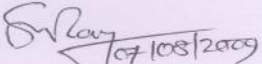


REVISED SYLLABUS
FOR THREE YEARS B.Sc. (MAJOR) COURSE
IN
SERICULTURE
According to the New Examination Pattern
Part – I, Part- II & Part- III
WITH EFFECT FROM THE SESSION
2009 – 2010


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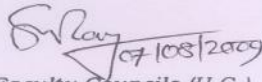
University of Kalyani

Revised Syllabus of Sericulture (Major Course)

(w.e.f. the session 2009-2010)

Content

Part-I			
Paper-I	Group-A : General Sericulture	(M -1)	
	Group-B : Biology of Silkworm and Silkworm rearing Technology	(M -2)	
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Paper- III	Group-A : Soil Science & Biology of Mulberry	(M -5)	
	Group-B : Diseases and pests of mulberry & Silkworm	(M -7)	
Paper- IV	Practical	(M -9)	
Part-III			
Paper- V	Group-A : Genetics and Breeding of Mulberry & Silkworm	(M -12)	
	Group-B : Silkworm seed Technology	(M -13)	
Paper- VI	Group-A : Silk Technology	(M -14)	
	Group-B : Non-mulberry Sericulture & Sericulture Extension, Organization and management	(M -15)	
Paper- VII	Practical	(M -17)	
Paper- VIII	Entrepreneurship Development	Group-A	(M -19)
		Group-B	(M -22)


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PART - IPaper – I

Full Marks – 100

Group – A : General Sericulture**50 Marks**No. of Lectures

- | | |
|--|---|
| 1. Introduction to Sericulture, scope | 1 |
| 2. Origin and history of Sericulture, silk route | 2 |
| 3. World output of silk, other natural fibres and man made fibres.
Importance of natural fibres vis-à-vis man made fibres – Role of silk fibres amongst natural fibres. | 2 |
| 4. Silk industry in the World- Silk industry in China, Japan, South Korea, North Korea, India, USSR, France, Italy, Brazil, Thailand, Iran, Sri Lanka, Bangladesh, Pakistan and other countries | 3 |
| 5. Silk industry in India, West Bengal, Jammu & Kashmir, Karnataka, Tamil Nadu, Andhra Pradesh and other states (Mulberry and non - Mulberry Sericulture). Mulberry area Cocoon production, silk production, Number of reeling units (Charka, Cottage, Basin, Filature basin, Handlooms and Powerlooms. | 4 |
| 6. Prospects and problems of Sericulture, Qualities of different types of Textile fibres - Advantages of silk fibres over other fibres – International demand for silk – constraints in silk production like labour, land, environmental conditions, skill and production cost. | 4 |
| 7. Organisation of Sericulture industry in India – Government of India – Central Silk Board – State Departments of Sericulture | 4 |
| 8. Mulberry silkworm and its food plants – Mulberry sericulture – Silkworm races
Classification of Mulberry silkworm on the basis of its origin and voltinism. | 4 |
| 9. Non-mulberry – their food plants. Different species of non -mulberry silkworm. | 4 |
| Brief account of :
a) Tasar food plants
b) Muga food plants
c) Eri food plants | |
| Types of cocoon and silk produced by them | 5 |
| 10. Out line of different reeling machineries and reeling process. History of Reeling Industry- Charka- Cottage basin- Filature basin- Multi end basin
Semiautomatic and Automatic reeling machinery - Different types of cocoon stifling – Different types of cocoon cooking – Principles of reeling, reeling process. | 4 |

	<u>No. of Lectures</u>
11. Marketing of cocoon and silk – Marketing set-up in different States – Market operation – cocoon and silk – cocoon grading – Silk grading – Brief idea of Silk Conditioning and Testing.	4
12. Employment Generation 0.4 hectare under rainfed and Irrigated Mulberry	
i) Direct a) Up to Raw silk b) Up to Fabric production	
ii) Indirect a) Marketing b) Materials and Machinery Manufacturing	
13. Seed organization- Need for seed organization- seed cocoon production at different levels- Silkworm egg production. a) Pure b)Hybrid	4
14. Twisting and weaving- Twisting machinery and processing – Handloom Weaving (Different types) Power loom weaving (Different types) printing - Dyeing Calendaring and Finishing.	4
15. Utilization of by products and Seri wastes.	
16. Role of women in Sericulture – women participation in Mulberry garden and Rearing management – silk reeling – Weaving and Finishing.	2

Group – B : Biology of Silkworm and Silkworm rearing Technology

50 Marks

Silkworm Biology

	<u>No. of Lectures</u>
1. System position of silkworm, salient features of silkworm order. Geographical distribution of serigenenous insects.	2
2. Life history of <u>Bombyx mori</u> - morphology of egg, larva, pupa and adult	3
3. Morphology and anatomy of following organ systems of silkworm a) Digestive including mouth parts b) Reproductive c) Excretory d) Nervous system	3
4. Morphology of silk gland silk proteins and their synthesis.	2
5. Moulting – structure of integument and cuticle, Formation and shedding of cuticle, hormonal control.	3
6. Silkworm metamorphosis – hormonal control	2
7. Embryology : Structure of egg – development stages – blastokinesis – eyespot and blue egg stage – hatching.	3
8. Nutrition : Factors influencing – silkworm growth and development.	3

<u>Rearing Technology</u>	<u>No. of Lectures</u>
9. Rearing House : Requirements for ideal rearing house – site selection- size of rearing house. Orientation – Model rearing house - B Model – advantages and disadvantages rearing houses.	2
10. Rearing appliances – design and cost requirements of caring appliances for 100 dfls.	1
11. Disinfection – Importance – different disinfectants – types – effective Concentration – method of preparation – usage – time of disinfections – Requirement – disinfections per unit area – estimation of surface area of rearing house.	
12. Selection of silkworm races/breeds for rearing – advantages and disadvantages of bivoltine, multivoltine and their hybrids.	2
13. Estimation of leaf quality – time for estimation of leaf yield – calculation of brushing capacity based on yield.	
14. Incubation (brief idea) – environmental conditions required for incubation – their influence in egg development – incubation method – low cost- incubation devices – earthen pot, double brick wall chamber –black boxing.	1
15. Brushing – methods – loose eggs and short eggs – capping and net Method – selection of Leaf brushing – advantages and disadvantages of different types of brushing – cellular and mass brushing.	2
16. Harvesting of leaf – method- time- transportation and storage of leaf for chawki.	2
17. Chawki rearing – importance-environmental conditions required-leaf requirement- selection of different chawki - use of nets and feeding schedules - spacing- chawki rearing centers - labour requirements.	2
18. Moulting –symptom – care during pre moulting – moulting and post moulting periods.	2
19. Late age rearing, spacing – leaf requirement-environmental conditions required – frequency of feeding - bed cleaning schedule.	2
20. Rearing methods – shelf, shoot and floor rearing –advantages and disadvantages- rational utilization of mulberry leaves – bed clearing methods – appliances – labour requirement.	2
21. Preparation of moulting – methods- manual, shelf and jebrai methods- advantages and disadvantages -types of mountages –bamboo, plastic, revolving and rotary collapsible brush mountages - advantages and disadvantages of their use, spinning – environmental conditions required for spinning.	3
22. Harvesting of cocoons – time harvesting – hybrid crop of cocoons – preservation and transportation of cocoons.	2
23. Mountages : Different types and its advantages.	
24. Cocoon assessment – significance –cost of cocoon production cocoon ratio - maintenance of rearing records.	2

Paper – II (Practical)**Full Marks – 100****A. General Sericulture : (Marks 25)**

1. Sericulture maps -
 - a) World map of silk road
 - b) India
2. Organisation set up in India –
 - a) Government of India
 - b) Five traditional states- Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal, Jammu and Kashmir.
3. Identification and study of sericulture production :
 - a) Cotton and silk yarn types
 - b) Pupae
 - c) Silk waste
 - d) Spun yarn
 - e) Nail yarn
 - f) Other byproducts
4. Preparation of Histograms on World out put :
 - a) of silk and other textile fibre
 - b) World out put of silk fibre of different countries
5. Preparation of line graph on trend of silk yarn and other textile fibre production over a period of 10 years.
 - a) Pie-chart on out put of different types of silk production in India
 - b) Pie-chart on Mulberry silk production in different States.

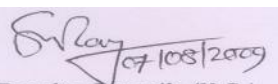
B. Silkworm Biology : (Marks 25)

6. **Morphology :**
 - a) Mouth parts of silkworm
 - b) External morphology of larva, pupa and moth
 - c) Sex separation of larva, pupa and moth
7. **Anatomy :**
Digestive system, silk gland, nervous system, reproductive system of silkworm.
8. Cocoon characters of uni, bi and multivoltine races.
9. Mounting of different stages of embryos.

C. Rearing Technology : (Marks 25)

10. Rearing appliances – utilization of rearing appliances for 100dfles.
11. Effective concentration of disinfectants, preparation of disinfectants – Uzi control-use of nets.
12. Incubation of silkworm eggs – black boxing and hatching, recording temperature and humidity.
13. Mulberry leaf estimation – harvesting – preservation techniques – leaf selection for different instars.
14. Identification of moulting larva.
15. Assessment and preparation of harvest report – mountages.

D. Viva – Voce : (Marks 15)**E. Laboratory note book : (Marks 10)**


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PART – IIParer – III**Full Marks - 100**

Question no. 1 of 10 marks , short/ objective type is compulsory. Answer any six questions from the rest, taking at least one from each unit not more than two from each unit.

Group – A : Soil Science & Biology of Mulberry**Unit – I : Soil Science****25 Marks**No. of Lectures

- | | |
|--|---|
| 1. Soil Formation-an interactive influence of soil forming factors; and soil profile development. | 2 |
| 2. Different types of soil – basics of soil classification | 2 |
| 3. Physical properties of soil | 5 |
| i) Volume constitution of soil | |
| ii) Soil texture – a) Soil separates b) Soil textural Classes | |
| iii) Soil Structure- a) Type b)Importance c) Ways to improve soil structures | |
| iv) Soil colour | |
| v) Soil permeability- a)Soil bulk and particle density b) soil porosity c) permeability
As related to soil texture and structure. | |
| vi) Soil air. | |
| 4. Soil Water: | 4 |
| i) Importance of water | |
| ii) Physical and biological classification of soil water | |
| iii) Soil moisture content and their measurement | |
| iv) Soil moisture calculation relating to irrigation schedule | |
| v) Forms of soil water mulberry growth | |
| vi) Water requirements of mulberry | |
| vii) Factors affecting soil water holding capacity including capillary rise and leaching | |
| viii) Soil water conservation and management. | |
| 5. Soil organic matter: | 3 |
| i) Soil organic and chemical nature of its constituents. | |
| ii) Importance of soil organic matter | |
| iii) Carbon : Nitrogen ration of organic matter and its significance | |
| iv) Soil micro organism : Types role in mineral nutrition. | |
| 6. Mulberry growth and nutrition: | 3 |
| i) Elements (nutrients) essential for plant growth and their classification | |
| ii) Forms of elements taken up by plants, their absorption and utilization | |
| iii) Sources of nutrient elements in the soil | |
| iv) Role of essential elements in plant growth | |
| v) Deficiencies/ and toxicity | |
| 7. Importance of soil types of India related to mulberry cultivation | 4 |
| i) Alluvial soils | |
| ii) Black soils | |
| iii) Red soils | |
| iv) Laterites and lateritic soils | |
| 8. Soil testing for various chemical and physical properties. | 2 |

Unit -II Biology of Mulberry**25 Marks**

		<u>No. of Lectures</u>
9.	Biology of mulberry	2
	i) Taxonomy of mulberry and popular mulberry cultivars	
	ii) Morphology and anatomy of mulberry (stem, root and leaf)	
	iii) An outline of floral biology of mulberry: flower, fruit and seed development	
10.	Different Agro climates of mulberry	1
11.	Propagation of mulberry	4
	i) Seedlings : Collection of viable seeds, methods of raising seedlings variability.	
	ii) Saplings : Selection of material for cuttings and its anatomical and physiological criteria : preparation and selection of cuttings	
	iii) Grafting: Selection of stock and scion materials and their anatomical and physiological: Types of grafting- Stem, Root and bud grafting techniques.	
	iv) Layering : Types and techniques	
	v) Raising of nursery: preparation, layout, bed size, soil composition, importance of drainage.	
	vi) Use of growth regulators in mulberry propagation	
12.	Establishment of mulberry gardens:	7
	i) Strategies of long term basis: Intensive cultivation for high leaf productivity and quality	
	ii) Cropping patterns : mono crop and mixed crop	
	iii) Selection and preparation of site	
	iv) Selection of varieties for cultivation	
	v) Different planting materials and their practical relevance in various agro climate conditions	
	vi) Planning systems : advantages and disadvantages and recommended systems.	
	vii) Spacing of mulberry and its significance in leaf productivity and quality under various field conditions.	
	viii) Time and type of initial harvests and their effect on the young plant	
	ix) Measures to promote development of root system and long term significance	
13.	Mulberry cultivation practices : (under irrigated and dry land conditions)	8
	i) Irrigation :	
	a) Water requirement of mulberry in different field situations and seasons	
	b) Water resources, irrigation systems (surface, sub soil, sprinkler and drip systems) and their practical relevance	
	c) Water quality and its effects on soil productivity	
	d) Periodicity and quantity of irrigation	
	e) Over irrigation and its effects	
	f) Drainage : Methods and importance	
	g) Sewage water irrigation and its effects. Treatment for irrigation	
	ii) Water management practices in dry land mulberry :	
	a) Land leveling, bunding, contour bunding. <i>In situ</i> moisture conservation practices and rain water re-cycling.	
	b) Mulching : Purpose, methods(surface and sub-soil mulching). Mulching materials and cost effectiveness.	
	iii) Manures and their applications :	
	a) Basic approaches in mulberry cultivation	
	b) Natural farming and vermiculture	
	c) Organic manures : types (FYM ; Compost). Method of compost preparation and its use in mulberry fields, Advantage and constraints.	

- d) Biofertilizers : Types, importance, application methods and limitations.
- e) Chemical fertilizers : role of major nutrients and trace elements in plant growth. Types . Importance of chemical fertilizers in mulberry cultivation. Chemical composition of different fertilizers, Fertilizers doses and schedules of application for irrigation and rain fed gardens. Calculation of required dosages for a given unit area. Soil test based fertilizers application and its significance. Storage of chemicals fertilizers.
- f) Foliar nutrition : Foliar nutrients and commercial formulations, scope and limitations.
- iv) Inter-cultivation practice; Purpose, methods, time and frequency.
- v) Common weeds of mulberry, their effect on mulberry, productivity and quality and control measures.
- vi) Pruning and training objectives : Types and methods of pruning and importance, utility of mulberry pruning in sericulture management practices.
- vii) Harvesting : Effects of harvest on mulberry plant. Harvesting methods (Leaf and shoot harvest) in relation to cultivation and rearing practices. Stages and times of harvest. Transportation and preservation methods.
- viii) The schedules of package of practices of mulberry cultivation.
 - a) Irrigated gardens
 - b) Rain fed gardens

		<u>No. of Lectures</u>
14.	Mulberry Management :	3
	<ul style="list-style-type: none"> a) Significance of 'leaf cocoon ratio' concept b) Measures of the maintenance of high soul productivity c) Exclusive mulberry garden for chawki rearing : concept and methods. d) Maintenance of mulberry plots in relation to rearing schedules e) Requirements, organization and management of labour f) Maintenance of farm records and their relevance g) Farm implements and machinery 	

Group – B : Diseases and pests of mulberry & Silkworm

Unit – III : Diseases and pests of Mulberry

25 Marks

1.	Concept of plant diseases and importance of plant protection	1
2.	Classification of diseases of mulberry	1
3.	Influence of biotic and a biotic factors on the incidence of mulberry diseases	1
4.	fungal diseases of mulberry, occurrence, symptoms, epidemiology and control	4
5.	Minor diseases of mulberry, occurrence, symptoms, epidemiology and control <ul style="list-style-type: none"> a) Leaf spot b) Leaf rust c) Powdery mildew d) Leaf blight e) Root rot 	2
6.	Bacterial- viral ad mycoplasmal diseases of mulberry control measures.	2
7.	Root knot nematode diseases of mulberry – its occurrence, symptoms and controls.	2
8.	Mineral deficiency symptoms in mulberry reclamation.	3
9.	Mulberry pests: Classification, life cycle, symptoms of attack, period of occurrence and types of damage caused by caterpillars and grasshoppers. Mealy bugs and scale insect, Wasps and jassids, borers and defoliators and Termites, mites and slugs.	5

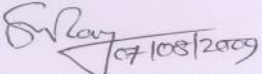
No. of Lectures

10. Management: Essential component, principles and concepts - physical-Machanical, photo tropical and cultural.
 Chemical - types of insecticides, forms and formulations. Pesticides
 Calculat ions and useful formulae. Application techniques and wetting periods.
 Biological – principles and concept, Useful natural enemies of pests of mulberry. 4

Unit – IV : Diseases and pests of Silkworm

25 Marks

11. Introduction and classification of different types of silkworm diseases
 Influence of environment and Nutrition on the incidence of diseases. 3
12. protozoon disease and pebrino - symptomology, structure and life history of
 Nosema bombycis- sources and mode of infection- prevention and control. 3
13. Bacterial diseases flacherie - symptoms of different types flacherie disease -
 causative agents, factors influencing Flacherie, sources and mode of infection -
 prevention and control. 3
14. Viral diseases- grasserie- symptoms of different types of viral diseases, causative
 agents, structure and life cycle of NPV, CPV - Kenchu & DNV viruses, sources
 and mode of infection, protection and control. 3
15. Fungal diseases- Muscardine-symptoms of different types of fungal diseases- causative
 agents, structureand life cycle of *Beauvaria* , mode of infection, prevention
 and control. 3
16. Aspergillus disease- Symptoms, causative agents, structure and life cycle of Aspergillus
 Sp. , mode of infection, prevention and control. 3
17. General account of disinfection and relative efficienctions of different disinfectants. 2
18. Silkworm pests : Life cycle of tachinid fly -Nature of damage, alternate host and other
 important behaviors in relation to mating, oviposition and flight, prevention, chemical
 control (ovicidal and chemical attractants), useful natural enemies of Tachinid flies,
 integrated management against tachin id fly, dermestid beetles : biology, prevention
 and control . Nature of damage, Prevention and control of other pests like ants,
 rodents and lizards. 3
19. Life cycle and methods of important natural enemies of pests of silkworm and mulberry.
 New strategies, use of kairomones, pheromones, growth regulators, autocidal methods.
 Necessity and concept of IPM with case studies against : Tachinid fly and Meal y bug. 2

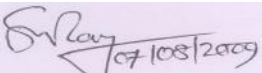

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Paper – IV (Practical)**Full Marks – 100****Unit – I : Soil Science****20 Marks**

1. Study of different types of soil
2. Soil Sampling
3. Determination of saturation capacity of soil
4. Soil analysis for pH and electrical conductivity
5. Determination of organic carbon by colorimetric method
6. Determination of available nitrogen by alkaline permanganate method
7. Determination of available phosphorus
8. Determination of available potassium
9. Visit to a soil testing laboratory
10. Visit to a Watershed

Unit – II : Biology of Mulberry**20 Marks**

1. Morphology and anatomy of few important mulberry cultivars.
2. Propagation methods :
 - a) Preparation of nursery beds
 - b) Collection of fruits and separation of viable seeds, seed sowing, seed Bed maintenance and rising of seedlings.
 - c) Selection of materials for cutting, preparation and selection of cuttings, Planting and raising of saplings in nursery beds and polythene bags, Selector and grading of saplings.
 - d) Preparation of various types of grafts and their maintenance.
 - e) Simple, air and trench layering techniques.
3. Farm implants and machinery
4. Preparatory practices for mulberry establishment.
5. Pit system and row system of planting
6. Different forms of mulberry training and methods of irrigation (Demonstration)
7. Identification of different types of fertilizers, Calculation of doses (Exercise)
8. Preparation of compost
9. Mulching practices and *in situ* moisture conservation practices
10. Identification of common weeds of mulberry and weeding
11. Estimation of leaf yield and harvesting methods.
12. Preparation of various forms for maintenance of farm records(Exercise)
13. Preparation of flow chart of Annual schedules of operations for 1 ha. Of Irrigated mulberry and also of rain fed mulberry(Exercise).


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Unit – III : Disease and pests of Mulberry & silkworm**20 Marks**

1. Collection of disease samples and their preservation
2. Isolation and identification of fungal and bacterial pathogens.
3. Identification of diseases, symptoms and spores of major fungal diseases.
4. Identification of bacterial, viral and minor diseases and their symptoms.
5. Identification of root knot diseases, root galls, egg masses, larvae and nematodes
6. Morphological features of Pebrine infected eggs, larvae, pupae and moths, isolation and microscopic examination, staining of spores (Giemsa staining).
7. Morphological features in larvae infected by different bacteria, isolation and microscopic examination of infected bacteria, staining of bacteria
8. Visual examination of larvae infected with NPV, CPV, -Kenchu & DNV- collection & microscopic examination of polyhedral bodies in the haemolymph, staining of polyhedra.
9. Examination of larvae, pupae and moths infected with fungal diseases collection & microscopic examination of different fungi, staining of pathogens.
10. Practical knowledge of various chemicals used to control silkworm disease, method of application.
11. Aspergillums disease : Examination of different stages of silkworm infected by aspergillus, collection and microscopic examination

Unit- IV : Pests of Mulberry & Silkworm**20 Marks**

1. collection, mounting/preservation of the insects from mulberry garden and silkworm rearing house, grainage, reeling units
2. Identification of pests of mulberry .
3. Identification of developmental stages of pests of mulberry with special reference to mealy bug and caterpillars.
4. Identification of developmental stages of pests of silkworm with special reference to technid fly and dermestid beetle.
5. Identification of the symptoms of pest (mulberry) attack.
6. Identification of the symptoms of pest (silkworm) attack.
7. Identification of the biological agents of the pests of mulberry & silkworm.
8. Assessment of the rates of Uzi infestation in silkworm corps, application/demonstration of prevention and control method.
9. determination and preparation of various concentrations of various insecticides.

Unit- V :**20 Marks**

- | | |
|---------------------------------------|----|
| 1. Submission of Laboratory note book | 5 |
| 2. Viva- vice | 5 |
| 3. Field report | 10 |

PART - III**Theoretical** Paper – V **100 marks**

Group – A	I. Genetics and Breeding of Mulberry II. Genetics and Breeding of Silkworm	- 50 marks
Group – B	Silkworm Seed Technology	- 50 marks

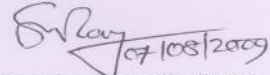
Paper – VI **100 marks**

Group – A	Silk Technology	- 50 marks
Group – B	I. Non-mulberry Sericulture ; II Sericulture Extension, Organization and Management	- 50 marks

Practical Paper – VII **100 marks**

Group – A	Genetics and Breeding of Mulberry Silkworm Silkworm Seed Technology Silk Technology Non-mulberry Sericulture	- 50 marks
Group – B	On the Job Training	- 50 marks

PAPER-VIII **100 marks****Entrepreneurship Development**


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PART - IIIPaper – V**Full Marks - 100****Group – A : Genetics and Breeding of Mulberry & Silkworm****Marks 50****I. Genetics and Breeding of Mulberry :**No. of Lectures

- | | |
|--|---|
| 1. Genetic variability in mulberry – sources of variability
Wild species – hybrids. Popular varieties of India -
chromosomal variations. | 2 |
| 2. Germ plasma conservation – significance and methods. | 2 |
| 3. General information to plant breeding – objectives of mulberry
breeding – parameters associated with growth, yield and quality
of mulberry. | 4 |
| 4. Selection – characters and importance of a) pure line selection
b) clonal selection c) mass selection | 3 |
| 5. Methods of plant breeding – a) Hybridization b) Polyploidy
c) Mutation | 3 |
| 6. Breeding stress resistance – draught, disease, pest , salinity & alkalinity. | 3 |
| 7. Tissue culture – meristem, callus, auther, pollen, endosperm, encapsulation of shoot buds and
cryopreservation of germ / | 4 |
| 8. Seed organization – types of seed, nucleus seed, foundation seed, certified seed, seed testing,
certification – seed multiplication and distribution, concept of seed farms. | 4 |

II. Genetics & Breeding of Silkworm :**Silkworm genetics :**

- | | |
|--|---|
| 1. Silkworm is a laboratory tool for genetic studies | 4 |
| 2. Mendel's principles – Dominance, Independent assortment and segregators,
Test cross and back cross. | 1 |
| 3. Inheritance of cocoon colour, larval markings, E -alleles, multiple alleles. | 1 |
| 4. Inheritance of voltinism, material inheritance, inheritance of
moultinism, environmental influence and hormonal control. | 1 |
| 5. Sex determination, sex linked and sex limited traits their special
significance in sericulture. | 2 |
| 6. Chromosome number and nature of chromosomes in different
types of silkworm. | 1 |
| 7. Mutation – use of induction-mutation in sericulture. | 2 |
| 8. Prospects of Biotechnology to improve silk production –preliminary
idea of Genetic Engineering. | |

Silkworm breeding.**No. of Lectures**

- | | |
|--|---|
| 9. Origin, distribution and differentiation of silkworm races – Chinese, Japanese, European and tropical races – characteristic features. | 2 |
| 10. Parameters relevant to silk production – qualitative and quantitative characters and its used in breed selection. | 2 |
| 11. Breeding of silkworm – prerequisites , aims and objectives- Types of Breeding- Methods- present status of silkworm breeding in India. Problems, priorities and goals. | 2 |
| 12. Selection methods – individual and family selection – indirect, stabilizing and directional selection. | 2 |
| 13. Inbreeding and out breeding- advantages and disadvantages -effects of inbreeding-consequences of homozygosity. | 2 |
| 14. Development of auto sexing breed for egg colour, larval marking and cocoon colour-its significance in sericulture. | 2 |
| 15. Heterosis – theoretical basis- utilization of heterosis in sericulture – hybrid vigour in different crossing system - hybrid vigour and environment - combining ability tests. | 2 |
| 16. Maintenance of races, breeds and strains. | 1 |

Group – B : Silkworm seed Technology**Marks 50**

- | | |
|---|---|
| 1. Morphology of silkworm egg :
Size, shape, weight and colour of egg, structure of egg -its constituents | 3 |
| 2. Embryology of silkworm egg :
Characteristics of different stages – critical stages of development. | 3 |
| 3. Seed organization :
Significance ; maintenance of parental stock and multiplication. | 2 |
| a) Seed areas : identification – concept of selected seed rearers and villages | 2 |
| b) Seed legislation : acts, rules and regulation. | 2 |
| c) Monitoring of seed crop : screening of egg shells, larval, faecal matters for disease. Disinfection and maintenance of hygiene during rearing. | 2 |
| d) Seed cocoon market – pupal examination – certification of seed cocoon lots- price fixation for seed cocoons. | 2 |

4. Commercial Egg Production
- | | | |
|----|---|---|
| a) | Plan of a model grainage building | 1 |
| b) | Disinfection and hygiene in seed production units. | 1 |
| c) | Procurement and transportation of seed cocoon | 1 |
| d) | Sorting and preservation of seed cocoon -role of temperature, humidity, light and air on seed cocoon preservation. | 3 |
| e) | Early test for detection of patria disease papal gut examination and forced eclosion test. | 2 |
| f) | Sex separation in seed production | 1 |
| g) | Synchronizations of emergence – synchronized brushing of roles in villages- Old storing of cocoons/pupal and moths | 3 |
| h) | Eclosion or emergence of moth-manipulating of photo - periodic condition- collection of male and female moth – influence of light or emergence. | 2 |
| i) | Pairing or coupling of moths- rejection weak and deformed moths, duration of pairing –potency of male moths – number of pairing – depairing and decoupling. | 2 |
| j) | Ovipositor – ideal condition for ovipositor – calculation of age of eggs. | 1 |
| k) | Mother moth examination – individual and mass method – green and dry moth – identification of patria spores – surface sterilization of eggs. | 2 |
5. Handling and Preservation of Silkworm eggs.
- | | | |
|----|---|---|
| a) | Handling of multivoltine eggs – ideal embryonic stages for cold storing. | 1 |
| b) | Handling bivoltine egg – methods for early hatching – hot and cold acid treatment – advantages – relationship between temperature and specific gravity of acid – ideal age of eggs for acid treatment – precautions during acid treated eggs. | 3 |
| c) | Preservation of bivoltine egg – short term chilling and long term chilling –hibernation schedules – 4 months, 6 months and 10 months hibernation schedules – importance of intermediate temperature-relationship between aestivation period and duration of cold stage. | 3 |
6. Preparation of loose eggs– advantages and disadvantages-handling of loose eggs. 1
7. Economics of seed production. 1
8. Protection measures on seed production. 1

Paper – VI**Full Marks - 100****Group – A : Silk Technology****Marks 50**

- | | | |
|----|---|---|
| 1. | Introduction to textile fibres – Natural fibres vs man made fibres. | 2 |
| 2. | Physical and chemical properties of silk – uses of silk. | 2 |
| 3. | Raw materials for silk reeling- selection of cocoon for reeling, assessment of renditta, raw material valuation Procedures of cocoon procurement, transportation of cocoon. | 3 |

No. of Lectures

4. Processing of cocoon:
- Stifling-definition-objective-different methods-sundrying-black cloth sundrying, steam stifling hot air drying, Mshuakothi. 3
 - Sorting- separation of defective cocoons. 1
 - Conditioning and preservation -methods of preservation of stifled cocoons. 3
 - Cocoon boiling/cooking-definition and objective, different methods - open pan, three pan and six pan cooking/boiling methods. 3
 - Cocoon brushing-methods-manual and mechanical building. 3
5. Reeling of cocoon
Objective – different types of reeling machineries comparative account of reeling in different reeling machineries-study of yarn passage in different reeling machineries. 4
6. Re-reeling and packing.
Objective-importance of rereeling ; book making and bail making; factors influencing the quality of fibre. 3
7. Quality of water required for silk reeling - effects of water in silk reeling - Japanese standards for silk reeling water-corrective measures. 3
8. Quality control in silk reeling and its necessity. 2
9. Cocoon testing and grading – objectives-different relevant methods adopted in India. 3
10. Raw silk testing and grading -different tests for raw silk quality measurement, methods of testing, condition for testing and grading. 3
11. Cocoon market and silk exchange - a general account. 2
12. Chemical processing of silk yarns and fabrics -degumming, bleaching and dyeing. 3
13. Silk industrial by products. Reeling waste classification and its utility in spun silk industry. Utility of pupae. 3
14. Silk testing-winding, warping and weaving - a general account; powerloom and handloom weaving. 3

Group – B:**I. Non-mulberry Sericulture****Marks 50**

- Type of non-mulberry silkworm and their distribution in India and other countries. 1
- Non-mulberry Sericulture and its relevance to social forestry; Industrialization vs non-mulberry sericulture in India-Existing forest potential and their relevance to non-mulberry sericulture and employment potential. 2
- Primary and secondary host plants of Tasar, Eri and Muga silkworm. 2
- Propagation of primary food plants of Tasar, Eri and Muga silkworm -Ecoraces of Tasar, Eri and Muga silkworms. - 3
- Morphology of egg, larva, pupa and moth of various non-mulberry silkworm – silk glands of Tasar, Eri and Muga silkworm. - 3
- Rearing : Ecological conditions that influence rearing of non-mulberry silkworms – Improved rearing methods for young stage and late stage silkworms. 3

	<u>No. of Lectures</u>
7. Muga culture and its endemic nature to Assam State.	1
8. Commercial egg production in Tasar, Eri and Muga silkworms -seed organization in Tasar, Eri and Muga silkworms.	2
9. Diseases of non- mulberry silkworms- Protozoon, bacterial, viral and fungal-symptoms- Causative agents-prevention and control measures. General account of common diseases of host plants.	2
10. Pests and predators of non- mulberry silkworms- their bionomics, seasonal abundance, nature and extent of damage of their various pests and their control.	2
11. Reeling : Reeling of cocoons-basis difference between mulberry and non - mulberry Silks-different reeling machines- Traditional and modern methods of reeling. Spinning- principles of spinning, different methods and different types of spun silk.	2

II. Sericulture Extension, Organization and management .

1. Extension :
Extension education, Definition –meaning-origin and growth principles and attributes of extension education- community development programmes-role of extension in rural developments-sericulture as a tool for rural development. 2
2. Extension education methods and communications :
Extension as an education purpose – Learning and teaching in extension, formal, informal and non-formal education. Extension-Principle-merit and limitations : Extension communication method-Farmers training methods-Trainer dominated method, Trainee dominated method and co-operative method. 3
3. Diffusion of innovations in Sericulture :
Concept of diffusion and adoption –lab to land programmed sources of information and adoption stages. Attributes of innovations and their impact on technology adoption. 3
4. leadership and motivation :
importance of leadership in sericulture -Identification of local leaders -importance of motivation in sericulture-key motivation facts in sericulture. 4
5. Marketing management :
Sericulture marketing organization – cocoon market and silk exchange - regulated and non regulated market – stabilization of price in cocoon market and silk exchange. 4
6. Sericulture co-operative :
Definition , characters and types of cooperative – principles of cooperative- advantages of cooperative-present status of co-operatives and sericulture- financing agencies in sericulture – short term, mid term and long term financing. 3
7. Feed back system :
Survey – types, merits and limitations Selection of data evaluation. 3
8. Project formulation/and evaluation Definition and characterization of a project – project formulation- Evaluation/appraisal of a project – project analysis. 3

PAPER – VII (Practical)

Full Marks - 100

Group – A :

Marks 50

Genetics and Breeding of Mulberry

1. Commercial characters of mulberry – some evolved varieties.
2. Cytological techniques-preparation of pretreatment, solutions -fixatives and stains-Procedure.
3. Somatic chromosomes –mitosis in root/shoot meristem.
4. Meiosis during microsporogenesis – smear preparation of pollen mother cells.
5. Hybridization techniques-sexual polymorphism-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. Biochemical estimation of nutrients in mulberry leaf estimation of moisture percentage, ash, chlorophyll(a,b, and total), soluble proteins, crude proteins and sugars.
7. Morphological variability in diploids, triploids, tetraploids and mutants.

Genetics & Breeding of Silkworm

1. Morphological Studies of :
 - a) Egg characters : Shape (Spindle, Elliptic, Kidney, Giant, small and Clumpy). Shell colour (yellow, green, grey and white). Yolk colour (light and dark yellow). Serosa colour (dark, brown, white, pink, red and brown).
 - b) Larval Characters : Colour of newly hatched larvae (black, brown and grey), Larval marking ; Moricaud, Stripped, Black, etc.,
 - c) Cocoon colour : Golden yellow, light yellow, white, pink, flesh and greenish yellow. Cocoon Shape : Oval, Dumbell, Elliptical, Spindle etc.
 - d) Pupal Characters : Brown and Black pupa.
 - e) Moth colour : White and Black.
2. Chromosome preparations and study of mitosis and meiosis in silkworm.
3. Analysis of quantitative traits (Cocoon Weight, Shell weight, shell ratio etc.,) S.E., Chi square test and t-test.
4. Observation of different characteristics in various silkworm breeds.
5. Observation/measuring various traits
 - a) Quantitative traits – Fecundity, ERR by No. ERR by weight, Larval duration, V age larval duration, Cocoon weight, shell weight, shell ratio, pupation ratio, defective cocoons and floss%
 - b) Reeling parameters – Boil of loss Reliability, Filament length, Denior rendition.
6. Selection of cocoons for breeding based on various characters.
7. Heterocyst – Single, Three way & Double cross and calculations.
8. Inbreeding and Inbreeding depression calculation.
9. Evaluation of pure breeds and hybrids.

Silkworm Seed Technology .

1. Plan of grain age building and grain age equipments –visit. to the commercial grainage.
2. maintenance of records in grainage.
3. Visit to the seed cocoon markets, commercial grainage, multivoltine and bivoltine.
4. Processing of seed cocoons- defocusing-sorting-selection of good cocoons – assessment of seed cocoons – pupa examination.
5. Cutting of seed cocoons-sex separation by pupal method-preservation of cocoon/pupa-Maintanance of temperature, humidity and light factors.
6. Emergence of moths –selection of moths- pairing and depairing – Oviposition-Maintanance of required environmental conditions-preservation of male moths.
7. Mother moth examination – individual and mass –whole and sampling, method – surface sterilization of silkworm eggs.
8. Sheet eggs and loose egg preparation- preparation of starch coated paper – washing of loose eggs- Drying-Treatment of eggs with acid –weighting and packing.
9. Acid treatment of bivoltine eggs -Hot acid and cold acid treatment.
10. Preservation of eggs-short term and ordinary chilling- hibernation schedules 3,4,6 and 10 months.

Silk Technology .

1. Identification of defective cocoon and their percentage in a lot of cocoon, determination of shell ratio of good cocoon.
2. Single cocoon reeling-determination of average filament length and average denier (size).
3. Study of filature basin racing machine, yarm passage diagram, measurement of crossure angle. Cooking and reeling and re-reeling of a simple cocoon lot, determination of : 1) Realability, 2) Average filament length and denier, 3) Non -breakable filament length, 4) raw silk percentage, 5) Renditta, 6) Silk waste percentage, lacing and Skoin finishing during re-reeling.
4. Study of silk reeling machine, automatic and semi automatic reeling machines. Practical demonstration visit to filatures.
5. Study of silk testing – winding test, denier (size) test, Seri plane test, serigraph test and cohesion test. Practical demonstration.
6. Degumming of raw silk yarn and silk waste by soap and soda method and estimation of degumming.
7. Spinning of dagummed silk waste on pedal spinning wheel.
8. Study of silk fabric manufacturing unit power loom and handloom (visit) to spun silk mill). Study of silk dyeing and pointing unit – (visit to practical centers).
9. Study of spun silk mill (visit to spun silk mill).
10. water analysis – pH Total hardness, Total alkalinity, electro conductivity, chlorides.
11. Charka reeling – Economic model of silk reeling unit.

Non – mulberry Sericulture.

1. Morphological studies of food plants of nonmulberry silk worms vis., I . tomentosa, I. Arjuna, S. Robusta. Q. serrate Q. doallbata, M. bambycina, L. polyanthus, R. communis, H. freg rans with reference to taxonomic traits.
2. Morphology of egg, larva, pupa, cocoon and moths of different non -mulberry silkworm. Different ocotypes of non-mulberry silkworm.

3. Rearing appliances used in rearing and seed preparation of non-mulberry silkworm (Drawings and sketches).
4. Practical observation and record of symptoms of protozoan, bacterial, viral and fungal diseases - microscopic observation of causative agents.
5. Determination of physical and commercial characters of cocoons - study of different reeling and spinning machines (drawings), identification of different types of yarn, spun silks and wastes.
6. Histograms, pie charts and case study regarding crop.

Group – B :

On –the- Job Training

Marks 50

Every candidate shall be required to undertake on -the-Job Training for a period of about 8(eight) weeks at the end of the second years of study. The purpose of the on -the-Job Training is to expose the students to the different aspects of sericulture in real situation. Following are the probable sites for on -the-Job training :-

- silkworm seed production center/Central Silk Board, Berhampore/Department of sericulture, Govt. of W.B.
- Soil testing laboratory, Department of sericulture, Govt. of W.B.
- Central sericulture Research and training Institute, Central Silk Board, Berhampore.
- State Filature, Govt. of W.B., Panchanantala, Berhampore or any other such center in W.B.
- Any Sericulture Firm/Technical Service Centres(Sericulture etc.)

One faculty member of the colleges will maintain liaison with the organization implanting the training. The candidate shall be under administrative control of the organization regarding site of work and duty hours etc.

Every candidate shall be required to maintain a daily diary of his attendance and work done/experience acquired during the training. The head of the organization/s will furnish a confidential report regarding attendance and an assessment of the performance in respect of every student to the principal of the college concerned on completion of the training which will be taken into account at the time of final evaluation.

The candidate shall have to submit two copies of bound and typed/neatly handwritten report on the training undertaken by him/her in the form of a Along with a certificate of the guide from the college duly endorsed by the Course Co-ordinator and principal of the college for evaluation. The report shall have to contain the following four separate parts having 10 marks allotted for each part.

- | | | |
|------------|---|---------------------------------------|
| Part – I | - | Seed Technology |
| Part – II | - | Mulberry Cultivation-silkworm rearing |
| Part – III | - | Cocoon Technology |
| Part – IV | - | Extension and Organization. |

The report shall have to be submitted to the college concerned at least seven days before the commencement of the University examination which will be jointly evaluated by the internal and external examiners.

PAPER-VIII**Full Marks - 100****ENTREPRENEURSHIP DEVELOPMENT**

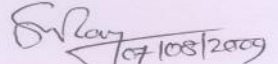
[Common paper for Three-Year B.A./B.Sc./B.Com.(Major) Degree Course subjects.]
Six Questions to be answered taking three from each group.

Group A**50 Marks****No. of periods.****1. ENTREPRENEURSHIP BUILDING :**

- | | | |
|---------|---|----|
| a) | Meaning-Importance-Psychological Sociological Factors and Distinctive Competence. Entrepreneurship Process. Identification of Opportunities -Choice of Technology- Make or Buy Decision-Biography of Indian Entrepreneurship –Status of Worldwide Entrepreneurship. | 3 |
| b) | Need, Scope and Characteristics of Entrepreneurship, Special Schemes for Technical Entrepreneurs, STED. | 2 |
| c) | Social responsibility and business ethics. | 1 |
| d) | Environmental Awareness. | 1 |
| e) | Human Resource Management, Management of self and understanding human behavior. Leadership, Motivation Attitude – Belief, Communication, Group Dynamics, Delegation, Setting of Goals, Self assessment, Organizational / Psychology- Transactional approach and Analysis Creativity , Problem Solving – Strength Weakness Opportunity and Threat (SWOT) Techniques – Decision Making –Stress Management – Positive Reinforcement, Recruitment, Selection, Training. | 5 |
| Total : | | 12 |

SOURCE OF FACULTY :

- i) In house experts and faculty members of the College.
- ii) Director, Cottage & Small Scale Industries, W.B., New Secretariat Building (9th floor), 1, Kiron Sankar Roy Road, Calcutta – 700 001.
- iii) SISI, Calcutta, 111 & 112, B.T. Road, Calcutta – 35.
- iv) GM / DIC of respective District.
- v) GNCCI / NEBCON.
- vi) Any successful Entrepreneur of the locality.
- vii) IIM, Calcutta.
- viii) Experts from Bengal Engineering & Science University.
- ix) IISWBM, Calcutta.


 Secretary, Faculty Councils (U.G.)
 University of Kalyani
 Kalyani, Nadia

2. <u>TECHNOLOGY MANAGEMENT :</u>	<u>No. of periods.</u>
a) Criteria for principles of product, selection and development.	2
b) Choice of technology, plant and equipment.	2
c) Energy requirement & utilization.	1
d) Resource Management –Men, Machine and materials.	1
e) Critical Path Method (CPM) & Project Evaluation Review Techniques (PERT) as planning tools for establishing SSI.	3
f) Plant Layout & Process Planning for the product.	1
g) Quality control/quality assurance and testing of product.	1
h) Production Management : Elements of production process, production planning and control, product development testing facilities, patents, Quality Assurance, Time control and Cost control, Total Quality Management.	3
i) Materials – Purchasing Management : Materials Planning and budgeting, Source selection, Public buying, Value engineering, Value analysis, Economic ordering quantity, Inventory control, Linkage with Import & Export Management.	2
Total :16	

SOURCE OF FACULTY :

- i) In house experts and faculty members of the College.
- ii) Experts from Bengal Engineering & Science University
- iii) Experts from Jadavpur University.
- iv) SISI, Calcutta, 111 & 112, B.T. Road, Calcutta – 35.
- v) IIM, Calcutta.
- vi) IISWBM

3. <u>PROJECT FORMULATION :</u>	<u>No. of periods.</u>
a) Needs, scopes and approaches.	1
b) Stages and methodology in project Identification -, selection of a project format, Project Report Writing.	1
c) Analysis and evaluation of a project report.	1
d) Critical decision making areas- Money-Market-People.	1
e) Interaction with appraisal authority and Financial Institutions, project outline of relevant professions.	1
f) Economic viability and financial feasibility.	2
g) Business and industrial laws, labour relations.	1
h) Entrepreneurs and society, changing concept of social responsibility, shift to ethics, institutionalizing & challenge of relativism.	2
Total : 10	

SOURCE OF FACULTY :

- i) In house resource persons and faculty members of the College.
- ii) SISI, Calcutta
- iii) GM/DIC of respective district.
- iv) Directorate of Cottage & Small Scale Industries, W.B.
- v) Experts from Bengal Engineering & Science University
- vi) Experts from Jadavpur University.

Group B**50 Marks****1. FINANCIAL MANAGEMENT :****No. of periods**

a)	Institutions, financing procedure and financial incentives, Banking norms as in vogue.	2
b)	Financial ratios & their significance.	2
c)	Costing and pricing.	2
d)	Knowledge of capital market and mobilization thereof	1
e)	Funds flow & cash flow concept.	1
Total :		8

SOURCE OF FACULTY :

- i) In house experts and faculty members of the College.
- ii) Cost Accountant Institutes.
- iii) Training Institutes of Bank.
- iv) Directorate of Cottage & Small Scale Industries, W.B., New Secretariat Buildings (9th floor), 1, Kiron Sankar Roy Road, Calcutta – 700 001.
- v) Reputed consultants.
- vi) BNCCI / WEBCON.
- vii) Business Management Deptt., C.U.

2. MARKETING MANAGEMENT :**No. of periods**

a)	Exposure to demand based, resource based, service based, Import substitute & Export promotion Industries.	3
b)	Market survey techniques.	
c)	Elements of marketing & Sales management.	1
d)	Nature of product and market strategy- Packing & advertising – After sales service.	2
e)	Touch an Import-Export procedure & methods.	1
f)	Analysing marketing opportunities, planning marketing strategy, forecasting, marketing mix, advertising the marketing programme & sales management.	4
Total :		14

SOURCE OF FACULTY :

- i) In house experts and faculty members of the College.
- ii) IIM, Calcutta.
- iii) Deptt. of Business Management, C.U.
- iv) Experts from Bengal Engineering & Science University
- v) SISI, Calcutta.
- vi) GM/DIC of respective district.
- vii) IISWBM

3. MONITORING & FOLLOWUP :

- | | | |
|----|---|---|
| a) | Sickness in small scale industries and their remedial measures. | 1 |
| b) | Coping with uncertainties and managing the situation. | 1 |

Total : 2

SOURCE OF FACULTY :

- i) In house experts and faculty members of the College.
- ii) Directorate of Cottage & Small Scale Industries, W.B.
- iii) Experts from Bengal Engineering & Science University
- iv) Experts from Jadavpur University.

4. DATA BASE MANAGEMENT :**No. of periods**

- | | | |
|----|---|---|
| a) | Books of accounts, financial statements. | 2 |
| b) | Creation of data base/Management Information System (MIS) | 2 |

Total : 4

SOURCE OF FACULTY :

- i) In house experts and faculty members of the College.
- ii) Experts from Bengal Engineering & Science University
- iii) Experts from Jadavpur University.
- iv) IIM, Calcutta.
- v) Business Management Deptt, C.U.
- vi) IISWBM, Calcutta.

5. STATUTORY PROVISION :**No. of periods**

- | | | |
|----|---|---|
| a) | Licensing, registration – Municipal bye laws and Insurance coverage. | 1 |
| b) | Important provisions of factory Act, Sales of goods Act, partnership Act. | 1 |
| c) | Pollution control & Environmental Act. | 2 |
| d) | Income Tax, Sales Tax and Excise Rules. | 1 |

Total : 5

SOURCE OF FACULTY :

- i) Faculty with Industrial Relation Management / Experience bac kground.
- ii) Tax Practioner / Lawyer.
- iii) Member from WBPCB, Calcutta.

6. KNOWLEDGE INPUT :**No. of periods**

- | | | |
|----|---|---|
| a) | Industrial and economic policy declared by Govt. from time to time. | 2 |
|----|---|---|

SOURCE OF FACULTY :

- i) Directorate of Cottage & Small Scale Industries, W.B.
- ii) SISI, Calcutta.

N.B. : The students shall be required to visit to linked institutions & promotional agencies, like Commercial banks, WBFC, SISI, DIG, Commercial Tax Offices, WBPCB & some testing centers for getting practical exposure.

Suggested Reading Material :

1. Deshpande M.V. : Entrepreneurship of Small-Scale Industries : Concept, Growth & management , Deep & Deep Publication, D-1/24, Rajouri Garden, New Delhi -110027, 1984.
2. Mc Clelland DC : The Achieving Society, Princeton, NJD, Van Nostrand Co. N.Y. 1961.
3. Meredith GG, Nelson : Practice of Entrepreneurship, ILO, Geneva, 1982. Be. et. al.
4. Pareek U & Rao TV : Personal Efficacy in Developing Entrepreneurship, Learning Systems, New Delhi, 1978.
5. Rao TV & Pareek U. : Developing Entrepreneurship - A Handbook, Learning Systems, New Delhi, 1982.
6. Vyas JN : Planning an Industrial Unit 1, Neelkunj Neelkanth Park Opp. Navrangpura, Ahmedabad.
7. Welsh JA & Jerry FW : Entrepreneurs Master Planning Guide – How to Launch a successful Business. Prentice Hall, Englewood Cliffs, 1983
8. Department of Industrial: Incentives & Concessions for Setting up Industries in Development. Backward Areas, Deptt. of Industrial Development, Govt. of India, New Delhi.
9. India Investment : Guide for Entrepreneurs, India Investment Centre, Industrial Centre. Jeevan Vihar Building, Sansad Marg, New Delhi.
10. Entrepreneurship : A handbook for New Entrepreneurs (with special Development reference to S & T group), Entrepreneurship Institute of India. Development Institute of India.
11. Philip Kotler Publisher: Marketing Management, Prentice Hall of India.
12. James C. Van Horne : Fundamentals of Financial Management, Publisher : Prentice Hall of India.
13. Edgar H. Schein : Organisation Psychology, Publisher : Prentice Hall of India.
14. A.K. Datta : Materials Management, Publisher : Prentice Hall of India.
15. Monthly Bullentin of Reserve Bank of India.
16. Industrial Survey of India, Hindu Group.
17. Business Today, Indian Express Group.
18. Economic Times.