

# **CBCS SYLLABUS FOR THREE YEARS UNDER-GRADUATE COURSE IN SERICULTURE (HONOURS)**

(w.e.f. 2017-18)



## **RAIGANJ UNIVERSITY**

*(Established by an Act No. XXVI of 2014 of West Bengal State Legislature)*

**RAIGANJ, UTTAR DINAJPUR – 733134**

**WEST BENGAL, INDIA**



# RAIGANJ UNIVERSITY

*(Established by an Act No. XXVI of 2014 of West Bengal State Legislature)*

RAIGANJ, UTTAR DINAJPUR – 733134

WEST BENGAL, INDIA

## B.Sc. in SERICULTURE (CBCS)

Prepared by-

**Dr. Debnirmalya Gangopadhyay,**

*Assistant Professor, Department of Sericulture, Faculty of Science, RGU*

**Dr. Soumen Saha,**

*Assistant Professor (HoD), Department of Sericulture, Faculty of Science, RGU*

**Dr. Amit Kr. Mandal,**

*Assistant Professor, Department of Sericulture, Faculty of Science, RGU*

**Mr. Abdul Sadat,**

*Assistant Professor, Department of Sericulture, Faculty of Science, RGU*

**Mr. Tanmay Chowdhury,**

*Part-time Lecturer, Department of Sericulture, Faculty of Science, RGU*

**Mr. Debjoy Bhattachariya,**

*Part-time Lecturer, Department of Sericulture, Faculty of Science, RGU*

Evaluated by-

- Prof. Parthadeb Ghosh, UGC-Emeritous Professor, Department of Botany, Kalyani University
- Prof. Dhrubajyoti Chattopadhyay, Hon'ble Vice-Chancellor, Amity University, Kolkata
- Prof. B. G. Unni, Director Research, Assam Down Town University
- Dr. Dhurjoti Choudhury, Project Director (Retd.), Rubber Board, Govt. of India
- Prof. Phanindra Kr. Mandal, Principal (Retd), Raiganj College (University College)
- Approved by the Members of the Board of Studies and Departmental Committee, Department of Sericulture, RGU (Ref No. R/F-RGU/SERI/001/2017-18/DC-3 dtd. 08-05-17; 15/RGU/UG-PG/BOS/CH.MAN/CE-17 dtd. 31-05-17 & 124/SERI/BOS/RGU/CE/2017 dtd. 12-06-17)

N.B. Approved by the West Bengal State Council for Higher Education, Govt. of West Bengal

## PREAMBLE

Sericulture being a rural agro-based labour intensive industry plays a vibrant role in improving the socio-economic conditions of the small and marginal farmers. India is the second largest silk producer in the world next only to China. It is the only country in the world, which produces all the five types of silks namely, mulberry, tropical tasar, oak tasar, eri and muga. Sericulture being a farm-based enterprise is highly suited for both large and small land holdings, with low capital investment. The very nature of this industry with its rural based on-farm (cultivation and propagation of mulberry, silkworm seed production, rearing of silkworm etc) and off-farm (post cocoon events such as reeling and weaving of silk etc) activities and enormous employment generation potential has attracted the attention of many planners and policy makers to recognize the industry as one of the most appropriate avenues for socio-economic development of a largely agrarian economy like ours.

Indian silkworm breeds are multivoltine (*i.e.*, they produce several broods a year) and though, good progress has been achieved in cross breed (multivoltine  $\times$  bivoltine) silk production, the quality still remains incomparable to that of Chinese breeds which are bivoltine. Though, India is the second largest producer of silk, however, its contribution to the world raw silk production is only 15%. In spite of abundant natural resources, socio-economic benefit of the sector like generation of employment for the large sections of tribals and marginalized rural men and women, growing export market as well as large domestic demand, a variety of problems have kept Indian sericulture away from achieving its true potential. These may include mediocre quality of silkworm breeds and sub-optimal processing technology, disease prevalent during silkworm rearing, lack of proper seed organization system, low technology adoption, inadequate/poor extension efforts, age-old practices of post-cocoon operations, absence of quality certification etc. The industry is also suffering from quality and skilled manpower.

Keeping these problems in view, a revision of the curriculum at the undergraduate and postgraduate level is felt very much important. The curriculum has been revised considering that the students will be benefited through increasing employability in their subject areas. Besides, the sericulture students from the session of 2017-18, shall have the benefit of a balanced, carefully-crafted course structure on different aspects of basic and modern biological sciences which may enhance their competitive-edge across various Universities along with national level examinations like JAM, JNU, GATE, UGC-CSIR-NET, ICMR-NET, ASRB-NET etc.

## STRUCTURE OF THE SYLLABUS

All total, there will be six semesters in the three-year B.Sc. Honours in Sericulture. The syllabus consists of 14 Core (C) Courses, 4 Discipline Specific Elective (DSE) Courses, 4 Generic Elective (GE) Courses [to be taken from the pool of GE courses], 2 Ability Enhancement Compulsory courses (AECC) and 2 Skill Enhancement Courses (SEC) [to be taken from the pool of SECs].

### SEMESTER-WISE COURSE STRUCTURE IN CREDITS

#### SEMESTER - 6

**CREDITS =140**

COURSES	SEM I	SEM II	SEM III	SEM IV	SEM V	SEM VI	TOTAL
<b>CORE COURSES (C)</b>	<b>12</b>	<b>12</b>	<b>18</b>	<b>18</b>	<b>12</b>	<b>12</b>	<b>84</b>
<b>DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)</b>	-	-	-	-	12	12	24
<b>GENERIC ELECTIVE COURSE (GE)</b>	6	6	6	6	-	-	24
<b>ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)</b>	8	2	-	-	-	-	6
<b>SKILL ENHANCEMENT COURSES (SEC)</b>	-	-	2	2	-	-	4
<b>TOTAL CREDITS</b>	<b>26</b>	<b>20</b>	<b>26</b>	<b>26</b>	<b>24</b>	<b>24</b>	<b>142</b>

### DETAILS OF COURSES IN SERICULTURE (HONOURS)

	COURSE	PAPER		CREDITS/PAPER		TOTAL CREDITS	
		Theory	Practical	Theory	Practical	Theory	Practical
<b>I.</b>	<b>Core Course</b>	14	14	4	2	14 × 4 = 56	14 × 2 = 28
<b>II.</b>	<b>Discipline Specific Elective Course</b>	4	4	4	2	4 × 4 = 16	4 × 2 = 8
<b>III.</b>	<b>Generic Elective Course</b>	4	4	4	2	4 × 4 = 16	4 × 2 = 8
<b>IV.</b>	<b>Ability Enhancement Compulsory Courses (AECC)</b>						
	• English/MIL	1	0	2	0	1 × 2 = 2	0 × 0 = 0
	• Environmental Studies	1	0	4	0	1 × 8 = 8	0 × 0 = 0
<b>V.</b>	<b>Skill Enhancement Courses (SEC)</b>						
	• SEC-I	1	0	2	0	1 × 2 = 2	0 × 0 = 0
	• SEC-II	1	0	2	0	1 × 2 = 2	0 × 0 = 0
	<b>TOTAL</b>	<b>26</b>	<b>22</b>	<b>-</b>	<b>-</b>	<b>102</b>	<b>44</b>

### SEMESTER-WISE DISTRIBUTION OF CREDITS & MARKS

Semester	Courses	Credits		Marks distribution						Total
				Theory				Practical		
				IA		ESE		ESE		
1 <sup>st</sup> Semester	2 Core Courses of 6 Credits Each	2 × 6 =	12	2×10 =	20	2×30 =	60	2×20 =	40	120
	1 Generic Elective of 6 Credits	1 × 6 =	6	1×10 =	10	1×30 =	30	1×20 =	20	60
	1 AECC (Environmental Studies) of 4 credits	1 × 4 =	8	-	-	1×50 =	50	-	-	50
2 <sup>nd</sup> Semester	2 Core Courses of 6 Credits Each	2 × 6 =	12	2×10 =	20	2×30 =	60	2×20 =	40	120
	1 Generic Elective of 6 Credits	1 × 6 =	6	1×10 =	10	1×30 =	30	1×20 =	20	60
	1 AECC (English/MIL) of 2 credits	1 × 2 =	2	-	-	1×20 =	20	-	-	20
3 <sup>rd</sup> Semester	3 Core Courses of 6 Credits Each	3 × 6 =	18	3×10 =	30	3×30 =	90	3×20 =	60	180
	1 Generic Elective of 6 Credits	1 × 6 =	6	1×10 =	10	1×30 =	30	1×20 =	20	60
	1 SEC of 2 credits	1 × 2 =	2	-	-	1×20 =	20	-	-	20
4 <sup>th</sup> Semester	3 Core Courses of 6 Credits Each	3 × 6 =	18	3×10 =	30	3×30 =	90	3×20 =	60	180
	1 Generic Elective of 6 Credits	1 × 6 =	6	1×10 =	10	1×30 =	30	1×20 =	20	60
	1 SEC of 2 credits	1 × 2 =	2	-	-	1×20 =	20	-	-	20
5 <sup>th</sup> Semester	2 Core Courses of 6 Credits Each	2 × 6 =	12	2×10 =	20	2×30 =	60	2×20 =	40	120
	2 Discipline Specific Elective of 6 Credits	2 × 6 =	12	2×10 =	20	2×30 =	60	2×20 =	40	120
6 <sup>th</sup> Semester	2 Core Courses of 6 Credits Each	2 × 6 =	12	2×10 =	20	2×30 =	60	2×20 =	40	120
	2 Discipline Specific Elective of 6 Credits	2 × 6 =	12	2×10 =	20	2×30 =	60	2×20 =	40	120
			146	220		770		440		1430

**Note:** L=Lecture (1 Credit = 1 hr); P= Practical (1 Credit = 2 hrs); The entire semesters carry 142 credits of total marks of 1420. The credit value of 2 indicates 20 marks.

## **SYLLABUS FOR B.Sc. SERICULTURE (HONOURS)**

### **B.Sc. (Hons) Sericulture: 1<sup>st</sup> Semester**

Course Code	Course Title		Course Type	L:T:P	Credit	Marks			
						Theory		Practical	Total
						IA	ESE	ESE	
SERHC1	Fundamentals of Sericulture		Core	4:0:2	6	10	30	20	60
SERHC2	Biochemistry & Metabolism		Core	4:0:2	6	10	30	20	60
Any one of the following									
SERHGE1	A.	Chemistry	GE-1	4:0:2	6	10	30	20	60
	B.	Botany							
	C.	Microbiology							
	D.	Zoology							
AECC1	Environmental Studies		AECC-1	8:0:0	8	-	50	-	50
Total in Semester - I					26	30	140	60	230

### **B.Sc. (Hons) Sericulture: 2<sup>nd</sup> Semester**

Course Code	Course Title		Course Type	L:T:P	Credit	Marks			
						Theory		Practical	Total
						IA	ESE	ESE	
SERHC3	Plant, animal & Microbial Physiology		Core	4:0:2	6	10	30	20	60
SERHC4	Biology of Mulberry & Agronomy		Core	4:0:2	6	10	30	20	60
Any one of the following									
SERHGE2	A.	Chemistry	GE-2	4:0:2	6	10	30	20	60
	B.	Botany							
	C.	Microbiology							
	D.	Zoology							
AECC2	English/Modern Indian Language		AECC-2	2:0:0	2	-	20	-	20
Total in Semester - II					20	30	110	60	200

### **B.Sc. (Hons) Sericulture: 3<sup>rd</sup> Semester**

Course Code	Course Title		Course Type	L:T:P	Credit	Marks			
						Theory		Practical	Total
						IA	ESE	ESE	
SERHC5	Cell Biology		Core	4:0:2	6	10	30	20	60
SERHC6	Soil Science		Core	4:0:2	6	10	30	20	60
SERHC7	Biology of Silkworm & Rearing Technology		Core	4:0:2	6	10	30	20	60
<b>Any one of the following</b>									
SERHGE3	A.	Chemistry	GE-3	4:0:2	6	10	30	20	60
	B.	Botany							
	C.	Microbiology							
	D.	Zoology							
<b>Any one of the following</b>									
SERHSEC1	A.	Apiculture	SEC-1	2:0:0	2	-	20	-	20
	B.	Mushroom Culture							
<b>Total in Semester - III</b>					<b>26</b>	<b>40</b>	<b>140</b>	<b>80</b>	<b>325</b>

### **B.Sc. (Hons) Sericulture: 4<sup>th</sup> Semester**

Course Code	Course Title		Course Type	L:T:P	Credit	Marks			
						Theory		Practical	Total
						IA	ESE	ESE	
SERHC8	Reproductive & Developmental Biology		Core	4:0:2	6	10	30	20	60
SERHC9	Silkworm Seed Technology		Core	4:0:2	6	10	30	20	60
SERHC10	Diseases & Pests of Mulberry & Silkworm		Core	4:0:2	6	10	30	20	60
<b>Any one of the following</b>									
SERHGE4	A.	Chemistry	GE-4	4:0:2	6	10	30	20	60
	B.	Botany							
	C.	Microbiology							
	D.	Zoology							
<b>Any one of the following</b>									
SERHSEC2	A.	EDP	SEC-2	2:0:0	2	-	20	-	20
	B.	Herbal Tech.							
<b>Total in Semester – IV</b>					<b>26</b>	<b>40</b>	<b>140</b>	<b>80</b>	<b>260</b>

### **B.Sc. (Hons) Sericulture: 5<sup>th</sup> Semester**

Course Code	Course Title		Course Type	L:T:P	Credit	Marks			
						Theory		Practical	Total
						IA	ESE	ESE	
SERHC11	Genetics & Genetic Engineering		Core	4:0:2	6	10	30	20	60
SERHC12	Genetics & Breeding of Mulberry		Core	4:0:2	6	10	30	20	60
Any one of the following									
SERHDSE1	A.	Bioinstrumentation	DSE-1	4:0:2	6	10	30	20	60
	B.	Silk Technology							
Any one of the following									
SERHDSE2	A.	General Microbiology & Immunology	DSE-2	4:0:2	6	10	30	20	60
	B.	Clinical Biochemistry							
Total in Semester – V					24	40	120	80	240

### **B.Sc. (Hons) Sericulture: 6<sup>th</sup> Semester**

Course Code	Course Title		Course Type	L:T:P	Credit	Marks			
						Theory		Practical	Total
						IA	ESE	ESE	
SERHC13	Genetics & Breeding of Silkworm		Core	4:0:2	6	10	30	20	60
SERHC14	Evolutionary Biology		Core	4:0:2	6	10	30	20	60
Any one of the following									
SERHDSE3	A.	Genomics & Proteomics	DSE-3	4:0:2	6	10	30	20	60
	B.	Non-Mulberry sericulture							
Any one of the following									
SERHDSE4	A.	Ecology	DSE-4	4:0:2	6	10	30	20	60
	B.	Biostatistics							
Total in Semester – VI					24	40	120	80	240



## **COURSES SERICULTURE (HONOURS) AT A GLANCE**

<b>Core Courses (C)</b>	
<b>C-1</b>	Fundamentals of sericulture
<b>C-2</b>	Biochemistry and metabolism
<b>C-3</b>	Plant, insect and microbial physiology
<b>C-4</b>	Biology of mulberry and agronomy
<b>C-5</b>	Cell biology
<b>C-6</b>	Soil science
<b>C-7</b>	Biology of silkworm and rearing technology
<b>C-8</b>	Reproductive and developmental biology
<b>C-9</b>	Silkworm seed technology
<b>C-10</b>	Diseases and pests of mulberry and silkworm
<b>C-11</b>	Genetics and genetic engineering
<b>C-12</b>	Genetics and breeding of mulberry
<b>C-13</b>	Genetics and breeding of silkworm
<b>C-14</b>	Evolutionary biology

<b>General Elective Courses [DSE] for other Departments (any one per semester in semesters I –IV)</b>	
<b>GE-1</b>	Science of sericulture
<b>GE-2</b>	Mulberry biology, production and protection
<b>GE-3</b>	Silkworm biology, cocoon production and protection
<b>GE-4</b>	Advanced concept in seri-biotechnology
<b>GE-5</b>	Sericulture extension and economics

<b>Ability Enhancement Compulsory Courses (AECC)</b>	
<b>AECC-1</b>	English / Modern Indian Languages (MIL) [Semester-I]
<b>AECC-2</b>	Environmental Science [Semester-II]
<b>Skill Enhancement Courses (any one per semester in semesters III -IV)</b>	
<b>SEC-1</b>	Apiculture
<b>SEC-1</b>	Mushroom culture
<b>SEC-2</b>	Entrepreneurship development
<b>SEC-2</b>	Herbal technology

<b>Discipline Specific Elective Courses (any two per semester in semesters V -VI)</b>	
<b>DSE-1</b>	Bioinstrumentation
<b>DSE-1</b>	Silk Technology
<b>DSE-1</b>	General microbiology and immunology
<b>DSE-1</b>	Clinical biochemistry
<b>DSE-2</b>	Genomics and proteomics
<b>DSE-2</b>	Non-mulberry sericulture
<b>DSE-2</b>	Ecology
<b>DSE-2</b>	Biostatistics

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-I

#### CORE COURSE I

#### TITLE: FUNDAMENTALS OF SERICULTURE

Course Code: SERHC1

(Credits: Theory-4; Practicals-2)

#### THEORY

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

#### Course Objectives:

After completion the course the learners will be able to explain:

1. Historical perspective of sericulture, its scope and significance.
2. Economic advantages of sericulture and its role towards rural development.
3. Organizational set up of sericulture in India
4. Various activities of sericulture and importance of sericulture byproducts.

#### Course Contents:

##### Unit-I: History, Concept, Scope and Significance of Sericulture

1. History, development and status of mulberry and non-mulberry sericulture in India; Silk production in India and other countries; export and import.
2. Insect and non-insect fauna producing silk; types of silk produced in India; host plants of mulberry and non-mulberry silkworms.
3. Introduction to textile fibres: types- natural/synthetic and their properties; importance of silk fibre.
4. Characteristic features and advantages of sericulture; scope of sericulture in India-employment potential and income generation.
5. Significance of sericulture vis.-a- vis other agricultural crops; role of women in sericulture.

## Unit-II: The Organizational Structure of Sericulture in India

1. Sericulture Organization in India: extension systems- Central Silk Board, State Sericulture Departments, Universities and voluntary organizations.

## Unit-III: Concepts of Moriculture

1. Mulberry cultivars – tropical and temperate regions, irrigated and rainfed conditions.
2. Propagation of mulberry – sexual and asexual (cuttings, grafting and layering).
3. Establishment of mulberry garden: Selection of land / soil, preparation and plantation.
4. Package of practices for mulberry cultivation under rainfed and irrigated conditions.
5. Pruning – objectives and methods; Harvesting, methods, transportation and preservation of mulberry leaf.

## Unit-IV: Concepts of Sericulture

1. Life cycle of *Bombyx mori*; rearing houses and equipments; disinfection and hygiene.
2. Rearing operations: brushing, young and late-age silkworm rearing, moulting, mounting, spinning, cocoon harvesting and marketing.
3. Physical and commercial characteristics of cocoons; cocoon sorting.
4. Cocoon stifling– objectives and methods; cocoon cooking– objectives and methods.
5. Silk reeling: charaka, cottage basin and multi-end, steps involved in silk reeling

## Unit-V: Byproducts of Sericulture Industry and their Utilization

1. Mulberry cultivation, Silkworm rearing and Grainage.
2. Silk reeling.
3. Biomedical importance of silk.

## Suggested Readings

### Suggested Readings

1. Charsley, S.R. (1982). *Culture and Sericulture*. Academic Press Inc., New York, U.S.A
2. *FAO Manuals- I Mulberry cultivation*. FAO Rome.
3. Foth, H.D. (1984) *Fundamentals of Soil Science*. 7th Edn., John Wiley & Sons, New York.
4. Ganga, G., and J. Sulochana Chetty. (1991) *An introduction to sericulture*. Oxford & IBH Publishing Company.
5. Hasao Aruga (1994). *Principles of Sericulture (Translated from Japanese )* Oxford & IBH publishing Co., Pvt. Ltd. New Delhi.
6. Kichisaburo M. (1997) *Moriculture – Science of Mulberry Cultivation*. Oxford & IBH
7. Krishnaswami, S.; Narasimhanna, M.N.; Suryanarayan, S.K and Kumararaj, S. (1973) *Sericulture Manual-2 - Silkworm Rearing*. Agriculture Service Bulletin, FAO, Rome.
8. Madan Mohan Rao, M. (1999) *Comprehensive Sericulture Manual*. PS Publications, Hyderabad.
9. Rajanna, L., Das, P.K., Ravindran, S., Bhogsha, K., Mishra, R.K., Singhvi, N.R., Katiyar, R.S. and Jayaram, H. (2005) *Mulberry Cultivation and Physiology*. Central Silk Board, Bangalore.
10. Rangaswami, G.; Narasimhanna, M.N.; Kasiviswanathan, K., Sastry, C.R. and Jolly, M.S. (1976) *Sericulture Manual-1- Mulberry cultivation*. Agriculture Services Bulletin, FAO, Rome.

**TITLE: FUNDAMENTALS OF SERICULTURE****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Preparation of Sericulture maps -
  - World map of silk-road
  - India
2. Preparation of Pie chart/histogram on world output of –
  - Silk and other textile fibre
  - Silk fibre of different countries
3. Preparation of Organizational set up of Sericulture in India (Schematic diagram) –
  - Central Silk Board
  - DoS of five traditional states (viz., AP, TN, Karnataka, WB and J&K)
4. Preparation of Pie chart/histogram on
  - Different types of silk production in India.
  - Mulberry silk production in different States.
  - Trend of silk exports and imports.
  - Revenue earned from silk exports.
5. Salient features of popular mulberry cultivars.
6. Life cycle of the mulberry silkworm.
7. Characteristic features of popular bivoltine and multivoltine races of silkworm.
8. Disinfection and hygiene practices in grainage.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-I****CORE COURSE II****TITLE: BIOCHEMISTRY & METABOLISM****Course Code: SERHC2****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Nature, scope and aims of biochemistry and metabolism of organism.
2. Structure of various macromolecules.
3. Energetics in biological system.

**Course Contents:****Unit-I: Types and significance of chemical bonds**

1. Structure and properties of water; pH and buffers.
2. Hydrogen bond, hydrophobic and hydrophilic interaction, ionic interaction, Van-der-Waal's forces, disulfide bond.

**Unit II: Bioenergetics**

1. Laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, entropy, mathematical relationship among them, standard free energy change and equilibrium constant.
2. Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP.

**Unit III: Carbohydrates**

1. Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates.

**Unit IV: Lipids**

1. Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids, lipid bilayer, liposome,  $\beta$ -oxidation.

**Unit V: Proteins**

1. **Amino acids:** Structure, Classification and General properties of  $\alpha$ -amino acids; Physiological importance of essential and non-essential  $\alpha$ -amino acids.
2. **Proteins:** Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins.

**Unit VI: Nucleic Acids**

1. Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids.
2. Cot Curves: Base pairing, Denaturation and Renaturation of DNA.
3. Types of DNA and RNA.

**Unit VII: Enzymes**

1. Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action.
2. Enzyme kinetics; Enzyme inhibition; Allosteric enzymes and their kinetics.

**Unit VII: Vitamins**

1. Classification and characteristics with suitable examples, sources and importance.

**Unit VIII: Introduction to metabolism**

1. Catabolism, anabolism, concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle.

**Suggested reading:**

1. *Biochemistry Ed. Lubert Stryer. W.H. Freeman and Company, New York.*
2. *Principles of Biochemistry. Ed. Lehinger, Nelson and Cox. CBS Publishers and distributors.*
3. *Harper's Biochemistry, Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stamford, Connecticut.*
4. *Textbook of Biochemistry with Clinical Correlations. Ed. Thomas M. Devlin, Wiley-Liss Publishers.*
5. *Tietz Textbook of Clinical Chemistry. Ed. Burtis and Ashwood. W.B. Saunders Company.*
6. *Biochemistry. Ed. Donald Voet and Judith G. Voet. John Wiley & Sons, Inc.*

**TITLE: BIOCHEMISTRY & METABOLISM****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Estimation of total protein (Kjheldal/ Bradford method).
2. Estimation of total carbohydrate.
3. Buffer preparation (Aetate buffer, Phosphate buffer, Tris-buffer).
4. Determination of Saponification values of fats and oils.
5. Determination of  $\beta$ -amylase activity.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-II****CORE COURSE III****TITLE: PLANT, INSECT AND MICROBIAL PHYSIOLOGY****Course Code: SERHC3****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Concept of physiology in plant, animal and microbes.
2. Plant water relationship
3. Digestion and absorption of food in animal.

**Unit-I: Plant-water relations**

1. Importance of water, water potential and its components, solute potential.
2. Transpiration and its significance, Transpiration pull.
3. Factors affecting transpiration, root pressure and guttation.

**Unit-II: Mineral nutrition and translocation in phloem**

1. Essential elements, macro and micronutrients, criteria of essentiality of elements; role of essential elements.
2. Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.
3. Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

**Unit-III: Photosynthesis**

1. Photosynthetic Pigments (Chl a, b, xanthophylls, carotene).
2. Photosystem I and II, reaction center, antenna molecules;
3. Electron transport and mechanism of ATP synthesis;
4. C<sub>3</sub>, C<sub>4</sub> and CAM pathways of carbon fixation; Photorespiration.

**Unit-IV: Respiration**

1. Glycolysis, anaerobic respiration, TCA cycle;
2. Oxidative phosphorylation, Glyoxylate,
3. Oxidative Pentose Phosphate Pathway.



**Unit-V: Plant growth regulators**

1. Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA and ethylene.

**Unit-VI: Physiology of Insects**

1. Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, nervous system and sensory receptors.
2. Growth and metamorphosis.

**Unit-VII: Insect-Plant Interaction**

1. Theory of co-evolution, role of allelochemicals in host plant mediation.
2. Host-plant selection by phytophagous insects.
3. Insects as plant pests, Insect as vector.

**Unit-VIII: Microbial physiology**

1. Growth, measurement of microbial growth.
2. Batch culture, continuous culture.
3. Generation time and specific growth rate, synchronous growth, diauxic growth curve.
4. Microbial growth in response to environment.
5. Microbial growth in response to nutrition and energy.

**Suggested reading:**

1. Devlin RM. (1975). *Plant Physiology*. 3rd edition, Willard Grant Press.
2. Stanier RY, Ingraham JI, Wheelis ML and Painter PR. (1987). *General Microbiology*. 5th edition, McMillan Press.
3. Madigan MT, Martinko JM and Parker J. (2003). *Brock Biology of Microorganisms*. 10th edition. Pearson/ Benjamin Cummings.

**TITLE: PLANT, ANIMAL AND MICROBIAL PHYSIOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Calculation of stomatal index and stomatal frequency of mulberry leaf.
2. Demonstration of Hill reaction.
3. Mounting of larval mouth parts of silkworm/ cockroach.
4. Dissect and display of digestive system of silkworm/ cockroach.
5. Dissect and display of excretory system of silkworm/ cockroach.
6. Dissect and display of nerves system of silkworm/ cockroach.
7. Study of haemocytes of silkworm/ cockroach.
8. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
9. Effect of temperature, pH and sodium azide (as inhibitor) on growth of *E. coli*.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-II****CORE COURSE IV****TITLE: BIOLOGY OF MULBERRY & AGRONOMY****Course Code: SERHC4****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Morphology, anatomy and floral biology of mulberry.
2. Various types of propagation techniques followed in mulberry.
3. Suitable agronomical practices for mulberry cultivation and management.

**Unit-I: Mulberry- Morphology, anatomy & floral biology**

1. Classification and distribution of mulberry.
2. Brief account of popular and evolved mulberry cultivars exploited in India.
3. Morphology: Root, stem, bud, leaf and flower.
4. Anatomy: Root, stem and leaf.
5. Floral Biology: Male and female reproductive organs, pollination, fertilization and development of fruit and seed.

**Unit-II: Propagation of Mulberry**

1. Seedlings: Collection of viable seeds, methods of raising seedlings-viability.
2. Saplings: Selection and preparation of cuttings and formation of roots.
3. Grafting: Types of grafting- Stem, root and bud, anatomy of grafting.
4. Layering: Concept, types and techniques. Use of growth regulators in mulberry propagation.

**Unit-III: Establishment of Mulberry Garden**

1. Selection of land, selection of suitable varieties of mulberry, spacing and planting systems.
2. Dosage of fertilizers and manures, common weeds and weeding, irrigation schedule, disease and pest control, inter-cultivation, pruning and harvesting.

**Unit-IV: Requirements of Mulberry cultivation: (under irrigated and dry land conditions)**

1. Irrigation: Water resources, irrigation systems (surface, sub soil, sprinkler and drip systems) and their practical relevance, Over irrigation and its effects, Water requirement of mulberry in different field situations and seasons, Sewage water irrigation and its effects; Drainage: Methods and importance.
2. Water management practices in dry land mulberry: Land leveling, bunding, contour bunding, *In-situ* moisture conservation practices and rain water re-cycling, Mulching: Purpose, mulching materials, methods of mulching. Water shed area concept and its practices.
3. Organic manures: Types, method of compost preparation and its use in mulberry fields, advantage and constraints, vermiculture.
4. Chemical fertilizers: Types, importance, composition of different fertilizers, doses and application for irrigation and rain fed gardens, Storage of chemicals fertilizers, Foliar nutrients and commercial formulations, scope and limitations.
5. Biofertilizers: Types, importance, application methods and limitations.
6. Inter-cultivation practice: Purpose, methods, time and frequency.
7. Weed management: Common weeds of mulberry, their effect on mulberry, productivity and quality and control measures.

**Unit-V: Pruning and training objectives**

1. Types and methods of pruning and importance.
2. Utility of mulberry pruning in sericulture management practices.

**Unit-VI: Harvesting**

1. Effects of harvesting on mulberry plant.
2. Harvesting methods (Leaf and shoot harvest) in relation to cultivation and rearing practices.
3. Stages and times of harvest.
4. Transportation and preservation methods.

**Suggested Readings**

1. *FAO Manuals- I Mulberry cultivation. FAO Rome.*
2. *Foth, H.D. (1984) Fundamentals of Soil Science. 7th Edn., John Wiley & Sons, New York.*
3. *Hortmann and Kesler (1993) Plant Propagation, principles and practices. Prentice Hall, Hemel Nemstead.*
4. *Kichisaburo M. (1997) Moriculture – Science of Mulberry Cultivation. Oxford & IBH*
5. *Rangaswami, G.; Narasimhanna, M.N.; Kasiviswanathan, K., Sastry, C.R. and Jolly, M.S. (1976) Sericulture Manual-I- Mulberry cultivation. Agriculture Services Bulletin, FAO, Rome.*

**TITLE: BIOLOGY OF MULBERRY & AGRONOMY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Morphology and anatomy of some important mulberry cultivars and their identification
  - Morphology of leaf, stem, root, bud, flower and fruit.
  - Anatomy of leaf, stem and root.
2. Preparation of nursery bed.
3. Different techniques of propagation.
  - Sexual propagation-seedling.
  - Vegetative propagation-cutting, grafting and layering.
4. Identification of different types of manures and fertilizers, calculation of fertilizer dosages.
5. Identification of common weeds of mulberry and their management.
6. Preparation of seri-compost from sericultural waste.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-III****CORE COURSE V****TITLE: CELL BIOLOGY****Course Code: SERHC5****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to conceptualize:

1. Overview of cell and cell organelles along with their functions.
2. Mechanisms of cell division and cell communications.

**Unit-I: Overview of Cells**

1. Cell as a unit of structure and function.
2. Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions.

**Unit-II: Cell wall and plasma membrane**

1. Chemistry, structure and function of Plant cell wall.
2. Membrane function; fluid mosaic model.
3. Chemical composition of membranes.
4. Membrane transport – passive, active and facilitated transport, endocytosis and exocytosis.

**Unit-III: Cell organelles**

1. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.
2. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.
3. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.
4. Endomembrane system: Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi apparatus; Lysosomes.

**Unit-V: Cell Division and Signaling**

1. Mitosis, Meiosis, Cell cycle and its regulation.
2. GPCR and Role of second messenger (cAMP).

**Suggested reading:**

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

CONFIDENTIAL

**TITLE: CELL BIOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains/blood cells).
2. Preparation of temporary stained squash of onion/ mulberry root tip to study various stages of mitosis.
3. Study of various stages of meiosis.
4. Preparation of temporary slide to show the presence of Barr body in human female blood cells/cheek cells.
5. Study the phenomenon of plasmolysis and deplasmolysis.



**B.Sc. SERICULTURE (HONOURS)****SEMESTER-III****CORE COURSE VI****TITLE: SOIL SCIENCE****Course Code: SERHC6****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Physical and chemical properties of soil.
2. Nutritional requirement for plant growth with special reference to mulberry.
3. Significance of soil and water conservation.

**Unit-I:**

1. Soil forming factors and soil profile development.
2. Different types of soil – basics of soil classification.

**Unit-II: Physical properties of soil**

1. Volume constitution of soil.
2. Soil texture – a) Soil separates, b) Soil textural classes.

**Unit-III: Soil Structure**

1. Type, importance, ways to improve soil structures.
2. Soil colour, soil permeability- Soil bulk and particle density, soil porosity, permeability as related to soil texture and structure, Soil air.

**Unit-IV: Soil chemical properties**

1. Ion exchange (cation and anion) and soil components (Colloids) responsible for the phenomenon and mechanisms involved- Layered silicate clays, Hydrous oxides or hydroxyl iron aluminium, Allophane, Organic colloids.
2. Significance of ion exchange including base exchange and base saturation.

**Unit-V: Soil water**

1. Importance of water, Physical and biological classification of soil water.
2. Soil moisture content and their measurement, Soil moisture calculation relating to irrigation schedule.
3. Water requirements of mulberry, Factors affecting soil water holding capacity including capillary rise and leaching.
4. Soil water conservation and management.

**Unit-VI: Soil organic matter**

1. Chemical nature of its constituents, importance of soil organic matter.
2. Carbon: Nitrogen ratio of organic matter and its significance.
3. Soil micro organism-types and role in mineral nutrition.

**Unit-VII: Soil nutrients**

1. Elements (nutrients) essential for plant growth and their classification.
2. Forms of elements taken up by plants, their absorption and utilization.
3. Sources of nutrient elements in the soil.
4. Role of essential elements in plant growth, Deficiencies/ and toxicity.

**Unit-VIII: Soil and water conservation**

1. Importance and measures- agronomic and mechanical measures.
2. Soil erosion-types, mechanism involved and associated problems.
3. Factors influencing erosion.

**Suggested Readings**

1. Dilip Kumr Das (2015). *Introductory Soil Science*. Kalyani Publisher; 4 edition
2. Foth, H.D. (1984) *Fundamentals of Soil Science*. 7th Edn., John Wiley & Sons, New York.
3. Kolay, A.K. (1996) *Basic Concepts of Soil Science*. New Age International Pvt. Ltd., New Delhi.
4. Ranjan Kumar Basak (2014). *Soil testing and Recommendation (A Text book)*. Kalyani Publishers; 2 edition.
5. Rathinasamy A (2014). *Fundamentals Of Soil Science*. Scientific Publisher; First edition
6. V.N. Sahai (2011). *Fundamentals of Soil*. Kalyani Publishers; Kalyani Publishers\_93 edition.

**TITLE: SOIL SCIENCE****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours**

1. Soil sampling techniques and preparation of soil sample in the laboratory for analysis.
2. Soil analysis for pH and electrical conductivity.
3. Determination of organic carbon by standard (colorimetric) method.
4. Determination of available nitrogen by standard method.
5. Determination of available phosphorus.
6. Determination of available potassium by flame photometer.
7. Visit to a soil testing laboratory.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-III

#### CORE COURSE VII

#### TITLE: BIOLOGY OF SILKWORM & REARING TECHNOLOGY

Course Code: SERHC7

(Credits: Theory-4; Practicals-2)

#### THEORY

Contact Hours per week	: 4	Maximum Marks	: 40
Examination Duration	: 2 hours	Internal	: 10
		ESE	: 30

#### Course Objectives:

After completion of the course the learners will be able to understand:

1. Morphology of silkworm and its anatomical features.
2. Scientific way of silkworm rearing.
3. Rearing technology of young and late age silkworm for raising assured cocoon crops.

#### Course Contents:

##### Unit-I: Classification of insects and metamorphosis

1. General characteristic features of insects.
2. Classification of sericigenous insects; characteristic features of order Lepidoptera and families –Bombycidae and Saturniidae.
3. Importance of metamorphosis in insects, types and hormonal influence.

##### Unit-II: Morphology of insect egg

1. Morphology and structure.
2. Oviparity, ovoviviparity and viviparity, polyembryony, parthenogenesis and pedogenesis.

##### Unit-III: Morphology of silkworm, *Bombyx mori* and its classification

1. Egg, larva, pupa and adult (moth).
2. Geographical distribution.
3. Moulting, voltinism, cocoon colour and shape.

**Unit-IV: Anatomical features of silkworm, *Bombyx mori***

- |   |                       |
|---|-----------------------|
| 1 Digestive   | 2 Nervous             |
| 3 Circulatory   | 4 Respiratory systems |
| 5 Excretory   | 6 Silk gland          |
| 7 Reproductive system and sex separation in larva and adult |                       |

**Unit-V: Planning for silkworm rearing**

1. Estimation of leaf quality and yield- appropriate time for estimation of leaf yield, method and calculation of brushing capacity based on yield.
2. Model rearing house: advantages and disadvantages; Rearing appliances- design and cost- requirements of rearing appliances for 100 dfls.
3. Disinfection- types, mode of application and importance.

**Unit-VI: Incubation of silkworm eggs and brushing techniques**

1. Incubation- definition- environmental requirement for incubation and their influence on egg development- methods of incubation- conventional method, incubator, low cost incubation devices- earthen pot, double brick wall chamber- black boxing.
2. Brushing- definition- different brushing methods, loose eggs and sheet eggs- tapping and net method- advantages and disadvantages of different types of brushing- cellular and mass brushing.

**Unit-VII: Environmental requirement, young age & late age silkworm rearing technology**

1. Environmental requirements for young and late-age silkworm rearing; Qualitative and quantitative requirements of mulberry for young and late-age silkworms.
2. Chawki silkworm rearing: Rearing methods and operations; chawki rearing centres – importance and functions.
3. Late age silkworm rearing: Rearing methods and operations.
4. Moulting: Characteristic features - before, at and after moult; care during moulting.

**Unit-VIII: Mounting and cocoon harvesting**

1. Mounting - types of mountages, methods of mounting matured silkworms, environmental requirements during spinning and density of mounting.
2. Cocoon harvesting, sorting, packing, transportation and marketing, preparation of crop harvest report.

**Suggested Readings**

1. Dokuhon, Z.S. (1998). *Illustrated Textbook on Sericulture*. Oxford & IBH publishing Co., Pvt. Ltd. Calcutta.
2. Ganga, G., and J. Sulochana Chetty. (1991) *An introduction to sericulture*. Oxford & IBH Publishing Company.
3. Hasao Aruga (1994). *Principles of Sericulture (Translated from Japanese )* Oxford & IBH publishing Co., Pvt. Ltd. New Delhi.
4. Krishnaswami, S.; Narasimhanna, M.N.; Suryanarayan, S.K and Kumararaj, S. (1973) *Sericulture Manual-2 - Silkworm Rearing*. Agriculture Service Bulletin, FAO, Rome.
5. Madan Mohan Rao, M. (1999) *Comprehensive Sericulture Manual*. PS Publications, Hyderabad.

CONFIDENTIAL

**TITLE: BIOLOGY OF SILKWORM & REARING TECHNOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Life cycle of *Bombyx mori*- Morphology of egg, larva, pupa and adult (moth).
2. Dissection and display of silkworm's-
  - Digestive system.
  - Silk glands.
  - Reproductive system of male and female moths.
  - Mounting of larval mouth parts and spiracle.
  - Nervous system.
3. Sex separation in larva and pupa of the silkworm.
4. Preparation of model silkworm rearing houses, identification of rearing appliances and their usage.
5. Incubation of silkworm eggs- Methods; black boxing; maintenance of temperature and humidity.
6. Brushing of silkworm eggs - methods; chawki rearing; use of paraffin paper and blue polythene sheet.
7. Preparation of brushing report (calculation of hatching % and fecundity).
8. Preparation of rearing report (Maintenance of records of silkworm rearing).

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-IV

#### CORE COURSE VIII

#### TITLE: REPRODUCTIVE & DEVELOPMENTAL BIOLOGY

Course Code: SERHC8

(Credits: Theory-4; Practicals-2)

#### THEORY

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

#### Course Objectives:

After completion the course the learners will be able to understand:

1. Embryonic development in both plant and animal.
2. Pollination and fertilization in plants.
3. Concept of polyembryony and apomixes.

#### Unit-I: Introduction

1. Historical perspective and basic concepts: History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope.
2. Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division.

#### Unit-II: Embryonic Development in animal

1. Early: Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of silkworm, frog and chick up to gastrulation; Embryonic induction and organizers.
2. Late: Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

#### Unit-III: Reproductive development in plant

1. Embryogenesis: Sexual plant reproduction; mechanisms of gametogenesis and fertilization the central role of hormones and environment in plant development; Mulberry plant as a model organisms and experimental tools in cell and developmental plant biology.



2. Anther and pollen biology: Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; abnormal features: Pseudomonads, polyads, massulae, pollinia.
3. Pollination and fertilization: Ovule, Structure; Types; Special structures—endothelium, obturator, aril, caruncle and hypostase; Female gametophyte— megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (Details of *Polygonum* type); Organization and ultrastructure of mature embryo sac. Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

#### Unit-IV: Polyembryony and apomixes

1. Introduction and classification.
2. Causes and applications.

#### Suggested Readings

1. Developmental Biology: Scott F Gilbert
2. Essentials of Developmental Biology: JMW Slack
3. Principles of Developmental Biology (2nd, edition): Louis Wolpert
4. Ecological developmental Biology-integrating epigenetics, medicine and evolution: Scott F Gilbert and Epel.
5. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
6. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
7. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.

**TITLE: REPRODUCTIVE & DEVELOPMENTAL BIOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Mounting and identification of reproductive part of mulberry.
2. Intra-ovarian pollination; Test tube pollination through photographs.
3. Study of development of dicot embryo of mulberry.
4. Study of mammalian sperm.
5. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13), 24, 36, 48, 72, and 96 hours of incubation.
6. Identification of different parts of human placenta through photograph.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-IV

#### CORE COURSE IX

#### TITLE: SILKWORM SEED TECHNOLOGY

Course Code: SERHC9

(Credits: Theory-4; Practicals-2)

#### THEORY

Contact Hours per week	: 4	Maximum Marks	: 40
Examination Duration	: 2 hours	Internal	: 10
		ESE	: 30

#### Course Objectives:

After completion the course the learners will be able to understand:

1. Scientific method of raising quality silkworm seed.
2. Seed organization system of sericulture and management of grainage operation etc.

#### Course Contents:

##### Unit-I: Basic concepts of silkworm seed technology

1. A general account of silkworm seed, grainages, production and demand trends.
2. Role of temperature, humidity, light and air on seed cocoon preservation and oviposition.
3. Procurement, transportation, processing and preservation of seed cocoons.
4. Sex separation, synchronization of emergence, influence of light on emergence, pairing of moths and mother moth examination.
5. Studies on silkworm seed (egg), and identification of critical stage of development.

##### Unit-II: Silkworm seed organization system in India

1. Significance of seed organization- Maintenance of pure parental stock and multiplication.
2. Four-tier system of silkworm seed multiplication, seed areas—identification—concept of selected seed rearers / villages.
3. Monitoring of seed crop - disinfection and maintenance of hygiene during rearing.
4. Planning for seed cocoon production- programme of brushing- synchronized brushing of races in villages.
5. Seed cocoon markets - certification of seed cocoon lots—price fixation for seed cocoons.

### Unit-III: Preparation of quality silkworm seed

1. Preparation of sheet and loose eggs- advantage and disadvantages of loose eggs over sheet eggs.
2. Handling of multivoltine and bivoltine silkworm eggs, breaking of diapause of bivoltine eggs - physical and chemical methods - hot and cold acid treatment- advantages and disadvantages.
3. Seed Production Centers (SPC) / License seed producers (LSPs) – functions - plan of a model grainage inclusive of cold storage facility, infrastructure for a SPC — requirements of each room—equipments and their utilization.

### Unit-IV: Management of silkworm grainage operation

1. Grainage management- 15 lakh production capacity / year - Staff component for grainage.
2. Grainage equipments- Arrangement for seed cocoon procurement - Deployment of working force.
3. Maintenance of good cocoon - Rapport with seed cocoon growers - Maintenance of grainage and cold storage equipments.

### Suggested Readings

1. Chapman, R.F. (1992). *The Insects: Structure and functions*.
2. Narasimhanna and Ullal (1978). *Handbook of silkworm egg production*, CSB Publications.
3. Narasimhanna. M.N. (1998). *Manual on Silkworm egg Production*. CSB., Govt. of India, Bangalore.
4. Tazima, Y. *The silkworm egg*.

**TITLE: SILKWORM SEED TECHNOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Processing of seed cocoons - deflossing – sorting - selection of good cocoons - assessment of seed cocoons.
2. Cutting of seed cocoons - sex separation by pupal method.
3. Emergence of moths—Selection of moths - Pairing and departing – Oviposition - Maintenance of required environmental conditions - Preservation of male moths.
4. Mother moth examination—individual and mass—whole and sampling method —Surface sterilization of silkworm eggs.
5. Sheet eggs and loose egg preparation— Preparation of starch coated paper—Washing of loose eggs - Drying - Treatment of eggs with acid weighing and packing.
6. Acid treatment of bivoltine eggs—hot acid and cold acid treatment.
7. Plan of grainage building and grainage equipments.
8. Conducting silkworm rearing and preparation of report on maintenance of grainage records.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-IV****CORE COURSE X****TITLE: DISEASES AND PESTS OF MULBERRY & SILKWORM****Course Code: SERHC10****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Different types of mulberry and silkworm diseases and pests and
2. Their effective management for the enhancement of productivity and quality etc.

**Course Contents:****Group-A – diseases and pests of Mulberry****Unit-I: Mulberry diseases, types, symptoms and management**

1. Introduction to plant diseases and importance of plant protection.
2. Classification of mulberry diseases.
3. Influence of biotic and abiotic factors on the incidence of mulberry diseases.
4. Root-knot disease of mulberry- occurrence, symptoms, preventive and control measures.
5. Fungal diseases of mulberry: Occurrence, symptoms, etiology, preventive and control measures of the following diseases :
  - Powdery mildew.
  - Leaf spot.
  - Black/grey spot.
  - Leaf blight.
  - Leaf rust.
  - Root rot.
6. Viral, bacterial and dwarf diseases of mulberry- their occurrence- symptoms, preventive and control measures.

## Unit-II: Mulberry pests, types, mode of infestation and management

1. Pest: definition, classification based on mouth parts, feeding type and crop loss.
2. Mulberry pests: Major pests: Bihar hairy caterpillar, mealy bugs, jassids and thrips – their preventive and control measures.
3. Minor pests: Scale insects, girdlers, termites and mites-their preventive and control measures.
4. Biological control of mulberry pests.
5. Integrated Pest Management.
6. Pesticides: Forms, formulations, application and pesticide calculation.

## Group-B – diseases and pests of Silkworm

### Unit-III: Silkworm diseases, types, symptoms and management

1. Introduction; classification of silkworm diseases.
2. Protozoan disease of the silkworm – symptomatology, structure of pebrine spore, life cycle of *Nosema bombycis*, source, mode of infection and transmission, cross infectivity, prevention and control.
3. Bacterial diseases of the silkworm - causative agents, symptoms, factors influencing flacherie, source, mode of infection and transmission prevention and control.
4. Viral diseases of the silkworm (grasserie, infectious flacherie, cytoplasmic polyhedrosis, densovirus and gattine) - causative agents- symptoms – sources, mode of infection and transmission- prevention and control.
5. Fungal diseases of the silkworm (white & green muscardine and aspergillosis) - causative agents, symptoms, structure and life cycle of fungal pathogen- mode of infection and transmission- prevention and control.
6. Integrated management of silkworm diseases.

### Unit-IV: Silkworm pests, types, mode of infestation and management

1. Introduction; classification of silkworm pests.
2. Life cycle of Indian uzifly- seasonal occurrence; oviposition and host-age preference; nature and extent of damage; prevention and control; integrated management of Indian uzifly.
3. Cocoon pests of silkworm - dermestid beetle- life cycle; nature and extent of damage; prevention and control measures.
4. Predators of silkworm - cockroaches, ants, lizards and rodents; prevention and control measures.
5. Integrated Pest Management – concept, brief account of methods of pest control: Cultural, mechanical, physical, legislative (Quarantine), chemical, genetical / autocidal, biological and IPM.

### Suggested Readings

1. *A Text Book of Morden Plant Pathology* – K.S Bilgrami and H.C Dube. (1980).
2. *Agriculture Insect Pests of the tropics and their control*. Dennis. S. Hill. Cambridge University Press.
3. *Diseases and Pests of mulberry and their control*. Sen Gupta, Govindaiah and Pradeep Kumar CSR & TI Mysore (1991).
4. *Entomology and Pest management*. Pedigo (Lorry, P) Macmillon Publishing.
5. Govindan, R. and Devaiah, M.C: *Bacterial flacherie of silkworm*. CBS publication Bangalore.
6. Govindan, R. and T.K. Narayanaswamy, Devaiah (1998). *Principles and silkworm pathology-text book*.
7. *Hand book of pests and disease control of mulberry and silkworm*; United Nation Publication, Bangkok, Thailand (1990).
8. *Hand Book of Practical Sericulture* –Ullal and M.N. Narasimhanna, CBS Publicationa, Bangalore (1978).
9. *Hand Book on Pest and diseases of mulberry and silkworm* Sen Gupta, Pradeep Kumar, Nuathuza Baug & Govindaiah. United Nations
10. Lu Yup Lian (1995). *Silkworm diseases: oxford and IBH Publication. Co. Pvt. Ltd.*
11. *Microbial control of insect and mites*. Ed. H.D. Burges and N.W. Hussey; Academic press London.(1971).
12. *Mulberry cultivation* – FAO manual I- G. Rangaswmi, M.N. Narasimhanna, K. Kasiviswanathan, C.R. Sastry and Manjeet .S. Jolly. Oxford and IBH Publishing Co. Ltd. Rome (1976).
13. Narasiomhanna, M.N., Suryanarayana, S.K. and Kumararaj, S.(1988) *Manuals on Sericulture Vol. II*
14. *Plant pathology* –George N Agrios, Harcourt Asia Pvt., Ltd. And Harcourt Publishers International Co. Singapore. (2000).
15. *Plant pathology*-R.S. Mehrotra, Tata, M.C. Graw-Hill Publishing Co. Ltd. New Delhi. (1980).
16. *Plant Pests and their control*. Fenemone, P.G. Butterworths, London.
17. *Publication (ESCAP)*. Bangkok, Thailand.
18. Samson, M.V., Sridharan, T.O and Singh, R.N; *Pebrin-monitoring and disease management strategies*; CSB Publication.



**TITLE: DISEASES AND PESTS OF MULBERRY & SILKWORM****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Group-A**

1. Collection of diseased samples and their preservation.
2. Identification of different diseased mulberry leaf/plant parts based on external symptoms (fungal, bacterial, viral, root knot etc.)
3. Collection and preservation of pests from mulberry garden and their identification.
4. Identification of pests of mulberry.
5. Visit to different sericulture farms, mulberry garden for field study.

**Group-B**

1. Identification of different diseased silkworms based on external symptoms (grasserie, flacherie, muscardine and pebrine).
2. Identification of pathogens associated with silkworm diseases: Staining and preparation of temporary slides of bacteria, spores of pebrine, polyhedra of nuclear polyhedrosis virus and mycelial mat of muscardine.
3. Collection, preservation and identification of silkworm pests.
4. Methods of application of insecticide/ fungicide/formalin solution and management of silkworm diseases.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-V

#### CORE COURSE XI

#### TITLE: GENETICS & GENETIC ENGINEERING

Course Code: SERHC11

(Credits: Theory-4; Practicals-2)

#### THEORY

Contact Hours per week	: 4	Maximum Marks	: 40
Examination Duration	: 2 hours	Internal	: 10
		ESE	: 30

#### Course Objectives:

After completion the course the learners will be able to:

1. Principles of heredity and crossing over.
2. Mutations, Sex determination and extra chromosomal inheritance
3. Central dogma.
4. Recombinant DNA technology and its application.

#### Unit-I: Mendelian Genetics and its Extension

Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

#### Unit-II: Linkage, Crossing Over and Chromosomal Mapping

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

#### Unit-III: Mutations

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB methods, attached X method.

#### Unit-IV: Sex Determination

Chromosomal mechanisms of sex determination in *Drosophila* and man

#### Unit-V: Extra-chromosomal Inheritance

Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces*, Infective heredity in *Paramecium* and Maternal effects.

**Unit-VI: Polygenic Inheritance**

Polygenic inheritance with suitable examples; simple numericals based on it.

**Unit-VII: Flow of genetic information**

Replication, types, DNA repair, Transcription, Genetic code, translation and post translational modification and processing.

**Unit-VIII: Mechanisms of Genetic Exchange in bacteria**

Transformation, conjugation and transduction.

**Unit-IX: Recombinant DNA Technology**

Introduction, Cloning vectors, Construction, selection and identification of recombinants, PCR and DNA sequencing, expression of cloned genes.

**Suggested reading:**

1. Brown TA. (2006). *Gene Cloning and DNA Analysis*. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. *Principles of Genetics*. Wiley India.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. *Introduction to Genetic Analysis*, W. H. Freeman & Co.
4. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics*. XI Edition. Benjamin Cummings.
5. Primrose SB and Twyman RM. (2006). *Principles of Gene Manipulation and Genomics*, 7th edition. Blackwell Publishing, Oxford, U.K.
6. Russell, P. J. (2009). *iGenetics- A Molecular Approach*. III Edition. Benjamin Cummings.
7. Sambrook J, Fritsch EF and Maniatis T. (2001). *Molecular Cloning-A Laboratory Manual*. 3rd edition. Cold Spring Harbor Laboratory Press.
8. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.

**TITLE: GENETICS & GENETIC ENGINEERING****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. To study the Mendelian laws and gene interactions.
2. Blood Typing: ABO groups & Rh factor.
3. Linkage maps based on data from *Drosophila* crosses.
4. Study of human karyotype.
5. Pedigree analysis of some human inherited traits.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-V

#### CORE COURSE XII

#### TITLE: GENETICS AND BREEDING OF MULBERRY

Course Code: SERHC12

(Credits: Theory-4; Practicals-2)

#### THEORY

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

#### Course Objectives:

After completion the course the learners will be able to understand:

1. Various concepts related to mulberry breeding and selection.
2. Significance of mulberry breeding in sericulture.
3. Different techniques of plant breeding.

#### Course Contents:

##### Unit-I: Genetic variability in mulberry

1. Sources of variability, chromosomal variations.
2. Wilde species – hybrids; popular varieties of India.
3. Sexual polymorphism in mulberry.
4. Genetic consequences of self and cross pollination in mulberry.

##### Unit-II: Plant breeding, concepts and methods

1. Objectives of mulberry breeding.
1. Parameters associated with growth, yield and quality of mulberry.
2. Selection: characters and importance of pure line selection, clonal selection and mass selection.
3. Hybridization: Types and objectives, methods of hybridization in mulberry and achievements.
4. Mutation breeding: types of mutation, methods of mutation breeding in mulberry, limitations and achievement in mulberry.
5. Polyploidy breeding: occurrence and classification of polyploids, methods of polyploidy breeding in mulberry, identification of tetraploids, characteristics of polyploids, achievements in mulberry.

**Unit-III: Stress resistance breeding in mulberry**

1. Genetic basis of disease resistance, methods of breeding for disease resistance.
2. Morpho-anatomical characteristic features for drought resistant, methods of draught resistant.

**Unit-IV: Tissue culture & Germ plasma conservation**

3. Culture method, equipments and facilities, preparation of material, micropropagation, meristem, callus, anther, pollen and endosperm culture, somaclonal variation.
4. Application of tissue culture in mulberry breeding, gene transfer, characteristics of transgenic lines and constraints.
5. Significance and methods of germplasm conservation, encapsulation of shoot buds and cryopreservation of germplasm.

**Suggested Readings**

1. Amitabha Sarkar (2009). *Mulberry Breeding*. Kalyani Publishers
2. B.D. Singh (2015). *Plant Breeding principles & Methods*.
3. N. Nadarajan & Lt. M. Gunasekaran (2012). *Quantitative Genetics and Biometrical Techniques in Plant Breeding*.
4. Phundan Singh (2015) *Essentials of Plant Breeding*. Kalyani Publishers; 5th edition
5. Phundan Singh (2013). *Practical and Numerical problems in Plant Breeding*.
6. Robert W. Allard (2010). *Principles of Plant Breeding*.
7. S. Roy Chowdhuri, B.B. Bindroo S.P. Chakraborti (2013). *A Textbook on Mulberry Breeding and Genetics*. Kalyani publishers

**TITLE: GENETICS AND BREEDING OF MULBERRY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Commercial characters of mulberry- some evolved varieties.
2. Cytological techniques-preparation of pretreatment solutions- fixatives and straining procedure.
3. Somatic chromosomes-mitosis in root / shoot meristem.
4. Meiosis during microsporogenesis-smear preparation of pollen mother cells.
5. Hybridization techniques- selection of parents-pollen fertility and viability-bagging, collection of pollen and crossing-harvest of hybrid seeds-raising and preliminary screening of F1 progeny.
6. Drought resistant genotypes-morphological, anatomical and physiological features.
7. Stomatal frequency of different mulberry varieties.
8. Biochemical estimation of nutrients in mulberry leaf, estimation of moisture percentage, ash, chlorophyll (a, b and total), soluble proteins, crude proteins and sugars.
9. Morphological variability in diploids, triploids, tetraploids and mutants.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-VI

#### CORE COURSE XIII

#### TITLE: GENETICS AND BREEDING OF SILKWORM

Course Code: SERHC13

(Credits: Theory-4; Practicals-2)

#### THEORY

Contact Hours per week	: 4	Maximum Marks	: 40
Examination Duration	: 2 hours	Internal	: 10
		ESE	: 30

#### Course Objectives:

After completion the course the learners will be able to understand:

1. Principles and concept of genetic approaches applied to silkworm.
2. Genetic basis of inheritance in silkworm.
3. Various types of breeding methods followed in silkworm breeding.

#### Course Contents:

##### Unit-I: Sex determination mechanism in silkworm

1. Importance of ZZ and ZW chromosomes- sex-limited races.
2. Hereditary traits of silkworm egg and larva.
3. Radiation and chemical mutagenesis in silkworm.

##### Unit-II: Genetic basis of inheritance pattern in silkworm

1. Genetic basis of voltinism and moultinism in the silkworm, *Bombyx mori*.
2. Genetics of cocoon colours- inheritance pattern of cocoon colours in silkworm.
3. Quantitative genetics (QTL) – Mendelian population; Maternal inheritance.

##### Unit-III: Different modes of reproduction in silkworm

1. Mosaicism - types and theories; induction of mosaics in silkworm.
2. Parthenogenesis – types, induction and significance.
3. Androgenesis - types, induction and significance.



#### Unit-IV: Concepts of silkworm breeding

1. Scope and objectives of silkworm breeding, different types of breeding methods- line breeding, cross breeding and mutation breeding.
2. Inbreeding and out breeding concepts – inbreeding depression - merits and demerits.
3. Selection in silkworm breeding, criteria, index and parameters, methods of selection for qualitative and quantitative traits - individual and mass selection - fixation of characters.
4. Evolution of new breeds, evaluation index - race authorization.

#### Unit-V: Heterosis and hybrid vigour

1. Genotype - environmental interactions. heritability studies in *Bombyx mori* – broad and narrow range of heritability for various economic traits in silkworm.
2. Hybridization: concept of single, double and polyhybrids.
3. Heterosis and hybrid vigour; theories of heterosis; combining ability - general and specific; line  $\times$  tester and di-allele analysis.
4. Exploitation of heterosis in silkworm and Indian sericulture.
5. Sex limited breeds - role of translocation in silkworm breeding, methods of evolving sex-limited breeds.

#### Suggested Readings

1. Goldsmith, M and Wilkinson, A.S. (1996) *Molecular model system in Lepidopterons*. Cambridge Press, London.
2. Hiratsuka. (1999) *Silkworm Breeding Oxford & IBH publishing Co, Pvt. Ltd. New Delhi. Calcutta.*
3. Morohoshi, S (2000) *Development, and Physiology of Silkworm*. Oxford & IBH Publishing Co, Pvt. Ltd., New Delhi.
4. Sreeramreddy (ed), G. (1998). *Silkworm Breeding*. IBM Publishers, New Delhi.
5. Strickberger, M.W.(1996). *GENETICS*. Prentice-Hall of India, New Delhi.

**TITLE: GENETICS AND BREEDING OF SILKWORM****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Racial characters of the silkworm, *Bombyx mori*: Egg, larva and cocoon.
2. Studies on sex-limited traits – egg, larva and cocoon.
3. Observation of various quantitative traits of silkworm (fecundity, ERR by no. and wt., larval duration, cocoon wt, cocoon shell wt, cocoon shell ratio, raw silk percentage etc).
4. Estimation of fecundity and hatching percentage in bivoltine and multivoltine races/breeds.
5. Calculation of inbreeding depression in silkworm.
6. Analysis of quantitative traits – (cocoon wt, cocoon shell wt, cocoon shell ratio), measurement of heterosis through MPV, BPV and chi-square test.
7. Selection of cocoons for breeding based on various characters.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-VI****CORE COURSE XIV****TITLE: EVOLUTIONARY BIOLOGY****Course Code: SERHC14****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Mechanisms and concept of evolution of life.
2. Population genetics and phylogenetic relationships.

**Unit-I: Origin of Life**

1. Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis.
2. Evolution of eukaryotes, Origin of eukaryotic cell (Endosymbiotic theory).
3. Geological time scale.

**Unit-II: Theories of Origin**

1. Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism.

**Unit-III: Factors of Evolution**

1. Sources of variations: Heritable variations and their role in evolution.

**Unit-IV: Population genetics**

1. Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium.
2. Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection.
3. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies.

**Unit-V: Speciation**

1. Inter-population variations, clines, races, Species concept.
2. Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches).

**Unit-VI: Extinctions**

1. Extinctions, Back ground and mass extinctions (causes and effects).
2. Detailed example of K-T extinction.

**Unit-VII: Concept of Phylogeny**

1. Phylogenetic trees, multiple sequence alignment.
2. Construction of phylogenetic trees, interpretation of trees.

**Suggested Readings**

1. Campbell, N.A. and Reece J.B (2011). *Biology. IX Edition. Pearson, Benjamin, Cummings.*
2. Douglas, J. Futuyma (1997). *Evolutionary Biology. Sinauer Associates.*
3. Hall, B.K. and Hallgrimson, B (2008). *Evolution IV Edition. Jones and Barlett Publishers.*
4. Pevsner, J (2009). *Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell*
5. Ridley, M (2004) *Evolution III Edition Blackwell publishing*
6. Snustad. S *Principles of Genetics.*

**TITLE: EVOLUTIONARY BIOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Study of fossils from models/ pictures.
2. Study of homology and analogy from suitable specimens.
3. Study and verification of Hardy-Weinberg Law by chi square analysis.
4. Phylogeny chart of horse with diagrams/ cut outs of limbs and teeth of horse ancestors.
5. Chart OF Darwin's Finches with diagrams/ cut outs of beaks of different species.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-V****DISCIPLINE SPECIFIC ELECTIVE COURSE I****TITLE: BIOINSTRUMENTATION****Course Code: SERDSE1 (A)****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Methods of biological sciences.
2. Techniques of bio-analysis and mechanisms of bioinstrumentation.

**Course Contents:****UNIT- I: Microscopy**

1. Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM).
2. Absorption and emission spectroscopy.

**UNIT- II: Principle and law of absorption**

1. Fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared).

**UNIT-III: Centrifugation**

1. Centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

**UNIT IV: Chromatography**

1. Introduction to the principle of chromatography.
2. Paper chromatography, thin layer chromatography.
3. Column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

**UNIT V: Electrophoresis**

1. Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, Immuno-electrophoresis, isoelectric focusing, western blotting.

**Unit V: Biosensors**

1. Introduction, nanotechnology based biosensors.

**Unit VI: Spectroscopy**

1. Uv-Vis, FT-IR, Raman, CD/ORD, NMR.

***Suggested reading:***

1. Wise, D. L. (1991). *Bioinstrumentation and biosensors*. CRC Press.
2. Greenfield, A. A. (1980). *Introduction to bioinstrumentation (with biological, environmental and medical applications)*: By Clifford D Ferris. pp 352. Humana Press Inc, Clifton, New Jersey, USA.
3. Concerned literature will be given by individual faculty member.

CONFIDENTIAL

**TITLE: BIOINSTRUMENTATION****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Native gel electrophoresis of proteins.
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.



## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-V

#### DISCIPLINE SPECIFIC ELECTIVE COURSE I

#### TITLE: SILK TECHNOLOGY

**Course Code: SERDSE1 (B)**

**(Credits: Theory-4; Practicals-2)**

#### THEORY

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

#### Course Objectives:

After completion the course the learners will be able to understand:

1. Physical and chemical properties of various types of textile fibres including silk fibre.
2. Concept of post cocoon technology and steps involved in manufacturing of silk fabric.
3. Properties of silk and its importance.

#### Course Contents:

##### Unit-I: Introduction to textile fibres

1. Introduction to different textile fibres.
2. Physical and commercial characteristics of cocoons: cocoon colour, shape, size, hardness, grain/wrinkle, weight of cocoon, weight of cocoon shell, shell ratio etc.
3. Cocoon sorting: Objectives and procedure; defective cocoons - double, flimsy, melted, urinated, stained, uzi-infested, moth emerged, deformed and flossy.

##### Unit-II: General concept of post-cocoon technology

1. Cocoon stifling: Definition, objectives, different methods - conventional and modern techniques - steam stifling. Hot air drying - Batch type and conveyer type; advantages and disadvantages.
2. Cocoon cooking/boiling: Definition and objectives, different methods of cocoon boiling - Mono pan, three pan and pressurized cocoon boiling methods.
3. Cocoon brushing: Definition and objectives; methods - stick, hand and mechanical brushing.
4. Reeling water; quality required for silk reeling, total and permanent hardness, optimal pH; corrective measures.

5. Reeling: Objective and cocoon reeling from various devices - country charaka, cottage basin, multi end reeling machine, auto and semi-automatic, improved CSTR I Reeling devices; advantages and disadvantages.
6. Re-reeling and packing: Objectives, process; lacing, skeining, booking and baling.

### Unit-III: Silk properties and its importance

1. Raw silk properties - physical, chemical and biological. Uses of raw silk - Textile and other commercial uses.
2. Raw silk testing and grading; Visual inspection. Mechanical tests - winding test, size deviation test, seriplane test, serigraph test and cohesion test. Supplementary tests - conditioning weight, scouring loss, exfoliation tests.
3. Silk throwing: Introduction, objectives of silk throwing, preparation for twisting, soaking, winding, doubling, twisting (high & low), heat/steam setting, rewinding.

### Suggested Readings

1. Anon. 1972 *Manual on Sericulture, Vol.3 Silk Reeling* FAO, Agriculture Service Bulletin No. 72/3.
2. Byong Ho Kim. 1989. *Filature water Engineering*, Seoul national University Press, Republic of Korea.
3. Huang Guo Rui. 1988. *Silk reeling*, Oxford and IBH Publishing Co. Pvt. New Delhi.
4. Mahadeveppa, D., Halliyal, V.g., Shankar, A.G. and Bhandiwad, R. 2000 *Mulberry Silk Reeling Technology*, Oxford and IBh publishing Co. Pvt. Ltd. New Delhi.
5. Song, K.E and Lee, Y.W. 1973. *Modern Silk Reeling Technology*. Sericulture Expt. Station, Republic of Korea
6. Sonwalker, T.N. *Handbook of silk Technology*, New Age International Pvt.,ltd.
7. Yong Woo Lee. 1999. *Silk Reeling and Testing Manual*, FAO Agricultural services bulletin No. 136, Rome, Italy.

**TITLE: SILK TECHNOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Categorization of different types of cocoons - good and defective cocoons - calculation of percentage of each type.
2. Cocoon stifling - different methods and determination of degree of drying.
3. Reeling water: Determination of total and permanent hardness, alkalinity and pH.
4. Determination of commercial characters of cocoon - average cocoon weight, shell weight, shell percentage or shell ratio, average filament length, reelability, raw silk recovery percentage, renditta and denier; reeling on epprouvette.
5. Identification of silk, cotton, wool and synthetic fibre (viscose/nylon/polyester) by physical method - flame and microscopic test, chemical and confirmatory tests.
6. Study of charaka, cottage basin, multi-end silk reeling machine, automatic and semi-automatic reeling machine - practical demonstration. (visit to private reeling unit and filature).
7. Study of silk fabric manufacturing unit - Power & handloom. Identification of Weaving defects (Visit only).

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-V****DISCIPLINE SPECIFIC ELECTIVE COURSE II****TITLE: GENERAL MICROBIOLOGY & IMMUNOLOGY****Course Code: SERDSE2 (A)****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to conceptualize:

1. Various aspects of microbiology and its significance.
2. Immune system in plants, animals and microbes.

**Course Contents:****UNIT I: Ultra-structure of bacteria**

1. Cytoplasmic and outer membrane, capsule, flagella, pilli, endospore and special organelle.

**UNIT II: Cultivation of bacteria**

1. Aerobic, anaerobic and facultative.
2. Pure culture and its characteristics.

**UNIT III: Control of bacterial growth**

1. Physical & chemical agents, concepts on  $\beta$ -lactam antibiotics & their mode of action.
2. Preservation methods and stress responses.

**UNIT IV: Microbial nutrition, growth and its control**

1. Nutritional requirements in bacteria and nutritional categories, different types of cultural media, microbial culture, kinetics of microbial growth.
2. Microbial replication strategy: bacteria and virus (lytic, lysogenic cycle).

**UNIT V: Genetic recombination in bacteria**

1. Basic concept of transformation, conjugation and transduction.
2. Gene mapping by interrupting mating technique.

**UNIT VI: Overview of immune system**

1. Cells and organelles of immune system, lymphoid organs.

**UNIT VII: Immunity in plants**

1. Defensive role of ethylene, lignin, callose, tannin, hydrogen peroxide and lectin-enzyme complex in plants.
2. Phytoalexin vs. antibody.

**UNIT VIII: Elements of immunity in animals**

1. Innate vs. acquired immunity.
2. Passive vs. active immunity.

**UNIT IX: Antigenicity of molecules**

1. Immunogen vs. antigen; Characteristics and types of antigens.
2. Epitope, Adjuvants and Haptens.
3. Immunoglobulins: Molecular structure and classification.

**UNIT X: Antigen-antibody reaction**

1. Principle and a few basic application of antigen-antibody reaction.
2. Antigen processing and presentation, MHC, Complement system.
3. Tolerance and autoimmunity, Hypersensitivity, Transplantation Biology.

**Suggested Readings**

1. Atlas RM. (1997). *Principles of Microbiology*. 2nd edition. W.M.T. Brown Publishers.
2. Cappucino J and Sherman N. (2010). *Microbiology: A Laboratory Manual*. 9th edition. Pearson Education limited.
3. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). *General Microbiology*. 5th edition, McMillan Press.
4. Madigan MT, Martinko JM and Parker J. (2003). *Brock Biology of Microorganisms*. 10th edition. Pearson/ Benjamin Cummings.
5. Abbas AK, Lichtman AH, Pillai S. (2007). *Cellular and Molecular Immunology*. 6th edition Saunders Publication, Philadelphia.
6. Delves P, Martin S, Burton D, Roitt IM. (2006). *Roitt's Essential Immunology*. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
7. Goldsby RA, Kindt TJ, Osborne BA. (2007). *Kuby's Immunology*. 6th edition W.H. Freeman and Company, New York.

**TITLE: GENERAL MICROBIOLOGY & IMMUNOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs.
3. Preparation of stained blood film to study various types of blood cells.
4. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
7. Demonstration of: a. ELISA b. Immuno-electrophoresis.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-V****DISCIPLINE SPECIFIC ELECTIVE COURSE II****TITLE: CLINICAL BIOCHEMISTRY****Course Code: SERDSE2 (B)****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to conceptualize:

1. Clinical biochemistry, cutting-edge technologies and its importance.
2. Application of clinical biochemistry in evaluation of various diseases.

**Course Contents:****Unit- I: Introduction**

1. Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid.
2. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.

**Unit- II: Evaluation of biochemical changes in diseases**

1. Basic hepatic, renal and cardiovascular physiology.
2. Biochemical symptoms associated with disease and their evaluation.

**Unit- III: Assessment of glucose metabolism in blood**

1. Clinical significance of variations in blood glucose - Diabetes mellitus.

**Unit- IV: Lipid profile**

1. Composition and functions of lipoproteins.
2. Clinical significance of elevated lipoprotein.

**Unit- V: Renal function tests and urine analysis**

1. Use of urine strip / dipstick method for urine analysis.

**Unit- VI: Tests for cardiovascular diseases**

1. Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

**Suggested Readings**

1. T.G. Cooper: *Tool of Biochemistry*.
2. Keith Wilson and John Walker: *Practical Biochemistry*.
3. Alan H Gowenlock: *Varley's Practical Clinical Biochemistry*.
4. Thomas M. Devlin: *Textbook of Biochemistry*.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
6. Talwar, G.P. & Srivastava, M. *Textbook of Biochemistry and Human Biology*, 3rd Ed. PHI Learning.
7. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry* 7th Ed., W. H. Freeman.
8. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles
9. *Harwood Series on Analytical Chemistry*, John Wiley & Sons, 1979.

CONFIDENTIAL



**TITLE: CLINICAL BIOCHEMISTRY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Collection of blood and storage.
2. Separation and storage of serum.
3. Estimation of blood glucose by glucose oxidase peroxidase method.
4. Estimation of triglycerides.
5. Quantitative determination of serum creatinine and urea.
6. Estimation of creatine kinase MB.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-VI****DISCIPLINE SPECIFIC ELECTIVE COURSE III****TITLE: GENOMICS & PROTEOMICS****Course Code: SERDSE3 (A)****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to understand:

1. Basic concept of genomics and proteomics.
2. Structure, functions and evolution of human genome.

**Course Contents:****Unit- I: Protein structure**

1. Secondary structure and super-secondary structure.
2. Mechanisms of protein folding, tertiary folds. Formation of oligomers.
3. Relationship between protein structure and function. Prions.

**Unit- II: Proteomics**

1. Structure prediction and human proteomics. Mutant proteins.
2. Use of computer simulations and knowledge-based methods in the design process.
3. De-novo design; making use of databases of sequence and structure.
4. Protein structure and drug discovery, Proteins in disease.

**Unit- III: Genomics**

1. The structure, function and evolution of the human genome.
2. Strategies for large-scale sequencing projects. Human disease genes. Expression.

**Unit- IV: Bioinformatics**

1. Bioinformatics for the analysis of sequence data.
2. Approaches for determining gene expression patterns and functions.

**Suggested reading:**

1. Russell, P. J. (2009). *iGenetics- A Molecular Approach*. III Edition. Benjamin Cummings.
2. Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. ASM Press, Washington.
3. Pevsner, J. (2009). *Bioinformatics and Functional Genomics*. II Edition. John Wiley & Sons.

**TITLE: GENOMICS & PROTEOMICS****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. RAPD and electrophoresis/ DNA fingerprinting by PCR.
2. Estimation of amino acids by Sorenson's method.
3. Estimation of proteins in liver of rat/mouse by Lowry's method.
4. Homology sequence analysis using BLAST.
5. Protein 3D structure visualization by Rasmol.
6. Multiple sequence analysis.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-VI

#### DISCIPLINE SPECIFIC ELECTIVE COURSE III

#### TITLE: NON-MULBERRY SERICULTURE

Course Code: SERDSE3 (B)

(Credits: Theory-4; Practicals-2)

#### THEORY

Contact Hours per week	: 4	Maximum Marks	: 40
Examination Duration	: 2 hours	Internal	: 10
		ESE	: 30

#### Course Objectives:

After completion the course the learners will be able to understand:

3. Different types of non-mulberry silks and their importance.
4. Management of non-mulberry sericulture for maximization of production etc.

#### Course Contents:

##### Unit-I: Introduction to Non-mulberry Sericulture

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

##### Unit-II: General account of different types of non-mulberry sericulture

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

**Unit-III: Non-mulberry silkworm seed production, diseases/pests & their management**

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

***Suggested Readings***

1. Chowdhury, S.N. (1998) *Muga Culture*. Central Silk Board, Bangalore, India
2. Dokuhon, Z.S. (1998). *Illustrated Textbook on Sericulture*. Oxford & IBH publishing Co., Pvt. Ltd. Calcutta.
3. Jolly, M.S. Chowdhuty, S.N and Sen. (1975). *Non-Mulberry Sericulture in India*. Central Silk Board, Bombay, India.
4. Jolly, M.S (1998). *Tasar Culture*. Central Silk Board, Bangalore, India.
5. Sarkar, D.C. (1998) *Eri Culture*. Central Silk Board, Bangalore

**TITLE: NON-MULBERRY SERICULTURE****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Rearing appliances used in rearing and seed preparation of non mulberry silkworms (drawing sketches).
2. Taxonomic features of non-mulberry food plants (*Terminalia arjuna*, *Terminalia catapa*, *Ricinus communis*, *Michilia champaca*, *Quercus sp.*, *Bauhinea vareigata* and *Manihot utilissima*).
3. Life cycle and morphology of egg, larva, pupa, cocoon and moths of different non-mulberry silkworms.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-VI****DISCIPLINE SPECIFIC ELECTIVE COURSE IV****TITLE: ECOLOGY****Course Code: SERDSE4 (A)****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to study:

1. Various concepts of ecology and its significance.
2. Ecology and sericulture.

**Course Contents:****UNIT I: Concept of Ecosystem**

1. Components, Basic properties, Principles, Examples.

**UNIT II: Energy flow**

1. Energy flow through trophic levels and Ecological pyramids.

**UNIT III: Population Dynamics**

1. Natality, Mortality, Growth forms, Regulation of population density.

**UNIT IV: Community Structures and Function**

1. Characteristics, Types, Niche Concepts, Resource partitioning.

**UNIT V: Ecological Succession**

1. Concept of Community change, Theories of Succession, Model of Succession.

**UNIT VI: Environmental pollution**

1. Air and Water pollution, Global Warming, Acid Rain, Eutrophication.

**UNIT VII: Environmental hazards in Sericulture**

1. Pollutants and their effects on Silkworm and Mulberry.

**TITLE: ECOLOGY****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method).
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.

**Suggested Readings**

1. Colinviaux, P. A. (1993). *Ecology*. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). *Ecology*. VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). *Fundamentals of Ecology*. Indian Edition. Brooks/Cole
4. Robert Leo Smith *Ecology and field biology* Harper and Row publisher
5. Ricklefs, R.E., (2000). *Ecology*. V Edition. Chiron Pres



**B.Sc. SERICULTURE (HONOURS)****SEMESTER-VI****DISCIPLINE SPECIFIC ELECTIVE COURSE IV****TITLE: BIOSTATISTICS****Course Code: SERDSE4 (B)****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Objectives:**

After completion the course the learners will be able to study:

1. Various theories of biostatistics and its application.

**Course Contents:****UNIT I: Sampling**

1. General idea and method.

**UNIT II: Measures of Central Tendency**

1. Mean, Mode and Median; General idea and Simple problem solving.

**UNIT III: Probability**

1. General idea about probability.

**UNIT IV: Test of Significance**

1. Student's t-Test.

**UNIT V: Goodness of fit**

1. Chi-Square Test.

**Suggested Readings**

1. Concerned literatures will be communicated by the faculty members.

**TITLE: BIOSTATISTICS****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

## 4. Data Analysis –

- Mean
- Mode
- Median
- Standard Deviation
- Probability

## 2. Hypothesis testing-

- Chi-square
- t-test.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-III****SKILL ENHANCEMENT COURSE I****TITLE: APICULTURE****Course Code: SERHSEC1 (A)****(Credits: Theory-2)****THEORY**

**Contact Hours per week : 2**  
**Examination Duration : 1.5 hours**  
**Maximum Marks : 20**

**Course Contents:****Unit-I: Biology of Bees**

1. History, Classification and Biology of Honey Bees.
2. Social Organization of Bee Colony.

**Unit-II: Rearing of Bees**

1. Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage.
2. Selection of Bee Species for Apiculture, Bee Keeping Equipment, Methods of Extraction of Honey (Indigenous and Modern).

**Unit-III: Diseases and Enemies**

1. Bee Diseases and Enemies.
2. Control and Preventive measures.

**Unit-IV: Bee Economy**

1. Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis, Pollen etc).

**Unit V: Entrepreneurship in Apiculture**

1. Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.
2. Queen rearing, low cost nursery raising techniques, value addition from bee-wax etc.

**Suggested Readings**

1. Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
2. Bisht D.S., *Apiculture*, ICAR Publication.
3. Singh S., *Beekeeping in India*, Indian council of Agricultural Research, NewDelhi.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-III****SKILL ENHANCEMENT COURSE I****TITLE: MUSHROOM CULTURE****Course Code: SERHSEC1 (B)****(Credits: Theory-2)****THEORY****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 1.5 hours****Course Contents:****Unit-I: Introduction mushroom**

1. History. Nutritional and medicinal value of edible mushrooms;
2. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.

**Unit-II: Cultivation Technology**

1. Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag.
2. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

**Unit-III: Storage and nutrition**

1. Short-term storage (Refrigeration - upto 24 hours), Long term Storage (canning, pickles, papads), drying, storage in salt solutions.
2. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

**Unit-IV: Food Preparation**

1. Types of foods prepared from mushroom.
2. Research Centres - National level and Regional level.
3. Cost benefit ratio - Marketing in India and abroad, Export Value.

**Suggested Readings**

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) *Oyster Mushrooms*, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) *Food and Nutrition*. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). *Mushroom cultivation*, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) *Hand book of Mushrooms*, II Edition, Vol. I & Vol. II.

## B.Sc. SERICULTURE (HONOURS)

### SEMESTER-IV

#### SKILL ENHANCEMENT COURSE II

#### TITLE: ENTREPRENEURSHIP DEVELOPMENT PROGRAMME (EDP)

Course Code: SERHSEC2 (A)

(Credits: Theory-2)

#### THEORY

Contact Hours per week : 2  
 Examination Duration : 1.5 hours  
 Maximum Marks : 20

#### Course Contents:

##### Unit-I: Entrepreneurship development programme (EDP)

1. Emergence and objectives of EDP.
2. Essential qualities to become an entrepreneur.
3. Selection of a potential entrepreneur.

##### Unit-II: Planning for EDP

1. Objectives, selection of a centre.
2. Purpose of pre-training promotional work.

##### Unit-III: Follow-up for EDP

1. Need, extent and mechanism.
2. Facilitating follow-up.
3. Approach to competence development.

##### Unit-IV: Concept of Cluster Development

1. Principles and Methodology.
2. Government support etc.

##### Unit-V: Project formulation (project appraisal)

1. Meaning and purpose, personnel / agencies interested in project appraisal.
2. Market feasibility of the project, technical and market analysis.
3. Means of finance, profitability, risk analysis and liquidity management.
4. Agencies supporting sericulture projects.

##### Unit-VI: Marketing

1. Approach and essence.
2. Market assessment – demand and supply.
3. Steps involved in market study.

#### Suggested Readings

1. Deshpande M.V. (1984) *Entrepreneurship of Small-Scale Industries: Concept, Growth & management*, Deep & Deep Publication, D-1/24, Rajouri Garden, New Delhi.

**B.Sc. SERICULTURE (HONOURS)****SEMESTER-IV****SKILL ENHANCEMENT COURSE II****TITLE: HERBAL TECHNOLOGY****Course Code: SERHSEC2 (B)****(Credits: Theory-2)****THEORY**

**Contact Hours per week : 2**  
**Examination Duration : 1.5 hours**  
**Maximum Marks : 20**

**Course Contents:****Unit-I: Herbal medicines**

1. History and scope - definition of medical terms - role of medicinal plants in herbal medicine.
2. Cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

**Unit-II: Pharmacognosy**

1. Systematic position, medicinal uses of the following herbs in curing various ailments- (Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka).

**Unit-III: Phytochemistry**

1. Active principles and methods of testing.
2. Identification and utilization of the medicinal herbs - *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

**Unit-IV: Analytical pharmacognosy**

1. Drug adulteration - types, methods of drug evaluation.
2. Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

**Unit-V: Medicinal plant banks**

1. Micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy).

**Suggested Readings**

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

## GENERAL ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF SERICULTURE FOR THE UG STUDENTS OF OTHER DEPARTMENTS

### GENERAL ELECTIVE COURSE I

#### TITLE: SCIENCE OF SERICULTURE

**Course Code: SERHGE1**

**(Credits: Theory-4; Practicals-2)**

#### THEORY

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

#### Course Contents:

##### Unit-I: Basic concept of Sericulture

1. Characteristic features and advantages of sericulture; scope of sericulture in India-employment potential and income generation; role of women in sericulture.
2. Sericulture Organization in India: extension systems- Central Silk Board, state sericulture departments, universities and voluntary organizations.
3. Introduction to textile fibres: types- natural/synthetic and their properties; importance of silk fibre.
4. General account of silkworm egg production and demand, sex separation, pairing and depairing, oviposition, sheet and loose egg preparation, mother moth examination, acid treatment, surface sterilization, washing, packing and sale of eggs.
5. Life cycle of *Bombyx mori*, rearing house and equipments, disinfection and hygiene, Rearing operations, brushing, young and late age silkworm rearing, moulting, mounting, spinning, cocoon harvesting and marketing.

##### Unit-II: Basic concept of Moriculture

1. Host plants of mulberry and non-mulberry silkworms. Mulberry cultivars – tropical and temperate regions, irrigated and rainfed conditions.
2. Propagation of mulberry – sexual and asexual (cuttings, grafting and layering).
3. Establishment of mulberry garden: Selection of land / soil, preparation and planting.
4. Package of practices for mulberry cultivation under rainfed and irrigated conditions.
5. Biomedical importance of mulberry and silkworm.

#### Suggested Readings

1. Ganga, G., and J. Sulochana Chetty. (1991) *An introduction to sericulture*. Oxford & IBH Publishing Company.
2. Hasao Aruga (1994). *Principles of Sericulture (Translated from Japanese )* Oxford & IBH publishing Co., Pvt. Ltd. New Delhi.
3. Krishnaswami, S.; Narasimhanna, M.N.; Suryanarayan, S.K and Kumararaj, S. (1973) *Sericulture Manual-2 - Silkworm Rearing*. Agriculture Service Bulletin, FAO, Rome.
4. Madan Mohan Rao, M. (1999) *Comprehensive Sericulture Manual*. PS Publications, Hyderabad.

**TITLE: SCIENCE OF SERICULTURE****(Credits: Theory-4; Practicals-2)****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 25****Examination Duration : 2 hours****Course Contents:**

1. Salient features of popular mulberry cultivars.
2. Life cycle of the mulberry silkworm.
3. Characteristic features of popular bivoltine and multivoltine races of silkworm.
4. Sorting, processing of seed cocoons for egg production.
5. Sexing of pupae and moths.



**GENERAL ELECTIVE COURSE II****TITLE: MULBERRY BIOLOGY, PRODUCTION AND PROTECTION****Course Code: SERHGE2****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Contents:****Unit-I: Biology of Mulberry**

1. Phytogeography, taxonomy and systematics of mulberry. Distribution and economic importance of primary and secondary host plants of tasar, eri and muga silkworms.
2. Reproductive biology of mulberry: Sexual polymorphism; male and female flowers, pollination, fertilization, embryo and seed of mulberry; polyembryony and parthenocarpy.
3. Anatomy of root, stem and leaf of mulberry; secondary growth – structure and organization of shoot and root meristems.

**Unit-II: Production of Mulberry**

1. Soils for mulberry cultivation: Soil profile and classification; physical, chemical and biological properties; soil sampling and testing; problematic soils and their reclamation.
2. Weather elements, climatic factors on growth and productivity of mulberry.
3. Propagation of mulberry: Sexual and asexual methods (cuttings, grafting and layering), types and techniques – significance.
4. Raising of nursery for large scale production of saplings (Kisan nursery) and its economics.
5. Assessment of mulberry leaf yield and quality and its importance.

**Unit-III: Protection of Mulberry**

1. Pests and diseases of mulberry - classification and status.
2. Major and minor diseases of mulberry: Causal organism, symptomatology, seasonal incidence, disease cycle, yield and quality loss and their management.
3. Major and minor pests of mulberry: Life cycle, symptoms of attack, seasonal occurrence, nature of damage and their management.
4. Integrated pest and disease management – concepts, principles and essential components. Pest and disease forecasting and outbreak.

**TITLE: MULBERRY BIOLOGY, PRODUCTION AND PROTECTION****(Credits: Theory-4; Practicals-2)****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Morphology of mulberry.
2. Anatomy of stem and root of mulberry.
3. Raising of saplings - cutting preparation, planting and maintenance of nursery.
4. Grafting and layering in mulberry.
5. Planting methods – row and pit systems and tree planting.
6. Identification and study of leaf, stem and root diseases of mulberry.

**Suggested Readings**

1. *FAO Manuals- I Mulberry cultivation. FAO Rome.*
2. *Foth, H.D. (1984) Fundamentals of Soil Science. 7th Edn., John Wiley & Sons, New York.*
3. *Kichisaburo M. (1997) Moriculture – Science of Mulberry Cultivation. Oxford & IBH*
4. *Rajanna, L., Das, P.K., Ravindran, S., Bhogsha, K., Mishra, R.K., Singhvi, N.R., Katiyar, R.S. and Jayaram, H. (2005) Mulberry Cultivation and Physiology. Central Silk Board, Bangalore.*
5. *Rangaswami, G.; Narasimhanna, M.N.; Kasiviswanathan, K., Sastry, C.R. and Jolly, M.S. (1976) Sericulture Manual-I- Mulberry cultivation. Agriculture Services Bulletin, FAO, Rome.*
6. *Ravichandra N.G (2013). Fundamentals of Plant Pathology. Prentice Hall India Learning Private Limited.*
7. *Dube H.C. (2007). A Textbook of Fungi, Bacteria and Viruses (Student Edition). Agrobios India.*
8. *Agrios (2006). Plant Pathology. Elsevier; Fifth edition (22 September 2006).*
9. *Mulberry Crop Protection, Central Silk Board, Bangalore, India.*

**GENERAL ELECTIVE COURSE III****TITLE: SILKWORM BIOLOGY, COCOON PRODUCTION AND PROTECTION****Course Code: SERHGE3****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Contents:****Unit-I: Biology of Silkworm**

1. Metamorphosis in insects, Morphology and life cycle of mulberry and non-mulberry silkworms - egg, larva, pupa and adult.
2. Anatomical features of silkworm: Digestive, circulatory, excretory, nervous and respiratory systems and silk gland, reproductive systems of silk moth.
3. Classification of silkworm races/breeds.

**Unit-II: Cocoon Production**

1. Planning for silkworm rearing: Estimation of leaf yield and quality and brushing.
2. Rearing houses: Selection of building site, rearing houses for young and late age silkworms.
3. Concept of disinfection and hygiene in silkworm rearing.
4. Rearing technology for young and late age silkworm.
5. Mounting, harvesting and marketing of silkworm cocoon.

**Unit-III: Cocoon Protection**

1. Pests and diseases of silkworm - classification and status.
2. Major and minor diseases of silkworm: Causal organism, symptomatology, seasonal incidence, disease cycle, yield and quality loss and their management.
3. Major and minor pests of silkworm: Life cycle, symptoms of attack, seasonal occurrence, nature of damage and their management.
4. Integrated pest and disease management – concepts, principles and essential components. Pest and disease forecasting and outbreak.

**TITLE: SILKWORM BIOLOGY, COCOON PRODUCTION AND PROTECTION****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Morphology of silkworm.
2. Dissection of silkworm digestive system and silk gland.
3. Characteristic features of popular bivoltine and multivoltine races/breeds of silkworm.
4. Preparation of model rearing house.
5. Conducting silkworm rearing and maintenance of records of silkworm rearing.
6. Visit to silkworm rearing houses and preparation of field reports.
7. Disinfection and hygiene practices during silkworm rearing.

**Suggested Readings**

1. Charsley, S.R. (1982). *Culture and Sericulture*. Academic Press Inc., New York, U.S.A
2. Ganga, G., and J. Sulochana Chetty. (1991) *An introduction to sericulture*. Oxford & IBH Publishing Company.
3. *Manual-2 - Silkworm Rearing*. Agriculture Service Bulletin, FAO, Rome.
4. Madan Mohan Rao, M. (1999) *Comprehensive Sericulture Manual*. PS Publications, Hyderabad.
5. S. Morohoshi (2001). *Development Physiology of Silkworms*. Science Publishers, U.S.
6. Yataro Tazima (2001). *Improvement of Biological Functions in the Silkworm*. Science Publishers
7. M Amin Masood and Afifa S Kamili (2000). *Principles of temperate sericulture*. Kalyani Publisher.
8. *Silkworm Crop Protection*, Central Silk Board, Bangalore, India.

**GENERAL ELECTIVE COURSE IV****TITLE: ADVANCED CONCEPT IN SERIBIOTECHNOLOGY****Course Code: SERHGE4****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Contents:****Unit-I: Basic concept of biotechnology**

1. DNA replication, transcription and translation.
2. Whole Genome Sequence of the silkworm, *Bombyx mori*: -sequence method and strategies, genome features, genomic resources and application. Mulberry chloroplast genome – method and properties.

**Unit-II: Genome mapping in mulberry**

1. Molecular markers and their application in genome analysis.
2. Molecular linkage and genetic map – construction based on RFLP, RAPD, AFLP, SSR and ISSR.
3. Physical map – construction based on clone (BAC-FISH), ESTs, STSs. Long range restriction mapping (with special reference to silkworm).

**Unit-III: Comparative and functional genomics**

1. A brief account on Bombyx, C. elegans, Drosophila, human and rice genome projects and their relationship.
2. Gene variation and SNPs, SNPs and disease associations, repetitive and coding sequences, transcriptome.
3. DNA chip and micro array in functional genomics.

**Unit-IV: Basic concept of immunity**

1. Immunity types, organs associated with immunity, antigens and their features, antigen-antibody reactions.
2. Cells associated with immune system: Origin of cells, types of cells-lymphocytes, null cells, monocytes, polymorphonuclear leucocytes, mast cells, antigen presenting cells, platelets, Immune system in insects with special reference to *Bombyx mori*.

**TITLE: ADVANCED CONCEPT IN SERIBIOTECHNOLOGY****(Credits: Theory-4; Practicals-2)****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Estimation of chlorophyll content in mulberry leaf.
2. Estimation of nitrogen content in mulberry leaf (Kjeldahl method).
3. Estimation of protein by – Lowry method, Bradford method.
4. Isolation of genomic DNA.
5. Quality and quantity checking of DNA and RNA by UV spectrophotometer.
6. Demonstration of RFLP and RAPD in plants.
7. Qualitative analysis of secondary metabolites in plant.

**Suggested reading:**

1. Brown, T. A. (2016). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
2. Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. ASM Press, Washington.
3. Kundu, S. (Ed.). (2014). *Silk biomaterials for tissue engineering and regenerative medicine*. Elsevier.
4. Murray, D.R. (1991) *Advanced Methods in Plant Breeding Biotechnology*. CAB, International, Wallingford, Oxon, United Kingdom.
5. Pevsner, J. (2009). *Bioinformatics and Functional Genomics. II Edition*. John Wiley & Sons.
6. Russell, P. J. (2009). *iGenetics- A Molecular Approach. III Edition*. Benjamin Cummings.

**GENERAL ELECTIVE COURSE V****TITLE: SERICULTURE EXTENSION AND ECONOMICS****Course Code: SERHGE5****(Credits: Theory-4; Practicals-2)****THEORY**

<b>Contact Hours per week</b>	<b>: 4</b>	<b>Maximum Marks</b>	<b>: 40</b>
<b>Examination Duration</b>	<b>: 2 hours</b>	<b>Internal</b>	<b>: 10</b>
		<b>ESE</b>	<b>: 30</b>

**Course Contents:****Unit-I: Basic concept of extension**

1. Extension Education - Definition, meaning, origin and growth.
2. Attributes and training of Extension work.
3. Community development programmes- role of extension in rural development.
4. Sericulture as a tool for rural development.

**Unit-II: Sericulture Extension Organizations**

1. Organizations at various level-development, research, training and policy at state and national levels.
2. Sericulture service net work- B. S. F., Seed area, grainages, nurseries, CRC, TSCs, Cocoon Markets, filature, Silk exchanges and cocoon certification centres.

**Unit-III: Marketing management**

1. Sericultural marketing organizations- seed, cocoon, raw silk and silk fabric.
2. Traditional and regulated markets-merits and limitations.
3. Government intervention - legislation, implications. Marketing institutions- marketing boards, co-operatives, stabilization of price.

**Unit-IV: Economics and sericulture**

1. Principles of economics, micro and macro economics.
2. Classification of costs – explicit and implicit, fixed, variable, marginal, average; profits – gross and net.
3. Sericulture and income generation.
4. Economics of sericulture, value addition, profitability vis-à-vis other cash crops.

**Suggested Readings**

1. Dhama, O.P. and Bhatnagar (1984): *Education and communication for development*
2. *FAO Agricultural Extension Manual (Second edition).*
3. Kumaresan, P. and Srinivasa, G. (2005) *Sericulture Extension Management and Economics*. Central Silk Board, Bangalore.
4. Mc Grath, E.H (1986): *Basic managerial skill for all*. Prentice Hal of India Pvt, Ltd., New Delhi

**TITLE: SERICULTURE EXTENSION AND ECONOMICS****(Credits: Theory-4; Practicals-2)****PRACTICAL****Contact Hours per week : 2****Maximum Marks : 20****Examination Duration : 2 hours****Course Contents:**

1. Preparation of leaflets and flash cards on various activities of sericulture.
2. Preparation of comparative charts on economic significance of sericulture with other cash crops.
3. Preparation of tabular chart on various economic activities associated with sericulture and its importance to eradicate rural poverty.
4. Visit to museum of Extension Division of CSRTI, Mysore.
5. Visit to field and farmers rearing house to study sericulture technologies adopted.
6. Preparation of report based on field studies.