), eye colour (white and red eye) and cocoon colour.
4	Study of adult life span (longevity) in multivoltine, bivoltine races/breeds/hybrids and sexes of <i>Bombyx mori</i>
5	Study of toxic symptoms in larval stages of <i>Bombyx mori</i> .
6	Selection of cocoons for breeding and maintenance of breeding data.
7	Assessment of qualitative and quantitative traits of silkworm for breeding.
8	Calculation of inbreeding depression in silkworm.
9	Breeding plan for evolution of robust and productive breeds.
10	Study of larval and cocoon character / segregation in F ₁ and F ₂ progenies of multi x bi hybrids of <i>Bombyx mori</i> to observe Mendelian pattern of inheritance.
11	Evaluation of heterosis and over - dominance in F ₁ silkworm hybrid.
12	Estimation of filament length and denier in cocoons for breeding by cold reeling.
13	Preparation of layings of double hybrids of silkworm (plan).

SERBT - 1.5: SCIENCE OF SERICULTURE

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the insect and non-insect fauna producing silk.
2. Acquire knowledge on organization of sericulture industry in India.
3. Obtain knowledge on cultivation of mulberry and production of cocoons.

Pedagogy

1. Presentation through power point slides, display of charts, photos, etc.
2. Group discussion and one-to-one interaction.
3. Demonstration of mulberry and silkworm materials.

Theory

3 Credits

Theory		3 Credits
	Unit-I	
1	Introduction to textile fibres; types – natural and synthetic fibres and their properties; importance of silk fibre.	2hrs.
2	Insect and non-insect fauna producing silk; types of silk produced in India.	2hrs.
3	History, development and status of mulberry and non-mulberry sericulture in India. Silk production in India and other countries; export and import.	3hrs.
4	Characteristic features and advantages of sericulture; scope of sericulture in India vis-à-vis other agricultural crops - employment potential and income generation; role of women in sericulture.	3hrs.
5	Sericulture organization in India. Sericulture extension: Extension systems - Central Silk Board, state sericulture departments, universities and voluntary organizations.	2hrs
	Unit-II	
6	Host plants of mulberry and non-mulberry silkworms. Mulberry cultivars - tropical and temperate regions, irrigated and rainfed conditions.	1hrs.
7	Propagation of mulberry – sexual and asexual (cuttings, grafting and layering).	3hrs.
8	Establishment and maintenance of mulberry gardens under rainfed and irrigated conditions.	4hrs.
9	Pruning – objectives and methods; harvesting, transportation and preservation of mulberry.	2hrs.
10	Pests and diseases of mulberry and their management.	2hrs.
	Unit-III	
11	Silkworm seed organization and its significance; seed areas (bivoltine and multivoltine), selected seed rearers and silkworm seed legislation act. Silkworm races / breeds: Classification – geographical distribution, voltinism and moultnism,	2hrs.

	indigenous and exotic, multivoltine and bivoltine.	
12	General account of silkworm egg production and demand. Grainage building and equipments, disinfection and hygiene, procurement and preservation of seed cocoons, sex separation, eclosion, pairing and depairing, oviposition – sheet and loose egg preparation, mother moth examination, acid treatment, surface sterilization, washing, packing and sale of eggs.	4hrs.
13	Life cycle of <i>Bombyx mori</i> . Rearing houses and equipments; disinfection and hygiene. Transportation, incubation and black boxing of silkworm eggs. Rearing operations - brushing, young and late-age silkworm rearing, moulting, mounting, spinning, cocoon harvesting and marketing.	4hrs.
14	Pests and diseases of silkworm and their management.	2hrs.
Unit-IV		
15	Physical and commercial characteristics of cocoons. Cocoon sorting, cocoon stifling – objectives and methods, cocoon preservation and cocoon cooking – objectives and methods.	4hrs.
16	Silk reeling: Charaka, cottage basin and multi-end; re-reeling and packing – objectives and operations. Properties of mulberry silk; silk testing and grading – objectives; silk exchanges; weaving and dyeing.	4hrs.
17	Biomedical importance of mulberry and silkworm.	2hrs.
18	Byproducts of sericulture industry and their utilization – mulberry cultivation, silkworm rearing, grainage and silk reeling.	2hrs.

Tutorial (Demonstration)

1 Credit

1	Silkworms and their host plants.
2	Propagation of mulberry.
3	Pruning and harvesting of mulberry.
4	Pests and diseases of mulberry.
5	Grainage equipments and operations.
6	Silkworm races and life cycle.
7	Rearing equipments and operations.
8	Pests and diseases of silkworm.
9	Silk cocoons and textile fibres.
10	Defective cocoons - identification and sorting.
11	Silk reeling devices and operations.
12	Sericulture byproducts and handicrafts.
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

SERBT - 1.6: APPLICATIONS OF COMPUTER AND BIOSTATISTICS

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire knowledge on the computer and its use in support of their studies.
2. Gain knowledge on statistical tools and its application.
3. Gain knowledge on analysis and interpretation of biological data.

Pedagogy

1. Presentation through power point slides, display of charts, etc.
2. Hands on training using computers.
3. Hands on training in collection, tabulation and analysis of data

Theory

3 Credits

Unit-I		
1	Fundamentals of computers: Introduction, characteristics, history and evolution; generation and types of computers.	4hrs.
2	Computer architecture; Input and output devices; number systems, primary and secondary storage devices; central processing unit.	4hrs.
3	Operating system: Types, booting, Windows and its applications.	4hrs.
Unit-II		
4	M.S. Office: Word, Excel and Power Point.	5hrs.
5	Computer security: Symptoms, detection and protection from virus, hacking, cyber-crime and cyber-security	2hrs.
6	Introduction to internet: Networking, types, connecting devices, world wide web, e-mail and chat; e-commerce, animation.	3hrs.
7	Role and uses of computers in sericulture.	2hrs.
Unit-III		
8	Biostatistics: Importance, functions and basic concepts.	1hr.
9	Collection, classification and tabulation of data. Techniques of recording observations – mulberry and silkworm rearing.	3hrs.
10	Frequency distribution – with and without class intervals, cumulative, relative and per cent relative frequencies. Measures of central tendency and dispersion, standard error – variance and co-efficient of variation and probability.	4hrs.
11	Graphic presentation of data: Time series graphs and frequency distribution graphs - histogram, frequency polygon and frequency curve. Diagrammatic presentation of data: Line diagrams, bar diagrams, pie diagrams, pictograms and cartograms.	4hrs.

Unit-IV		
12	Tests of significance – Chi-square, Student ‘t’ and F-tests; levels of significance.	2hrs.
13	Experimental designs: Basic principles and Analysis of variance. Systematic and randomized designs.	2hrs.
14	Design and analysis - CRD, RCBD, LSD and factorial experiments.	5hrs.
15	Correlation and regression analysis. Use of statistical packages in data analysis, Databases – components and applications.	3hrs.

Tutorial (Demonstration)

1 Credit

1	Windows and its applications.
2	MS Word and its applications.
3	MS Excel and its application.
4	MS Power Point and its applications.
5	Virus, antivirus and computer security
6	Internet – browsing, surfing, e-mail and e-commerce
7	Introduction to photoshop, multimedia, social media and animation
8	Uses and applications of computers in sericulture.
9	Record of observations on mulberry – growth and yield parameters.
10	Record of observations on silkworm - rearing, cocoon and grainage parameters.
11	Applications of measures of central tendency.
12	Graphic and diagrammatic presentation of data.
13	Analysis of data through Chi square and Student ‘t’ tests.
14	Analysis of data through CRD and RCBD.
15	Analysis of data through LSD
16	Analysis of data through factorial experiments.
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

II SEMESTER

SERBT – 2.1: MULBERRY PHYSIOLOGY, GENETICS AND BREEDING

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the physiological aspects in relation to growth and development of mulberry.
2. Acquire the knowledge on genetic resources and cytological aspects of mulberry.
3. Gain the knowledge on breeding and evaluation techniques for improvement of mulberry.

Pedagogy

1. Presentation through point slides, charts, photos, etc.
2. Field work: Hybridization techniques in mulberry
3. Visit to tissue culture laboratory.

Theory

3 Credits

	Unit-I	
1	Crop growth and development - crop development stages, physiological growth components, leaf growth, tillering and branching; growth analysis; yield analysis – biological and economic yield.	4hrs.
2	Plant and water relations: concept of water potential. Absorption of water – active and passive absorption; absorption of minerals; translocation of solutes; Munch hypothesis, source and sink relationship.	4hrs.
3	Transpiration: Types; mechanism of stomatal opening and closing, significance; Guttation. Anti transpirants; factors affecting rate of transpiration.	4hrs.
	Unit-II	
4	Mineral nutrition: Macro and micronutrients, physiological role, deficiency symptoms in mulberry, mineral toxicity.	3hrs.
5	Plant growth regulators: Distribution and physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene. PGRs in moriculture.	2hrs.
6	Biological nitrogen fixation – types, mechanism and genetics: Role of nif genes, huf genes and leg haemoglobin.	2hrs.
7	Physiology of flowering: Photoperiodism and vernalization. Phytochrome – concept. Senescence, dormancy and seed germination.	2hrs.
8	Stress physiology: Biotic and abiotic stresses in crops, effects on mulberry: Mechanism of resistance to drought, salinity, mineral toxicity. Disease resistance	3hrs.

	in crop plants with special reference to mulberry.	
	Unit-III	
10	Yield and quality of mulberry leaf; Variations in relation to irrigated and rainfed systems and mulberry varieties.	3hrs.
11	Cytogenetics: chromosome number (basic, somatic and gametic). Karyotype; chromosome banding; meiosis in mulberry, meiotic irregularities.	3hrs.
12	Objectives of mulberry breeding; reproductive systems - parameters associated with yield and quality of mulberry leaf; problems in breeding. Variability in economic traits of mulberry.	3hrs.
13	Genetic resources of mulberry; Germplasm - collection, characterization, conservation and utilization; cryopreservation, genetic erosion.	2hrs.
14	Plant introduction - purpose, agencies, procedures' quarantine. Achievements, merits and demerits. Acclimatization.	1hr.
	Unit-IV	
15	Selection techniques - mass, pure line and clonal selections. Hybridization: Objectives, types and procedure.	3hrs.
16	Mutation breeding in mulberry - chimeras; achievements and limitations.	2hrs.
17	Breeding for disease, drought, salinity and alkalinity: Sources, genetics and methods.	3hrs.
18	Polyploidy breeding: Types of heteroploids and their importance. Induction of tetraploids and evolution of triploids in mulberry and their importance.	2hrs.
19	Evaluation techniques of selected mulberry genotypes - PYT, FYT & MLT; Plot experimentation; multiplication and authorization of variety.	2hrs.

Practical

1 Credit

1	Determination of water potential of potato tuber.
2	Study of mineral deficiency symptoms in mulberry.
3	Separation of chloroplast pigments by paper chromatography.
4	Extraction of chloroplast pigments by solvent wash method.
5	Use of micrometers - measurement of pollen and stomatal size.
6	Mitotic chromosomes of onion – karyotyping
7	Meiosis - chromosomal associations in mulberry.
8	Hybridization demonstration with mulberry and determination of seed setting percentage.
9	Colchicine treatment – induction of tetraploidy in mulberry.
10	Stomatal size, frequency and index and pollen fertility in mulberry varieties.
11	Estimation of total chlorophyll, chlorophyll a & b contents in mulberry leaves.
12	Estimation of protein in mulberry leaves.
13	Estimation of carbohydrate in mulberry leaves.
14	Determination of moisture content and moisture retention capacity of mulberry leaf in popular cultivars.

SERBT – 2.2: SILKWORM COCOON PRODUCTION TECHNOLOGY

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire both theoretical and practical knowledge to undertake silkworm rearing.
2. Understand the factors and procedures involved in silkworm rearing.
3. Develop confidence to address the critical issues during silkworm rearing.

Pedagogy

1. Presentation through power point slides, photos, etc.
2. Hands on training on large scale silkworm rearing.
3. Visit to chawki rearing centres and farmers field.

Theory

3 Credits

Unit – I		
1	Planning for silkworm rearing: Pre-requisites for silkworm rearing. Estimation of leaf yield and quality, brushing capacity; selection of silkworm races / breeds and hybrids.	4hrs.
2	Rearing houses: Types, location and orientation; rearing houses for young (chawki) and grown up (late-age) silkworms; rearing appliances and their uses.	4hrs
3	Disinfection and hygiene: Importance, types of disinfectants, preparation of disinfectant solution and quantum required for a unit area, disinfection methods and mode of action of disinfectants. Hygiene practices in silkworm rearing.	4hrs.
Unit-II		
4	Environmental requirements for silkworm egg incubation, young and late-age silkworm rearing.	4hrs.
5	Egg transportation – time and devices; egg incubation – methods and black boxing; brushing – methods, merits and demerits.	3hrs.
6	Qualitative and quantitative requirements of mulberry leaf for young and late-age silkworms.	3hrs.
7	Harvesting, transportation and preservation of mulberry leaves.	2hrs.
Unit – III		
8	Chawki silkworm rearing: Rearing methods – advantages and disadvantages; Procedure – feeding, spacing and bed cleaning; chawki rearing centres – importance and functions.	5hrs.
9	Late age silkworm rearing: Rearing methods – advantages and disadvantages; Procedure - feeding, spacing and bed cleaning.	5hrs.
10	Moulting: Characteristic features - before, at and after moult; care during moulting.	2hrs.

Unit-IV		
11	Mounting – features of mountages, types of mountages – traditional and improved, methods and density of mounting, environmental requirements during spinning.	4hrs.
12	Cocoon harvesting, sorting, deflossing, packing, transportation and marketing, preparation of crop harvest report.	4hrs.
13	Artificial diet for silkworm rearing: Composition, merits and demerits.	2hrs.
14	By-products of silkworm rearing and their utilization.	2hrs.

Practical

1 Credit

1	Estimation of leaf yield in mulberry garden.
2	Silkworm rearing houses - model and plan
3	Silkworm rearing equipments and their uses.
4	Disinfection of rearing house and equipments.
5	Incubation and black boxing of silkworm eggs.
6	Brushing of silkworms - methods
7	Selection of mulberry for feeding young and late-age silkworms.
8	Preservation of mulberry for feeding young and late-age silkworms.
9	Young – age silkworm rearing – methods and operations.
10	Late – age silkworm rearing – methods and operations
11	Moulting – identification of moulting larvae and care.
12	Mounting – mountages, identification and mounting of spinning larvae.
13	Harvesting and sorting of cocoons.
14	Preparation of silkworm rearing report.

SERBT – 2.3: SILK TECHNOLOGY, SERICULTURE EXTENSION AND ECONOMICS

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire knowledge on pre, true and post reeling process.
2. Understand the extension services in sericulture industry.
3. Work out the economics of mulberry, cocoon and silk reeling.

Pedagogy

1. Presentation through power point slides, charts, photos, etc.
2. Hands on training on silk reeling, preparation of leaflets and flash cards.
3. Visit to sericulture extension and economics division and silk factory.

Theory

3 Credits

Unit-I		
1	Textile fibers: Brief introduction to natural and synthetic fibers.	1hr.
2	Physical and commercial characteristics of cocoons, cocoon sorting – objectives and procedure; defective cocoons.	2hrs.
3	Marketing of cocoon – functions and procedure.	2hrs.
4	Cocoon stifling: Objectives and methods – sun drying, steam stifling, hot air drying, Yamato hot air driers - advantages and disadvantages. Preservation of cocoons.	2hrs.
5	Cocoon cooking: Objectives and methods - open pan, three-pan, pressurized, floating and sunken systems - merits and demerits.	2hrs.
6	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.	3hrs.
Unit-II		
7	Re-reeling and packing: Objectives, grant reeling, hank preparation, lacing, skeining, booking, bale making and bundling.	2hrs.
8	Raw silk properties - physical, chemical and microscopic. Factors influencing the properties of raw silk. Silk exchanges – structure and function.	2hrs.
9	Raw silk testing: visual, winding, evenness, cleanness, neatness, tenacity and elongation, cohesion and condition weight; raw silk grading - international standards (ISA) and Bureau of Indian Standards (BIS).	3hrs.
10	Degumming, bleaching and silk dyeing – objectives and methods.	2hrs.

11	Silk throwing; silk weaving - hand and power loom; weaving defects.	2hrs.
12	Byproducts of silk reeling industry and their utilization.	1hr.
Unit-III		
13	Extension education: Objectives and importance; principles, concepts and functions of extension education; teaching and learning process.	2hrs.
14	Communication: Functions, models, elements, concepts and implications.	2hrs.
15	Extension programme management; sericulture development through plans; major programmes in sericulture.	2hrs.
16	Extension teaching methods adopted in sericulture. Use of audio-visual aids in sericulture. Training: meaning, principles, methods and training programmes in sericulture.	2hrs.
17	Adoption and diffusion of innovations. TOT: meaning and systems; role of extension in TOT.	2hrs.
18	Sericulture extension system: Extension systems of CSB, state governments, voluntary organizations and Universities. Extension services in sericulture.	2hrs.
Unit-IV		
19	Economics: Principles of economics, micro and macro economics; classification of costs – explicit and implicit, fixed, variable, marginal, average; profits – gross and net.	2hrs.
20	Advantages and characteristics of sericulture. Scope of sericulture in India – vis-à-vis other agricultural crops - income and employment generation.	2hrs.
21	Economics of mulberry production under rainfed and irrigated systems; comparative economics of mulberry production under traditional and improved practices.	3hrs.
22	Economics of silkworm egg production in government and private grainages. Economics of cocoon production for commercial purpose; comparative economics of cocoon production under traditional and improved methods of silkworm rearing.	3hrs.
23	Economics of raw silk production in charaka, cottage basin and multi-end reeling units.	2hrs.

Practical

1 Credit

1	Identification of textile fibres by microscopic, physical and chemical tests.
2	Study of physical and commercial characters of cocoons in multivoltine and bivoltine races / breeds.
3	Sorting of cocoons – identification of good and defective cocoons.
4	Cocoon stifling and cooking.
5	Determination of alkalinity and hardness of reeling water by titration methods.
6	Reeling techniques: Epprouvette, Charaka, Cottage basin, Multi-end and Automatic reeling devices.

7	Estimation of degumming loss in multivoltine and bivoltine cocoons and raw silk.
8	Estimation of bleaching loss in multivoltine silk.
9	Dyeing of multivoltine and bivoltine silk using acid, basic and compound dyes.
10	Study of different types of silk wastes.
11	Preparation of garlands / handicrafts by silk waste / pierced cocoons.
12	Visit to silk reeling establishments.
13	Preparation of leaflets and flash cards on various activities of sericulture.
14	Visit to museum of Extension Division of CSRTI, Mysore.
15	Visit to field and farmers rearing house to study sericulture technologies adopted.

SERBT - 2.4: CELL BIOLOGY AND GENETICS

Course Outcomes

On successful completion of this course, students will be able to

1. Learn basics of cell biology and the techniques involved.
2. Acquire knowledge on cell and chromosomal behavior and dynamics during cell division.
3. Gain knowledge on genetic expression of different traits in plants and animals.

Pedagogy

1. Presentation through power point slides, photos, etc.
2. Demonstration of cell biology based experiments.
3. Demonstration of genetics based experiments.

Theory

3 Credits

Unit-I		
1	Microscopy: Over view of different types of microscopy-light, phase contrast, fluorescence, electron and confocal microscopy.	3hrs
2	Cytological techniques: Fixation and staining, cell culture, autoradiography, cell fractionation and ultra centrifugation.	2hrs.
3	Organization and functions of cytoskeleton; microfilaments, microtubules and intermediate filaments.	3hrs.
4	Ultrastructural organization of cell organelles: Endoplasmic reticulum, golgi complex, mitochondria, ribosomes and chloroplast	4hrs.
Unit-II		

5	Types of chromosomes – eukaryotic chromosomes. Structure and organization of chromatin and synoptenemal complex. Special chromosomes: polytene, lampbrush and B-chromosomes.	3hrs.
6	Cell cycle: Chromosome dynamics during mitosis and meiosis; achromatic apparatus and cytokinesis; evolution of mitotic spindles.	3hrs.
7	Cytology of gamatogenesis: Spermatogenesis and oogenesis in animals with special reference to the silkworm	3hrs.
8	Germ cells and fertilization – biochemical events and ultra structural aspects of fertilization in animals with special reference to the silkworm, <i>Bombyx mori</i> .	3hrs.
Unit-III		
9	Mendelism: Mendelian law of inheritance- monohybrid, dihybrid and test cross in pea plants, inheritance pattern with reference to haploid organisms like <i>Chlamydomonas</i> and <i>Neurospora</i>	3hrs.
10	Interaction of genes: Epistasis and complementary factors. Polygenic inheritance - skin colour in man. Lethal genes - coat colour in mice.	3hrs.
11	Allelism: Multiple alleles, isoalleles and pseudoalleles; blood groups and Rh factor in man.	3hrs.
12	Linkage and crossing over in maize and <i>Drosophila</i> ; sex linked inheritance in <i>Drosophila</i> map.	3hrs.
Unit-IV		
13	Fine structure of a gene: Classical concept - Benzer's work on rII-locus in T4 phage; split genes and mobile genes.	4hrs.
14	Genetic code: Nature of genetic code, codons and anticodons, triplet code and evidences for triplet code.	2hrs.
15	Chromosomal aberrations - spontaneous and induced; deletion, duplication, translocation and inversion; numerical variations in chromosomes.	4hrs.
16	Introduction to eugenics – genetic counseling.	2hrs.

Tutorial (Demonstration)

1 Credit

1	Cytological techniques: Pre-treatment, fixation and preservation of specimens.
2	Preparation of different stains for cytological studies.
3	General morphology and life cycle of <i>Drosophila melanogaster</i> .
4	Identification of mutants of <i>Drosophila melanogaster</i> (white eye, red eye and bar eye).
5	Identification of mutants of <i>Drosophila melanogaster</i> (sepia, vestigial wing and yellow body).
6	Preparation and staining of salivary gland chromosomes of <i>Drosophila melanogaster</i> .
7	Genetic problems on Mendel's first law using experimental results of <i>Drosophila melanogaster</i> .
8	Genetic problems on Mendel's first law using silkworm.
9	Study of mitosis in onion root tip.
10	Study of meiosis in the testes of grasshopper.

11	Study of meiosis in the testes of silkworm.
12	Study of mitosis and meiosis in uzi fly.
13	Study of salivary gland chromosome in uzi fly.
14	Problems on Mendel's law of independent assortment using Chi-square test
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

SERBT-2.5: MOLECULAR BIOLOGY

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire basic knowledge on molecular biology.
2. Understand the mechanism of protein synthesis in prokaryotes and eukaryotes.
3. Gain knowledge on immunological techniques.

Pedagogy

1. Presentation through power point slides.
2. Presentation using photos, charts, etc.
3. Demonstration of molecular biology based experiments.

Theory

3 Credits

Unit-I		
1	Introduction to nucleic acids: Chemical and physical properties of DNA and RNA, helical structure of DNA and RNA, types of RNA, DNA organization in chromosomes and extra chromosomal DNA.	3hrs.
2	DNA replication in prokaryotes and eukaryotes: Semi - conservative synthesis of DNA, enzymes in DNA replication.	3hrs.
3	Transcription: Biosynthesis of RNA from DNA, RNA polymerase, initiation, elongation and termination of transcription, RNA processing in prokaryotes and eukaryotes.	3hrs.
4	Translation: Enzymes involved in protein synthesis; initiation, elongation and termination of translation in prokaryotes and eukaryotes. Wobble hypothesis, aminoacylation of t-RNA and inhibitors of protein synthesis.	3hrs.
Unit-II		
5	Gene regulation in prokaryotes: Lac operon, repressor protein, promoters, structural genes, fine structure of gene.	3hrs.
6	Gene organization in eukaryotes: Repetitive sequence, satellite DNA, jumping	3hrs.

	genes and transposons. Retrovirus and cellular oncogenes.	
7	Model organisms for molecular biology - bacteriophage, bacteria, yeast, fruit fly, silkworm, mice and <i>Arabidopsis</i> .	3hrs.
8	Cell death – necrosis and apoptosis, death signals, factors that oppose apoptosis.	3hrs.
Unit-III		
9	Fine structure of gene: Benzer's work on rII –locus in T4 Phage; split genes and mobile genes	4hrs.
10	Genetic code: Nature of genetic code, codons and anti codons, triplet code and evidences for triplet code.	4hrs.
11	Molecular basis of DNA repair mechanisms.	4hrs.
Unit-IV		
12	Mutation: Molecular basis of mutation-gene mutation; spontaneous and induced mutation; ionizing and non ionizing radiations and chemical mutagens	4hrs.
13	Molecular mechanism of sex determination in <i>Drosophila</i> , silkworm and man.	4hr.
14	Molecular organization of eukaryotic chromosomes and telomeres.	2hrs.
15	Molecular basis of silk protein synthesis	2hrs.

Tutorial (Demonstration)

1 Credit

1	Colorimetric estimation of DNA in silk gland.
2	Colorimetric estimation of RNA in silk gland.
3	Extraction of DNA from plant and animal sources.
4	Quantification of DNA by spectrophotometry.
5	Separation of amino acids by thin layer chromatography.
6	Separation of amino acids by paper chromatography.
7	Model organisms – Fruit fly, silkworm and <i>Arabidopsis</i> .
8	Purification of DNA – RAPD technique.
9	Determination of LC-50 values for silkworm using viral pathogens.
10	Study of meiotic anomalies
11	Study of translocation (Cockroach)
12	Measurement of mutation frequency in silkworm
13	Measurement of mutation frequency in <i>Drosophila</i>
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

III SEMESTER

SERBT – 3.1: MULBERRY AND SILKWORM CROP PROTECTION

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the biology and damage caused by the pests of mulberry and their management.
2. Gain knowledge on the diseases of mulberry and their management.
3. Acquire the knowledge on pests and diseases of silkworms and their management.

Pedagogy

1. Teaching using black board and power point slides.
2. Explanation using pest and disease specimens of mulberry and silkworm.
3. Visit to fields and pest and disease management laboratories.

Theory

3 Credit

	Unit-I	
1	Pests of mulberry. Classification of pests of mulberry based on their groups, feeding habits and status. Pest forecasting and outbreak.	3hrs.
2	Leaf eating pests of mulberry: Life cycle, symptoms of attack, seasonal occurrence, nature of damage and management strategies.	4hrs.
3	Shoot and root feeding pests of mulberry: Life cycle, symptoms of attack, seasonal occurrence, nature of damage and management strategies.	3hrs.
4	Integrated pest management – Goals, principles and concepts, components and benefits.	2hrs
Unit-II		
5	Parasitism; host - parasitic interaction; disease cycle and development.	1hr.
6	Plant diseases – classification, status of mulberry diseases. Disease forecasting and outbreak	2hrs.
7	Foliar diseases of mulberry: Causal organism, symptomatology, seasonal incidence, disease cycle, yield and quality loss and management strategies.	5hrs.
8	Shoot and root diseases of mulberry: Causal organism, symptomatology, seasonal incidence, disease cycle, yield and quality loss and management strategies.	4hrs.
Unit-III		
9	Insect and non-insect pests of mulberry silkworm and their status.	2hrs.
10	Insect and non-insect pests of grainage and their management.	2hrs.
11	Forecasting and outbreak of <i>Exorista bombycis</i> .	1hr.

12	Tachinid flies associated with <i>Bombyx mori</i> - classification, distribution, incidence, extent of damage and bio-ecology.	4hrs.
13	Management of uzi fly – physical, mechanical, exclusion, biological, chemical and integrated approaches.	3hrs.
Unit-IV		
14	Diseases of insects: Types, pathogenesis and predisposing factors.	1hr.
15	Diseases of <i>Bombyx mori</i> : Causal organism, mode of infection and transmission, symptomatology, incidence, extent of crop loss, cross infectivity and management of microsporidiosis (pebrine), virosis (NPV, CPV, IFV and DNV), bacteriosis (bacterial flacherie) and mycoses (muscardine and aspergillosis).	8hrs
16	Non-infectious diseases of <i>Bombyx mori</i> and their management.	1hr.
17	Bioassay of pathogens: Determination of median lethal concentration (LC-50).	2hrs.

Practical

1 Credit

1	Study of leaf eating pests of mulberry.
2	Study of shoot feeding pests of mulberry.
3	Study of root feeding pests of mulberry.
4	Study of leaf spot and leaf rust in mulberry.
5	Study of powdery mildew and stem canker in mulberry.
6	Study of root knot and root rot in mulberry.
7	Life cycle of the uzi fly, <i>Exorista bombycis</i> and estimation of damage to silkworm.
8	Evaluation of uzicide and bleaching powder solution against uzi fly.
9	Evaluation of parasitoids against uzi fly.
10	Study of mass production of parasitoids.
11	Life cycle of dermestid beetles and assessment of cocoon damage.
12	Preparation of temporary mounts of pebrine spores of <i>Nosema bombycis</i> and polyhedra of nuclear polyhedrosis virus infecting <i>Bombyx mori</i> .
13	Preparation of temporary mounts of fungal pathogens infecting <i>Bombyx mori</i> .
14	Application of bed disinfectants for management of silkworm diseases.

SERBT - 3.2: OMICS: GENOMICS, TRANSCRIPTOMICS, PROTEOMICS AND BIOINFORMATICS

Course Outcomes

On successful completion of this course, students will be able to

1. Know the concepts of genome, transcriptome and how these are linked in the process and governing the biological functions.
2. Understand the genome projects, genome organization, gene expression, proteome of an organism and learn different methods followed for analysis.
3. Acquire knowledge on bioinformatics aspects and its application to keep pace with the recent advances in technologies.

Pedagogy

1. Presentation through point slides, photos, etc.
2. Demonstration in handling and use of scientific equipments.
3. Conducting wet and dry lab experiments individually.

Theory

3 Credits

Unit-I		
1	Genomics: Definition, origin and historical background, Scope, Importance and its applications. Genome organization and diversity, Fundamentals of cloning: Restriction endonucleases, ligases, vectors. Genomic library (DNA and cDNA)-construction methods and screening. DNA sequencing methods- Maxam and Gilbert, Sanger, Whole-genome shotgun and next generation sequencing.	4hrs.
2	Genetic mapping: DNA markers for genetic mapping- Satellite DNA (micro, mini and macro), RFLP, RAPD, SSR and ISSR. Linkage analysis: Hybridization and PCR mediated characterization of molecular markers. Establishment of ESTs, STSs. Construction of SNP linkage map.	3hrs.
3	Physical mapping: Restriction mapping - basic methodology and direct examination of DNA molecule for restriction sites. Fluorescent <i>in situ</i> hybridization with radioactive fluorescent probes (BACs). Sequence tagged site mapping-STS mapping and analysis.	2hrs.
4	Genome projects: Genome size and gene number in silkworm, <i>Drosophila</i> , Mosquito and human. Whole-genome shotgun sequencing and composition of silkworm, <i>B. mori</i> .	3hrs.
Unit-II		
5	Transcriptomics: Definition, origin and historical background, Scope, Importance	2hrs.

	and its applications.	
6	Techniques-Whole transcriptome shotgun sequencing, Serial analysis of gene expression (SAGE), Whole-genome microarray construction. Analysis for differentially expressed mRNAs. Silkworm transcriptome analysis (mRNA extraction, cDNA library construction and sequencing analysis, validation through RT-PCR).	5hrs.
7	Mulberry transcriptome. Comparative transcriptomic analysis between silk gland tissue of <i>B. mori</i> and <i>B. mandarina</i> using next generation sequencing methods. Transcriptome analysis between silkworm and cytoplasmic polyhedrosis virus.	5hrs.
Unit-III		
8	Proteomics: Principles and methods of protein separation (1-DE and 2-DE), purification, immunoblot assay. Amino acid sequencing-chemical and enzymatic methods, Mass spectrometry - MALDI-TOF, MS-MS, LC-MS and ion trap.	6hrs.
9	Silkworm proteome analysis: Protein identification and analysis by various methods. Proteome of silkworm egg, silk glands, midgut, fat bodies, haemolymph, ovaries, and Malpighian tubules. Comparative proteomic analysis of posterior silk glands of wild and domesticated silkworms. Heat shock proteins and their application in silkworm strain improvement program.	6hrs.
Unit-IV		
10	Bioinformatics: Definition, origin, history and applications. Computational biology: Generation of high speed computers. FORTRAN and IBM. Sequence alignment methods-global, local, pairwise-dot-matrix methods, dynamic programming, and word methods). Multiple sequence alignment- conserved sequence and its evolutionary significance. Phylogenetic tree construction.	4hrs.
11	Biological databases sequence retrieval methods - NCBI, DDBJ, EMBL. Sequence similarity search tool-BLAST and its types. Unknown protein identification tools and databases- ExpASy and Matrix Science. Protein Structure prediction methods and tools-comparative modeling (SWISS-MODEL), threading (PHYRE) & Ab-initio (ROSETTA).	4hrs.
12	Silkworm genome databases- KAIKObase & SilkDB. Silkworm protein databases- KAIKO2DDB (Silkworm two-dimensional polyacrylamide gel electrophoresis federated database). Silkworm Pathogen Database: SilkPathDB (Comprehensive Resource for Silkworm Pathogens). Silkworm phylogeny and evolution history. Mulberry Genome Database: MorusDB (Resource for Mulberry Genomics and Genome Biology).	4hrs.

Practical

1 Credit

1	Preparation of metaphase and pachytene chromosome spreads for mapping from silkworm larvae.
2	Quantitative estimation of DNA from Mulberry and/or silkworm by spectrophotometry.
3	Isolation of genomic DNA from mulberry and estimation by spectrophotometry,

	biophotometer and gel electrophoresis.
4	Isolation of genomic DNA from silkworm larvae and/or silkmoth and estimation by spectrophotometry and biophotometer.
5	Isolation and qualitative estimation of DNA from silkworm larvae and/or silkmoth by electrophoresis.
6	Gene analysis by PCR.
7	Quantitative estimation of protein from silkworm eggs and different tissues by calorimetric method.
8	Protein profile studies in silkworm eggs, whole organism and different tissues of silkworm by single and two dimensional electrophoresis.
9	Analysis of heat shock proteins expression in silkworm.
10	Western blot analysis of protein.
11	Database Access and data retrieval from databases.
12	Construction of database – Home page and other supporting WebPages.
13	Studies of structure and composition of major databases.
14	DNA and protein sequence alignment and comparison by both manual and bioinformatics tools.

SERBT – 3.3: SKILL DEVELOPMENT IN SERICULTURE

4 Credits

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire practical knowledge and skill on various aspects of sericulture.
2. Gain practical experience through hands on training in silkworm rearing.
3. Aware with the practical difficulties encountered by the farmers.

Pedagogy

1. Field work: Establishment of mulberry nursery and cultivation.
2. Field work: Silkworm egg production and rearing and silk reeling.
3. Visit to silkworm egg production centres, chawki rearing centres and farmers fields.

Hands on training on mulberry cultivation, silkworm egg production, silkworm rearing, silk reeling, sericulture extension and economics, vanya sericulture, handicrafts will be the components of skill development in sericulture. All the students will interact with concerned teachers to undertake the field based work and field visits. At the end of the semester, each student shall submit final report for evaluation.

SERBT 3.4: VANYA SERICULTURE

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the distribution and status of vanya silk production.
2. Know the procedure involved in cultivation of host plants of vanya silkworms.
3. Learn the techniques involved in rearing of vanya silkworms.

Pedagogy

1. Presentation through power point slides, photos, etc.
2. Hands on training in establishment and maintenance of vanya silkworm host plants.
3. Hands on training in rearing of vanya silkworms.

Theory

3 Credits

Unit-I		
1	Classification of natural silk – plant origin, Insect and non-insect fauna producing silk and their characteristics, distribution, global and Indian scenario.	2hrs.
2	Status of vanya silks in India – importance, scope and impact on socio economic conditions of tribal's, production trends and demand.	4hrs.
3	Host plants of vanya silkworms: State-wise distribution in India, area and economic importance.	3hrs.
4	Botanical description of primary host plants of vanya silkworms.	3hrs.
Unit-II		
5	Establishment of primary host plants of vanya silkworms and package of practices for their cultivation.	4hrs.
6	Pests and diseases of primary host plants of vanya silkworms and their management.	3hrs.
7	Planning for vanya silkworm egg production and rearing; grainage and rearing equipments.	3hrs.
8	Disinfection and hygiene practices in grainages and silkworm rearing houses / premises and economic / block plantation.	2hrs.
Unit-III		
9	Morphology and life cycle of vanya silkworms, breeding, eco-races / races.	3hrs.
10	Egg production technology of vanya silkworms – selection and preservation of seed cocoons, emergence, synchronization, pairing and de-pairing of moths, oviposition, handling, collection, washing, drying and packing of eggs, mother moth examination.	3hrs.
11	Rearing technology of young and late-age vanya silkworms - traditional and improved techniques, feeding, cleaning and spacing, moulting care and	3hrs.

	mounting practices – indoor and outdoor techniques, harvesting and marketing of cocoons.	
12	Pests and diseases of vanya silkworms and their management	3hrs.
	Unit-IV	
13	Tasar and muga cocoon reeling: Selection, cooking and reeling; eri cocoon spinning. Marketing of raw silk and fabrics	3hrs.
14	Economics of tasar, eri and muga culture.	3hrs.
15	Byproducts of vanya sericulture and their utilization.	2hrs.
16	Constraints in vanya silk production; agencies and strategies for improvement of vanya sericulture in India.	4hrs.

Tutorial (Demonstration)

1 Credit

1	Host plants of eri silkworms.
2	Host plants of tasar silkworms.
3	Host plants of muga silkworms.
4	Pests and diseases of primary host plants of eri silkworms.
5	Pests and diseases of primary host plants of tasar silkworms.
6	Pests and diseases of host plants (primary) of muga silkworms.
7	Morphology and life cycle of eri silkworm.
8	Morphology and life cycle of tasar silkworm.
9	Morphology and life cycle of muga silkworm.
10	Egg production technology of vanya silkworms.
11	Rearing technology of vanya silkworms.
12	Pests and diseases of vanya silkworms.
13	Cooking and spinning technology of eri cocoons.
14	Cooking and reeling technology of tasar and muga silk cocoons.
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

SERBT - 3.5: ENTREPRENEURSHIP DEVELOPMENT IN SERICULTURE

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the entrepreneurial opportunities in sericulture.
2. Acquire knowledge on project formulation.
3. Gain knowledge to become an entrepreneur in various aspects of sericulture.

Pedagogy

1. Presentation through power point slides, charts, etc.
2. Hands on training in formulation of projects.
3. Visit to sericulture based EDP units.

Theory

3 Credits

Unit-I		
1	Entrepreneurship development programme (EDP): Emergence and objectives of EDP, essential qualities to become an entrepreneur; selection of a potential entrepreneur.	2hrs.
2	Planning for EDP: Objectives, selection of a centre, purpose of pre-training promotional work.	2hrs.
3	Follow-up for EDP: Need, extent and mechanism; facilitating follow-up; approach to competence development.	2hrs.
4	Project formulation (project appraisal): Meaning and purpose, personnel / agencies interested in project appraisal, market feasibility of the project, technical and market analysis, means of finance, profitability, risk analysis and liquidity management; agencies supporting sericulture projects.	4hrs.
5	Marketing: Approach and essence; market assessment – demand; steps involved in market study.	2hrs.
Unit-II		
6	Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.	2hrs.
7	Mass production of insect pathogens: Culturing of hosts / preparation of culture substrates, inoculation, collection of diseased/dead hosts; isolation, purification and storage of pathogens.	4hrs.
8	Mass production of parasitoids: Culturing of host insects, oviposition of parasitoids, emergence of parasitoid adults from hosts, collection of parasitoid adults, feeding and storage of parasitoid adults.	3hrs.

9	Mass production of insect predators: Culturing of prey insects, release of adults of predators on the colony of prey insects for oviposition, collection and feeding of predator adults, storage of predator adults.	3hrs.
Unit-III		
10	EDP in raising mulberry saplings (Kisan nursery).	2hrs.
11	EDP in organization of chawki rearing centres.	2hrs.
12	EDP in silkworm egg production and rearing.	2hrs.
13	EDP in silk reeling – charaka, cottage basin and multi-end reeling units.	3hrs.
14	EDP in mass production of parasitoids and predators.	3hrs.
Unit-IV		
15	Mechanization: Objectives, principles, technology and productivity, characteristic features, advantages and limitations.	2hrs.
16	Mechanization in mulberry cultivation, silkworm egg production and silkworm rearing - activities, scope and economics.	4hrs.
17	Advances in silk reeling technology - activities, scope and economics.	2hrs.
18	Contract farming and its scope in sericulture.	2hrs.
19	Occupational health hazards in sericulture.	2hrs.

Tutorial (Demonstration)

1 Credit

1	Planning the facilities required for establishment of insectary.
2	Observations on insect pathogens and symptoms.
3	Observations on insect parasitoids and predators.
4	Planning for raising mulberry saplings (Kisan nursery).
5	Planning for establishment of chawki rearing centers.
6	Planning for establishment of silkworm egg production centres.
7	Planning for establishment silk reeling - charka, cottage basin and multi-end reeling units.
8	Assessment of Benefit – Cost ratio under traditional and mechanized systems of mulberry cultivation.
9	Assessment of Benefit – Cost ratio under traditional and mechanized systems of silkworm egg production.
10	Assessment of Benefit – Cost ratio under traditional and mechanized systems of silkworm rearing.
11	Assessment of Benefit – Cost ratio under traditional and mechanized systems of silk reeling units.
12	Visit to units for mass production of parasitoids and predators.
13	Visit to grainage / silk reeling units to study the health related problems among the concerned personnel.
14	Visit to chawki rearing centres.
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

IV SEMESTER

SERBT – 4.1: SERI – BIOTECHNOLOGY

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the concepts and components of biotechnology.
2. Acquire knowledge on biotechnological techniques which can be applied for improvement of mulberry plant.
3. Gain knowledge on biotechnological tools for improvement of silkworm.

Pedagogy

1. Presentation through power point slides, photos, videos, etc.
2. Conduct of mulberry and silkworm based biotechnology experiments.
3. Visit to biotechnology and tissue culture laboratories.

Theory

3 Credit

Unit-I		
1	Introduction: Scope and importance of plant biotechnology.	1hr.
2	Plant cell and tissue culture techniques: Introduction and historical background of plant morphogenesis and tissue culture, laboratory requirements for plant tissue culture, culture media; applications of cell and tissue culture in mulberry.	3hrs.
3	Growth in relation to morphogenesis: Cell and organ differentiation; de-differentiation and re-differentiation; cell competence; concept of totipotency; regeneration. Micropropagation; somatic embryogenesis, multiple shoot formation, somaclonal variations, synthetic seeds in mulberry.	4hrs.
4	Production and uses of haploids: Anther culture, pollen culture, ovule culture, bulbasum technique; detection of haploids; applications of haploids in mulberry breeding.	2hrs.
5	Somatic hybridization: Isolation of protoplast; viability and plating density of protoplasts; protoplast culture; isolation of sub-protoplast; regeneration of plants; protoplast fusion and uses of somatic hybrids; genetic modification of protoplast.	2hrs.
Unit – II		
6	Preservation and screening of germplasm for drought, salinity and disease resistance in mulberry. Embryo and endosperm culture; bioreactors.	2hrs.
7	Recombinant DNA technology: Cloning vectors for recombinant DNA, cloning and expression of vectors.	2hrs.
8	Gene transfer methods in plants; target cells for transformation; gene transfer	2hrs.

	techniques using <i>Agrobacterium</i> ; selectable and scorable markers; agro infection and gene transfer in mulberry.	
9	Transgenic plants and their role in crop improvement; molecular farming and regulated gene expression. Transformation of chloroplast genome (Cg) in higher plants using <i>Agrobacterium</i> and particle gun; targeting of foreign protein into chloroplast and mitochondria.	4hrs.
10	Patenting transgenic organisms and isolated genes and DNA sequences; Plant breeder's rights (PBRs) and farmers' rights.	2hrs.
	Unit – III	
11	Animal cell and tissue culture: History, scope, advantages and disadvantages. Insect cell and tissue culture and their applications; media preparation and culturing procedures; somatic cell fusion.	4hrs.
12	Silkworm cell culture – establishment of primary and secondary cell lines, composition and preparation of media and maintenance of cultures.	2hrs.
13	Tissue and organ culture; whole embryo culture; tissue grafting.	2hrs.
14	Polymerase chain reaction (PCR): Gene amplification, application of PCR in silkworm biotechnology.	2hrs.
15	Principles and fundamentals of biotechnology; Application of biotechnology in silkworm – new textile fibres, improvement of silkworm strains and marker assisted breeding.	2hrs.
	Unit – IV	
16	A brief account of transgenic animals: Insect transgenesis – silkworm transgenesis, application of silkworm transgenesis, piggy bac transposon, red fluorescent protein expression in <i>Bombyx mori</i> .	3hrs.
17	Genetic resistance of the silkworm, <i>Bombyx mori</i> , to bacterial and viral diseases. Immune response against bacterial and viral diseases in silkworm; regulation of host gene expression, inducible anti-bacterial and anti-viral proteins in silkworm. Molecular triggering of anti bacterial proteins – antibacterial protein gene expression.	3hrs.
18	<i>BmNPV</i> vector – life cycle – genomic organization of <i>BmNPV</i> , biotechnological application for large - scale synthesis of recombinant proteins (valuable proteins) using <i>BmNPV</i> in different stages of <i>Bombyx mori</i> .	4hrs.
19	IPR, patenting, WTO-GATT and bioethics.	2hrs.

Practical

1Credit

1	Estimation of protein in mulberry leaf.
2	Separation and identification of amino acids by chromatography.
3	Procedure for sterilization and preparation of culture media.
4	Study of callus, embryogenesis and organogenesis in mulberry – <i>in vitro</i> .
5	Studies on isozyme polymorphism through PAGE in mulberry

6	Studies on protein polymorphism through PAGE in mulberry leaf.
7	Preparation of synthetic seeds in mulberry.
8	Media preparation for silkworm cell lines.
9	Selection of tissue for establishment of silkworm cell lines.
10	Protein profile in haemolymph and fat body tissues in silkworm through PAGE.
11	Polyacrylamide gel electrophoresis – esterases in silkworm.
12	Polyacrylamide gel electrophoresis – phosphatases and dehydrogenases in silkworm.
13	Estimation of protease enzyme in the mid gut tissue of silkworm through calorimetric method.
14	Demonstration of Northern blotting techniques.
15	Calorimetric estimation of RNA in silk gland of silkworm.

SERBT - 4.2: PROJECT WORK

Course Outcomes

On successful completion of this course, students will be able to

1. Ignite students for right choice of research topic and understand its relevance.
2. Acquire knowledge in planning and execution of project work.
3. Gain experience for conduct of research independently.

Pedagogy

1. Provide guidance for designing and execution of project work.
2. Provide guidance for presentation of research work through power point presentation.
3. Provide guidance for preparation of project report.

8 Credits

A topic for the major project will be assigned to each student or batch of students and it shall be either from the syllabus or from any other topic in the field of Sericulture and Seribiotechnology as approved by the guide and department council.

SERBT 4.3: BIOMATERIALS AND ITS APPLICATIONS

Course - SERBT 4.3: Biomaterials and Applications (Soft Core)

Course Outcomes

On successful completion of this course, students will be able to

1. Acquire basic knowledge on various types and properties of biomaterials.
2. Understand in general preparation, characterization and analysis of biomaterials.
3. Gain knowledge on methodology, properties and application of silk biomaterials.

Pedagogy

1. Presentation through power point slides, photos, videos, etc.
2. Display of silk based biomaterials.
3. Visit to pharmaceutical industries.

Theory

3 Credits

Unit-I		
1	Definition, origin and history of biomaterials. Characteristic features of sea shell dental implants, metallic suture wires, metals, stainless steel, cobalt chromium alloys, and titanium based alloys, nitinol, ceramics and glasses. Polymers in biomedical use: synthetic and natural polymers. Polysaccharide biopolymers: alginate and chitosan; Protein biopolymers: collagen and silk.	6hrs.
2	Biological response to biomaterials: biocompatibility assessment, implant associated infection, blood materials interactions, biomaterial implant rejection. Proteins interaction with foreign biomaterials: inflammatory responses, acute inflammation, chronic inflammation, foreign body response.	6hrs.
Unit-II		
3	Surface characterization of biomaterials – Scanning electron microscope, X-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy. Mechanical characterization of biomaterials- compressive and tensile testing, stress-strain curve. Thermal characterization – Differential scanning calorimeter.	6hrs.
4	In vitro biological characterization for cell–biomaterials interactions- cell adhesion and migration- chemotaxis, haptotaxis, durotaxis. Biomaterial degradation: surface and bulk erosion, oxidation, hydrolysis. Impact of degradation products to surrounding tissues – in vitro and in vivo analysis.	6hrs.
Unit-III		
5	Introduction to silk biomaterials: Silk fibroin and silk sericin proteins, molecular structure and evaluation. Silk fibroin nanostructures based on natural and	4hrs.

	engineered self-assembly. Properties of silk fibroin: mechanical strength and biocompatibility.	
6	Silk fibroin extraction from cocoons- degumming, rehydration and dialysis; Bioengineered silk fermentation- plasmid construction, expression and purification. Silk scaffold fabrication techniques: solvent casting films, porous freeze dried sponges, electrospun nanofibers and 3D bioprinted implants.	4hrs.
7	Silk sericin protein extraction, molecular structure and evaluation. Silk Sericin-immunogenicity. Properties of silk sericin: mechanical strength and biocompatibility.	4hrs
Unit-IV		
8	Pharmaceutical applications of silk. Silk as a reinforcement in polymer matrix composites. Silk as a suture material. Developments in the use of silk by-products and silk waste. Silk hydrogels, gelation of silk with ethanol, silk fibroin based dual-drug delivery system, silk fibroin hydrogels containing nano-particles, dual-drug release behavior from silk hydrogel.	4hrs.
9	Applications of silk biomaterials in clinics- silk fibroin scaffolds for bone, cartilage skin, cardiac and nervous tissue engineering applications. Silk fibroin based drug delivery systems for cancer therapy, silk fibroin based biosensors.	4hrs.
10	Silk Sericin based biomaterials for skin tissue repair, wound dressings. bone tissue engineering and drug delivery applications.	4hrs.

Tutorial (Demonstration)

1 Credit

1	Demonstration of different types of biomaterials.
2	Physical and chemical properties of silk-Mulberry, Tasar, Eri and Muga.
3	Degumming of silk.
4	Bleaching of silk.
5	Rehydration and dialysis.
6	Silk fermentation.
7	Silk scaffold fabrication.
8	Silk hydrogels.
9	Silk fibroin hydrogels containing nano-particles.
10	Silk fibroin scaffolds- Bone tissue engineering, cartilage skin, cardiac and nervous tissue engineering.
11	Silk fibroin based drug delivery systems.
12	Silk fibroin based biosensors.
12	Silk fibroin based biosensors.

SERBT 4.4: ECONOMIC ENTOMOLOGY

On successful completion of this course, students will be able to

1. Acquire knowledge of insects and their behavior.
2. Gain knowledge on harmful, beneficial and social insects.
3. Gain knowledge on management of insect pests.

Pedagogy

1. Presentation through power point slides, photos, pictures, videos, etc.
2. Explanation using insect specimens.
3. Hands on training in collection and preservation of insects.

Theory

3 Credits

Unit-I		
1	General characteristic features of insects. Insects in the service and man. Insects as enemies of man. Insect age, abundance and adaptations; causes for success of insects.	3hrs.
2	Salient features of insect orders with special reference to Lepidoptera, Diptera, Hymenoptera, Coleoptera, Homoptera and Neuroptera.	3hrs.
3	Collection and preservation of insects - methods, mounting and labeling.	1hr.
4	Metamorphosis in insects - ametabola, hemimetabola and holometabola.	2hrs.
5	Beneficial insects - silkworm, honeybee and lac insect – products and their uses; parasitoids and predators and their role in pest suppression; pollinators and their role in crop production.	3hrs.
Unit-II		
6	Insects as human food: Commonly eaten insects, nutritional value and advantages and problems of eating insects.	2hrs.
7	Insects as important laboratory tools for scientific research - silkworm, fruit fly, house fly and mosquito. Insects in the service of forensic science.	3hrs.
8	Social insects - termites, honeybees, wasps and ants.	2hrs.
9	Insect pests: Definition, origin, and types, pest forecasting and outbreak.	2hrs.
10	Symptoms and injuries caused by insect pests; economic threshold and economic injury levels.	3hrs.
Unit – III		
11	Insect pests of agricultural crops: Cereals, pulses, oilseeds and vegetables.	3hrs.
12	Insect pests of stored grains: Primary and secondary storage pests and their management.	3hrs.
13	Insect pests of farm animals: Blood sucking flies, myiasis flies, lice and fleas; arachnids.	3hrs.

14	Insect pests of public health importance: Mosquitoes, house flies, sand flies, eye flies, lice, bed bugs and rat fleas.	3hrs.
Unit – IV		
15	Insect pests and their control: General considerations and prior information's.	2hrs.
16	Natural control of insect pests: Climatic factors, natural barriers, natural enemies and diseases	3hrs.
17	Applied control of insect pests: Cultural, mechanical, physical, biological, genetical/autocidal, legal, microbial, pheromonal, hormonal and chemical methods.	3hrs.
18	Mass production of bio-control agents: parasitoids, predators and pathogens.	2hrs.
19	Integrated pest management – goals, principles and concepts, components and benefits.	2hrs.

Tutorial (Demonstration)

1 Credit

1	Collection and insect preservation – methods, mounting and labeling .
2	Studies on beneficial insects – silkworm, honeybee and lac insect.
3	Study of insects for scientific research - silkworm, fruit fly, house fly and mosquito.
4	Study of social insects - termites, honeybees, wasps and ants.
5	Study on symptoms and injuries caused by insect pests based on mouthparts
6	Estimation of economic threshold and economic injury levels.
7	Collection and identification of insect pests on cereals and pulses.
8	Collection and identification of insect pests on oilseed and vegetables.
9	Collection and identification of insect pests on stored grains/products.
10	Collection and identification of insect pests on farm animals
11	Collection and identification of insect pests on human beings.
12	Planning the facilities required for establishment of insectary.
13	Observations on insect parasitoids and predators.
14	Visit to crop fields / animal sheds to study the measures adopted for insect pest control.
15	Visit to hospitals/households to study the measures adopted for insect pest control
	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

OPEN ELECTIVE (FOR II, III AND IV SEMESTERS)

SERICULTURE TECHNOLOGY & ENTREPRENEURSHIP DEVELOPMENT

Course Outcomes

On successful completion of this course, students will be able to

1. Understand the properties of cocoon and silk.
2. Know the procedure involved in reeling of silk on different machines.
3. Gain knowledge on entrepreneurial aspects and opportunities in sericulture.

Pedagogy

1. Presentation through power point slides, photos, etc.
2. Demonstration of mulberry, silkworm and silk materials.
3. Visit to sericulture based EDP units.

Theory

3 Credits

Unit-I		
1	Introduction to textile fibres: Types – natural and synthetic fibres; importance of silk fibre, silk production in India and other countries – exports and imports.	2hrs.
2	Insect and non-insect fauna producing silk; types of silk produced in India; history, development and status of mulberry and non-mulberry sericulture in India.	3hrs.
3	Scope of sericulture in India vis-à-vis other crops; employment potential and income generation.	2hrs.
4	Sericulture organization in India and Karnataka; role of central, state and non - governmental organizations and universities in the development and promotion of sericulture industry.	3hrs.
5	Host plants of mulberry and non-mulberry silkworms; mulberry varieties for irrigated and rainfed conditions.	2hrs.
Unit-II		
6	Climate for mulberry cultivation. Propagation of mulberry – sexual and asexual – cutting, grafting and layering.	2hrs.
7	Establishment of mulberry gardens – selection of soil, preparation of land and planting of cuttings / saplings. Package of practices for mulberry cultivation under rainfed and irrigated conditions. Pruning – objectives and methods; harvesting, transportation and preservation of mulberry leaves.	2hrs.
8	Pests and diseases of mulberry and their management.	2hrs.
9	Grainages – seed and commercial, production and demand for silkworm eggs.	2hrs.

	Grainage building and equipments; disinfection and hygiene.	
10	Silkworm seed organization and its significance; seed areas (bivoltine and multivoltine); Silkworm seed legislation act.	2hrs.
11	Grainage operations, sheet and loose egg preparation, mother moth examination, surface sterilization of eggs, artificial hatching of hibernating eggs, packing and disposal of eggs.	2hrs.
	Unit-III	
12	Life cycle of the silkworm, <i>Bombyx mori</i> . Silkworm breeds: Multivoltine and Bivoltine. Rearing house: Location, plan and types; rearing appliances; disinfection and hygiene	3hrs.
13	Rearing operations: Incubation and black boxing of eggs, brushing of silkworms; young and late-age rearing - feeding, cleaning, spacing, moulting, mounting and spinning, cocoon harvesting, transportation and marketing. Environmental requirements for silkworm rearing.	2hrs.
14	Pests and diseases of silkworm and their management.	1hr.
15	Physical and commercial characteristics of cocoons. Cocoon sorting – defective cocoons, cocoon stifling – objectives and methods, cocoon cooking – objectives and methods.	2hrs.
16	Silk reeling: Reeling water and its importance, different reeling units – charaka, cottage, basin, multi-end, semi-automatic and automatic; re-reeling and packing. Fabric production - wet processing, silk throwing and weaving. Physical and chemical properties of silk.	3hrs.
17	Byproducts of sericulture industry – mulberry cultivation, silkworm rearing, grainage and silk reeling.	1hr.
	Unit - IV	
18	Entrepreneurship development programme (EDP): Emergence and objectives of EDP, essential qualities to become an entrepreneur, selection of a potential entrepreneur.	2hrs.
19	Planning for EDP: Objectives, selection of a centre, purpose of pre-training promotional work.	2hrs.
20	EDP in raising mulberry saplings (Kisan nursery) and vermicomposting.	2hrs.
21	EDP in organization of chawki rearing centres.	2hrs.
22	EDP in silkworm egg production and rearing.	2hrs.
23	EDP in silk reeling – charaka, cottage basin and multi-end reeling units.	2hrs.

Tutorial (Demonstration)

1 Credit

1	Identification of textile fibres by microscopic and physical tests.
2	Host plants of mulberry and non-mulberry silkworms – field observations.
3	Soil sampling and preparation of soil sample for analysis.
4	Propagation of mulberry – cuttings, grafting and layering.

5	Planting, pruning and harvesting of mulberry.
6	Pests and diseases of mulberry.
7	Grainage equipments and operations.
8	Silkworm races and life cycle of mulberry and non-mulberry silkworms.
9	Rearing equipments and operations.
10	Pests and diseases of silkworm.
11	Silk cocoons – physical and commercial characters
12	Defective cocoons - identification and sorting.
13	Silk reeling devices and operations.
14	Sericulture byproducts and handicrafts.
15	A consolidated report shall be submitted at the end of the course for evaluation towards C-2 component.

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5. Sericologia - Jacques Rousseau, 69350, La Mulatiere, France.
6. Indian Journal of Sericulture - Published by CSR & TI, Mysore.
6. Journal of Sericulture and Technology - Published by NASSI, Bangalore.
7. Indian Silk - Published by Central Silk Board, Bangalore.

8. Bulletin of Indian Academy of Sericulture - Bhubaneshwar, Orissa.
9. Reshme Krishi (Kannada) - Published by Department of Sericulture, Government of Karnataka, Bangalore.
10. Current Science – Published by Indian Institute of Science, Bangalore.

Sd/-

(Prof. H.B. MANJUNATHA)

Chairman – BOS in Sericulture

PATTERN OF QUESTION PAPER FOR THE THEORY EXAMINATION

M.Sc. Sericulture and Seribiotechnology

(Semester Scheme - CBCS Pattern)

Time: 3 Hours

Max. Marks: 70

Instructions: Answer all the questions.

SECTION – A: Define/explain **ANY FIVE** of the following:

5 x 2 = 10

(Questions from all the Units of the Syllabus by drawing minimum of one question from each unit)

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)

SECTION-B: Write short notes on **ANY FOUR** of the following:

4 x 5 = 20

(Questions from all the Units of the Syllabus by drawing minimum of one question from each unit)

- 8)
- 9)
- 10)
- 11)
- 12)
- 13)

SECTION-C: Explain in detail on **ANY FOUR** of the following:

4 x 10 = 40

(Questions from all the Units of the Syllabus by drawing minimum of one question from each unit)

- 14)
- 15)
- 16)
- 17)
- 18)
- 19)

Sd/-

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