

**RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY,
NAGPUR**

FACULTY OF SCIENCE

BOARD OF STUDIES IN SERICULTURE

**SYLLABUS FOR
P. G. DIPLOMA IN SERICULTURE AND BIORESOURCE MANAGEMENT
along with draft direction and examination scheme
(Semester I & II)**

(FROM SESSION 2016-17)



RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Direction No. 60 of 2016

**DIRECTION REGARDING THE EXAMINATIONS LEADING TO THE
P. G. DIPLOMA IN SERICULTURE AND BIORESOURCE MANAGEMENT
(SEMESTER WITH CREDIT BASED PATTERN) IN FACULTY OF SCIENCE**

One Year- (Two Semesters) Diploma Course

(Issued under Section (14(8) of the Maharashtra Universities Act, 1994)

WHEREAS the Maharashtra Universities Act, 1994, hereinafter referred to as Act has come into force from 22nd July, 1994 and was amended from time to time.

AND

WHEREAS the Management Council accepting the recommendation of the Board of College & University Development, recommended to the government of Maharashtra for grant of permission to start P.G. Diploma in Sericulture and Bioresource Management in the university from the academic session 2016-17 subject to preparing of ordinances and syllabi for the courses.

AND

WHEREAS the government of Maharashtra granted permission to the colleges to start P.G. Diploma in Sericulture and Bioresource Management from the academic session 2016-17.

AND

WHEREAS as per the recommendation of Board of Studies in Sericulture Faculty of Science approved the syllabus of P.G. Diploma in Sericulture and Bioresource Management course along with scheme of examination.

AND

WHEREAS Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur granted initial affiliation to the course to be started from the session 2016 -17.

AND

WHEREAS it is necessary to start the course in the same Academic Session i.e. the session in which Government granted the permission, or immediately in next session, otherwise the permission granted by the government shall stand cancelled.

AND

WHEREAS the Academic session 2016- 17 is already commenced w.e.f. 1st June 2016.

AND

WHEREAS, the Academic session 2016 - 17 has commenced from 1st June 2016, it is felt expedient in the interest of the student to give effect to the decision of Academic Council to start the P.G. Diploma in Sericulture and Bioresource Management course from the Session 2016 - 17.

AND

WHEREAS the ordinance making is a time consuming process.

Now therefore, I, Dr. S. P. Kane, Vice-Chancellor, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur in exercise of the power vested under section 14(8) of the Maharashtra University Act of 1994 do hereby issue the following direction:

The Examination leading to the course of P.G. Diploma in Sericulture and Bioresource Management (Semester with credit based Pattern) shall be held twice a year at such places and on such dates as may be appointed by the Academic Council.

Subject to the compliance with the provisions of this Ordinance and of any other Ordinance in force from time to time an applicant for admission to the examination shall have:

(a) Obtained a B. Sc. degree of this university or of any other Statutory University and had offered Biology as one of the optional subjects for the B. Sc. degree examination

OR

have offered Zoology, Botany, Biochemistry, Microbiology, Biotechnology, Life Science, Environmental Science, Agriculture, Sericulture and Veterinary as one of the subjects at degree level.

(b) Prosecuted a regular course of study for not less than one academic year in any relevant institution or and colleges affiliated to the Nagpur University where the course will be conducted.

Without prejudice to the other Provisions of the Ordinance No.6 relating to the Examinations in General, the provision of paras 5, 6, 10, 28 and 31 of the said Ordinance shall apply to every collegiate candidate.

(a) Course fee to be decided by the Academic Council.

(b) The fee for the examination to be decided by the Academic Council including practical examination.

The duration of the course shall be one Academic year (two semesters).

The final total assessment of the candidate is made in terms of an university practical and written theory exam for the course. For each paper, the practical and project the minimum passing is 40% marks and aggregates is 50% marks. Details are as follows:

Semester-wise Syllabus for P.G. Diploma in Sericulture and Bioresource Management Teaching and Examination Scheme

Semester-I

Sr. No	Theory Paper/ Practical	Subjects	Teaching Scheme (Hrs/Week)			Credits	Examination Scheme					
			Th	Pr	Total		Duration (Hrs)	Max. Marks		Total Marks	Min. Passing Marks	
								External Marks	Internal Marks		Th.	Pra.
1	I	Biology of mulberry silkworm and Host Plant	4		4	4	3	75	-	75	30	-
2	II	Sericulture Industry and Marketing	4		4	4	3	75	-	75	30	-
4	Practical			8	8	4	6	80	20	100	-	40
		Total	8	8	16	12	-	-	-	250	60	40

Semester-II

Sr. No	Theory Paper/ Practical /Project	Title of Paper	Teaching Scheme (Hrs/Week)			Credits	Examination Scheme					
			Th	Pr.	Total		Duration (Hrs)	Max. Marks		Total Marks	Min. Passing Marks	
								External Marks	Internal Marks		Th.	Pr.
1	I	Conservation and Utilization of Insect Resources	4		4	4	3	75	-	75	30	-
2	II	Pest Management, Cell & Molecular Techniques	4		4	4	3	75	-	75	30	-
	Practical			4	4	2	5	40	10	50	-	20
3	Project			2	2	2	1	30	-	30	-	12
	Seminar			2	2	1	1	-	20	20	-	08
		Total	8	8	16	13	-	-	-	250	60	40

7. a) The scope of the topic in various papers shall be as indicated in the syllabus.
b) The medium of instructions and the examination shall be in English only.
8. In order to pass the examination, an examinee shall obtain not less than 40% marks in each theory papers, practicals and project separately and not less than 50% marks in aggregate.
9. An examinee who is failed in the examination shall be eligible for admission to the next written and practical examination on payment of fee prescribed for the examination.
10. The casual student will be governed by the general rules applicable to them, if admitted by the Head of Department / Institute.
11. Successful examinee obtaining 60% or more marks in the aggregate at the examination shall be placed in the first division and those obtaining 60% but not less than 50% marks in the second division.
12. Provision of the Ordinance No.7-A relating to the condonation of deficiency of marks for passing the examination and Ordinance No. 10 relating to the exemption and compartments shall apply to the examination under this ordinance.
13. As possible after the examination but not later than the 30th June, Management Council shall publish the list of successful examinees.
14. Notwithstanding anything to the contrary in this, Ordinance no person shall be admitted to this examination if he has already passed the same examination or an equivalent examination of any other statutory University, which has been recognized as equivalent to the examination.
15. A successful examinee shall receive a Diploma in prescribed form signed by the Vice Chancellor.

Nagpur:
Date :-3.9.2016

Sd/-
Dr. S. P. Kane
Vice-Chancellor

**SYLLABUS FOR
P.G. DIPLOMA IN SERICULTURE AND BIORESOURCE MANAGEMENT
(Semester with credit based Pattern)**

The examination shall comprise of 04 (four) theory papers of 75 marks each. Each paper is equivalent to 4 credits hence total credits of 04 theory papers are 16 (4 x4 =16). There shall be two practicals (Practical-I 80 marks, Practical-II 40 marks and a project work of 30 marks, equivalent to the total 08 credits (2 practicals 4 +2 = 6 + a project work x 2= 2). The Examination in each theory paper shall be of three hours duration and that of each practical shall be of 6 hours. The seminar shall be conducted during the Second semester and shall be of 20 marks equivalent to 1 credit (1seminars x 1= 1 credit). At the end of second semester candidate has to submit a Project work. The project work shall be of 30 marks. Candidates are expected to pass separately in seminar, theory, project and practical examination. The work load for each theory paper shall be of 4 clock hours per week. Work load for each practical shall be of 8 clock hours per week. Two (02) clock hours per week will be devoted to seminar. Eight (08) clock hours per week will be devoted to project work. In Second semester, seminar and project work are compulsory for all the students.

The three typed copies of project work signed by teacher-in-charge and certified by the Head of the Department as a bonafide work of the examinee. The examinee shall be required to produce project work at the practical examination. The viva voce on the project work shall be held on the day of practical along with its evaluation by the external and internal examiners and the marks will be submitted to the University as project marks. The subject of project shall be given to a group of not more than four students or to a single student independently on any topic from Life Sciences.

SEMESTER - I

PAPER – I

(Biology of mulberry silkworms and Host Plant)

1.0 Introduction

- 1.1 Sericulture : History and present status and sericulture in India.
- 1.2 Silkworm Races : Types of races, parental, cross breed races in India.
- 1.3 Silk production : Mulberry silk production, status, export and income.
- 1.4 Recent trends in Sericulture : Modern cultural practices using high yielding hybrids of silkworm.

2.0 Mulberry Plant

- 2.1 Mulberry Tree : Taxonomy, Characteristics, Mulberry varieties, sexual and asexual propagation.
- 2.4 Plantation : Soil, water, manuring, methods of plantation, cultivation and management, leaf production.
- 2.2 Mulberry diseases : Red rust, common mulberry dwarf, mulberry wilt, leaf spot, powdery mildew, root knot (Nematode disease), control methods.
- 2.3 Mulberry pests : Leaf eating caterpillars, jassids, thrips, mealy bugs (Scale insect), gall midges, stem girdle beetle, powder pest beetle, and control methods.

3.0 Silkworm, *Bombyx mori*

- 3.1 Life Stages : Egg- shape, size and external structure, incubation period.
: Larva- Instars, morphological characters, individual life span, sexual dimorphism.
: Pupa- Male and Female pupae, pupal development, sexual dimorphism.
: Adult- Male and female, development, sexual dimorphism.

- 3.2 Structure and function : Mouth parts of the larva, External genitalia of adults, Digestive system in larva, Circulatory system in larva, Reproductive system in larva and adults.
- 3.3 Silk gland : Morphological structure, Histological Differentiation, Functional differentiation, Silk gland secretory cycle and silk synthesis, degeneration, silk proteins.
- 3.4 Neuroendocrines : Central nervous system, Neuroendocrine systems, Role of hormones in development, Pheromones.

4.0 Silkworm protection

- 4.1 Diseases and their management : Pebrine- Pathogen, *Nosema bombycis*, etiology, symptoms and mode of infection
Grasserie- Pathogen, Nucoepolyherosis virus, *Borrelina* sp. etiology, symptoms and mode of infection
Flacherie-Pathogen *Bacillus species*, etiology, symptoms and mode of infection
Muscardine- Pathogen, *Beuveria bassiana*, etiology, symptoms and mode of infection
Management of diseases-Preventive measures, Use of disinfectants Dusting, drug treatment
- 4.2 Silkworm Pests : Uzi fly- *Tricholyga bombycis*, Classification, Life cycle, Habits and nature of damage and control measures.
Ants - *Formica fusca* Classification, Life cycle, Habits and nature of damage and control measures.
Lizzards- Classification, nature of damage and control measures.
Birds- Classification, nature of damage and control measures.
- 4.3 Insect pests of Cocoon : Demisted beetle - *Dermestes cadverinus* Classification, Life cycle, Habits and nature of damage and control
- 4.4 Vertebrate pests of Cocoon : Squirrel - Classification, life cycle, nature of damage and control measures.
Rats- Classification, life cycle, nature of damage and control measures.

PAPER – II
(Sericulture Industry and Marketing)

1.0 Seed Production (Grainage)

- 1.1 Seed Cocoons : Selection, preservation, incubation
: Grainage Equipment.
- 1.2 Moths : Emergence, mating, egg laying, infection examination.
- 1.3 Eggs : Disease free egg laying (DFLs) preparation, Loose egg
preparation. Egg preservation
- 1.4 Egg hatching/Development : Embryonic development, Inhibition of embryonic
development. Artificial hatching, (Hot and Cold acid
treatment) Shipment of DFLs

2.0 Silkworm rearing

- 2.1 Rearing method/ requirements: Selection of silkworm race for rearing Collection of Seeds
(DFLs), Rearing Equipment, Rearing house (Model and
Thatched Roof)
- 2.2 Rearing requirements/ method: Disinfections of rearing house and appliances, brushing of
newly hatched larvae, Bed cleaning, Spacing and Dusting
of disinfectants. Maintenance of temperature, photoperiod
and humidity for rearing.
- 2.3 Food and Feeding : Quality, harvesting and storage of mulberry leaves.
Feeding and rearing of early and late stage larvae.
Schedule of feeding, artificial diet
- 2.4 Cocoon formation and adult : Ripening of worms, spinning of cocoon, emergence
Pre-pupal moulting, pupation and mounting of ripening
worms. Types of mountages, harvesting of cocoons.
Emergence of adult moths from cocoons, Inhibition of
adult emergence for silk production.

3.0 Reeling of cocoons

- 3.1 Cocoon preparations : Selection and preservation of cocoons for reeling, Drying /Stifling, Boiling, Top Boiling System, One Pan Boiling System, Three Pan boiling system, Sunken system, Brushing
- 3.2 Reeling appliances : Country Charkha, Cottage basin/Domestic machine Filature/Multiend machine, Automatic reeling machine
- 3.3 Reeling methods : Charkha reeling, Cottage basin reeling, Filature
- 3.4 Reeling operations : Reeling, Re-reeling, Lacing, Winding, Single and double twisting, Steaming, Twist reeling, Book press, Storage of yarn, Skeining unit
- 4.0 Marketing**
- 4.1 Cocoon marketing : Gradation of seed and reeling cocoons. Marketing of multivoltine, bivoltine and hybrid cocoons
- 4.2 Yarn marketing : Gradation of yarn Twisted/untwisted yarn, Marketing of yarn
- 4.3 Silk marketing prospects : Indian Market, International market, Foreign exchange earning
- 4.4 Cost benefit ratio : Cost of land and soil preparation. Cost of mulberry plantation and Management, Cost of silkworm rearing, Reeling of yarn, selling of the cocoons / yarn. Net profit.

PRACTICAL

1. Identification of mulberry varieties: External morphology and Anatomy of leaf, petiole, stem, root and stomatal frequency in leaf of different mulberry varieties.
2. Preparation of land and mulberry sowing
Ploughing, weeding, and leveling of land, manuring, methods of cutting (pruning), and transplantation of cutting into nursery and management, plantation methods, irrigation, doses of fertilizer, management of plantation.
3. Field collection
 - a) Diseases: Leaf spot, Powdery mildew, root knot, red rust, mulberry wilt.
 - b) Pests: Leaf eating caterpillar, Jassids, Thrips, Stem girdle beetle.

4. Preparation of life cycle of different races of silkworm
5. Rearing of silkworm and harvesting of cocoons
Disinfections, young age rearing, late age rearing, feeding, cleaning, spacing, dusting, moulting, determination of leaf, cocoon ratio, mountage, spinning and harvesting of cocoons.
6. External morphology and Sexual dimorphism in Larva, pupa and adults
7. Identification of internal organs of silkworm
Digestive system, Silk gland, Heart (Circulatory System), Central nervous system, Reproductive system of larva and adult, Mouth parts of larva
8. Silkworm seed
Selection and preservation of seed cocoons, sexing, regulation of mating, Mother moth examination, DFLs preparation, preparation of card and loose eggs and washing of eggs, hot and cold acid treatment.
9. Identification of embryonic growth in egg.
Stage of fertilization, blastoderm, germ band, spoon-shaped embryo, black head stage (4 – 10 days).
10. Identification of diseases and pests of silkworm and control strategy.
Diseases: Protozoan disease-pebrine (*Nosema bombycis*), Viral disease- Grasserie (NPV and CPV), Bacterial disease-Flacherie (*Cocoi and Bacillus*), Fungal disease- Muscardine (Red, White and Green) (*Beauvaria bassiana*).
Insect Pests: Uzi fly (*Tricholyga bombycis*), Dermestid beetle, Ants.
Vertebrate Pests: Lizards, Rats, Squirrels and Birds, Mechanical and Chemical Control.
11. Process of reeling
Cocoon drying/stifling, cocoon boiling, brushing, reeling, re-reeling, finishing and testing, winding, twisting, doubling, double twisting, steaming and twist reeling.
12. Market study with reference to silk cocoons, yarn and silk fibre.
13. Study tour.

SCHEDULE OF PRACTICALS AND DISTRIBUTION OF MARKS

Practical (6 hours duration)	(Marks) (80)
a) Silkworm anatomy	(10)
b) Identification of silkworm pathogens	(10)
c) Identification and comments on the spots (1-10)	(10)
d) Characteristics of mulberry leaves of different varieties	(05)

e)	Determination of stomatal frequency on mulberry leaves	(05)
f)	Demonstration of reeling and production of yarn	(05)
g)	Class Record	(05)
h)	Viva-Voce	(15)

Internal assessment	20
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Total Marks	100
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SEMESTER - II

Paper I

(Conservation and Utilization of Insect resources)

Unit I: Introduction to Insect

- 1.1 Introduction to insects : History, General Classification up to order.
- 1.2 General Body plan : Structure of Head, mouth parts, thorax, legs, wings, abdomen.
- 1.3 Development and life cycle : Development of Egg, Larva, Pupa, Adult.
- 1.4 Insect and Environment : Role of environmental factors (Temperature, Relative Humidity, Light) in development of life stages

Unit II: Sericulture

- 2.1 Sericulture : History and present status and sericulture in India.
- 2.2 Silkworms : Types, host plants, mulberry and Non-mulberry sericulture in India.
- 2.3 Silk production : Mulberry silk and non-mulberry silk production, Export and National income
- 2.4 Recent trends in Sericulture : Modernization of culture practices high yielding hybrid races of silkworm.

Unit III : Apiculture

- 3.1 Bee keeping : Present status of Apiculture in India,- Species of honey bees. life history, Structure of mouth parts, sting and hind legs (Pollen basket) of honeybee.
- 3.2 Bee colony : Castes, Natural colonies and their yield, Modern bee keeping, bee boxes, frames, queen excluder. Care and management - Bee diseases and enemies.

- 3.3 Bee foraging : Pollen and nectar yielding plants. Honey harvesting and processing maintenance and management.
- 3.4 Economics of Apiculture : Economic of apiary products: honey, bees wax, propolis, royal jelly.

Unit –IV: Lac culture

- 4.1 Lac insect : Taxonomy, Distribution, biology and life cycle of lac insect, Strains of lac insect
- 4.2 Host plants : Host plants: Ber, Palas, Kusum, Babul, Arhar (Tur), their diseases and Pest management.
- 4.3 Lac culture and their enemies : Lac cultivation techniques, natural inoculation and artificial inoculation, enemies of lac insect and their management.
- 4.4 Harvesting and Processing of lac : Harvesting of lac: Raw lac - Stick lac, Seed lac. Fine lac- Shellac, handmade process, heat process, Solvent process, Economic importance of lac.

Paper II

(Pest Management, Cell and Molecular Techniques)

Unit I : Insect pests

- 1.1 Insect Pests : Definition, Origin, Types of pests, Principles of integrated pest management.
- 1.2 Pests of Agriculture : Life cycle, Occurrence, host complex, Nature of Damage and control. Cotton boll worm, *Helicoverpa armigera* White fly, *Bemisia tabaci*, Paddy stem borer, *Scirpophaga incertulas*, Grass hopper, *Hieroglyphus* sp., Brown leaf hopper, *Nilaparvaat lugens*.
- 1.3 Pests of Vegetables & Fruits : Vegetable pests -Bringal shoot borer, *Leucinodes orbanalis*, Cabbage butterfly, *Pieris brassicae*, Fruit pests – Fruit sucking moth, *Othreis materna*, Citrus blackfly, *Aleurocanthus* sp.
- 1.4 Pests of stored grains : Pulse beetle, *Callosobruchus* sp. , Rice weevil, *Sitophilus oryzae*

Unit II: Insect vectors &Pest Management

- 2.1 Insects of medicinal importance : Mosquitoes – Anopheles, Aedes, Culex their Life cycle, Occurrence, hosts, transmitting pathogens and causing diseases, preventive and control measures.
- 2.2 Preventive measures : Mechanical control, Physical control, Cultural practices
- 2.3 Principles of Chemical control: Stomach poisons, Contact poisons, Systemic poisons, Fumigants, attractants and repellants and their mode of action with examples.
- 2.4 Principles of Biological control: Uses of Natural enemies - pathogen, parasite, predator, Microbial pesticides.

Unit III: Insect cell and tissue culture Technology

- 3.1 Facilities, equipment & Sterilization : Laboratory layout, Equipment, tools. Sterilization- Dry heat, moist heat (autoclaving), Radiation (UV, Gama Rays).
- 3.2 Preparation of Media : Balanced Salt Solutions, Natural Media, Chemically defined Insect Cell Culture Media, sterilization of culture media.
- 3.3 Setting up of Primary Cultures : Aseptic isolation of insect tissue, chopping of tissue, Cell Dissociation (Mechanical and Enzymatic), Transfer of cell and tissue fragments and cells to culture vessels.
- 3.4 Maintenance of cell lines : Methods of Sub-culturing, Measurement of cell growth, cell viability, Cryo-preservation of cell lines, Use of insect cell lines in production of insect pathogenic baculoviruses, recombinant viruses (bacmids) and recombinant protein.

Unit IV: Molecular Techniques & Bioinformatics

- 4.1 Immunological techniques : Single radial immune diffusion, Double radial immune diffusion, Rocket immune electrophoresis, PCR concept- Real time PCR.
- 4.2 Molecular Informatics : Protein Electrophoresis- Protein Quantification by Lowry and Bradford, Native PAGE, SDS PAGE, 2D Gel Electrophoresis, DNA Electrophoresis based Markers- RFLP, AFLP, and SSLP

- 4.3 Bioinformatics : Types of Database- Nucleic Acid, Protein, Metabolic Pathway databases, Literature survey by PUBMED, PUBMED CENTRAL.
- 4.4 Proteomics and genomics : Protein structure prediction, metabolic networking, Comparative genomics, Genome sequencing and alignment
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PRACTICAL

1. Visit to Apiculture, Lac culture, Sericulture units.
2. Rearing and maintenance of silkworm.
3. Field collection, identifications and preservation of pests, predators and natural enemies.
4. Assay of DNA by diphenylamine method. Assay of RNA by orcinol method. Assay of proteins by Lowry's method. Assay of proteins by E280/260 method.
5. Polyacrylamide gel electrophoresis of proteins, by SDS-PAGE protein, gel drying.
6. Analysis of protein and nucleic acid using Gel documentation system
7. Isolation of genomic DNA, Restriction digestion of a given DNA and electrophoresis of the digest, Restriction fragment length polymorphism.
8. Sterilization of glassware & culture media.
9. Preparation of media & Microbial culture.
10. Development of primary cell lines/maintenance of established cell lines, Observation of Characteristics of s in culture, measurement of cyto-toxicity.
11. PCR amplification of the given DNA fragment.
12. Survey of Literature databases using Internet.

SCHEDULE OF PRACTICALS AND DISTRIBUTION OF MARKS

The Practical comprises of two parts:

Part –I	(Marks)
Project work	(30)
Part –II	
(Practical) (6 hours duration)	(40)
a) Identification of Pests	(10)
b) Biochemical Estimation/Molecular Techniques	(05)

c)	Counting and viability testing of cultural cells/microbes	(05)
d)	Bioinformatics	(05)
e)	Class Record	(05)
f)	Viva-Voce	(10)

Internal assessment

10

(Project work + Practical + Internal (30+40+10) Total marks 80

BOOKS RECOMMENDED

- 1 **Handbook of Practical Sericulture** : Ullal, S.R. and Narasimhanna, M.N . (1987) Central Silk Board Publication, Bangalore.
- 2 **Advanced Economic Theory** : Ahuja, H.L., S. Chand & Co., Ltd., New Delhi.
- 3 **Exports and Development** : Koshy, T.D. (1990), Ashish Publication, New Delhi.
- 4 **Statistical Biannual** : CSB Publication, Bangalore.
- 5 **Statistical method** : Snedecor, G.W. and Cochran, W.C. (1979), Iowa State Univ. Press, Ames, Iowa.
- 6 **A Text Book of Economic Theory** : Stonier and Hague.
- 7 **Sericulture Society and Economy** : Hanumappa, H.G. (1993), Himalaya Publishing House, New Delhi.
- 8 **Development of Sericulture**: Narasaiah, M.L. and Jaya Raju (1999), Discovery Publishing House, New Delhi.
- 9 **Sericulture and Rural Development** : G. Sandhya Rani (1998), Discovery Publishing House, New Delhi.
- 10 **Comprehensive Sericulture Manual** : Mohan Rao, M.M. (1999), B.S. Publications, Hyderabad.
- 11 **Principles of Biostatistics** : Marcello Pagano Kimberlee Gauvreau, Duxburg, USA.
- 12 **Economics of Sericulture and Silk Industry in India** : Ramana, D.V. (1987), Deep and Deep Publishers, New Delhi.
- 13 **Silkman's Companion** : Anonymous (1992), CSB Publication, Bangalore.
- 14 **The Development of Indian Silk—A Wealth of Opportunities** : Sinha, S. (1960).
- 15 **An Introduction to Extension Education** : Supe, S.V.
- 16 **Extension Education** : Advi Reddy.
- 17 **Agricultural Marketing in India** Acharya, S.S. and Agrawal, N.L. (1999) Pub. By Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
- 18 **Education and Communication for Development** : Dahama, O.P. and Bhatnagar, O.P. Pub. by Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
- 19 **Silk Production, processing and marketing** : Nanavaty, M.N.
- 20 **Biostatistics** : Rama Krishna, P. 1996), Saras Publication, Kanyakumari.
- 21 **Economics of Sericulture under Irrigated and Rainfed Conditions** : (1982) M.S. Jolly, CSR & TI, Mysore.
- 22 **An Analysis of Demand and Supply prospectus for High Quality Raw Silk** : Naik, G and Babu, K.R. (1991), Centre for Management in Agriculture, Ahmedabad.
- 23 **Bioinformatics—Methods and Protocols** : Ed. By Stephen Misener and Stephen, A. Krawetz Humana Press Totowa, New Jersey.

- 24 **Culture of Animal Cells** by Freshney
- 25 **Biotechnology** by B. D. Singh
- 26 **Biophysical Chemistry: Principles and Techniques** by Upadhyay, Upadhyay, Nath
- 27 **MOLBIO: Fundamentals of Molecular Biology** by Upadhyay & Upadhyay
- 28 **Genetics (Vol 1& 2)** by C. B. Powar
- 29 **Molecular Biotechnology: Principles and Applications of Recombinant DNA** by Glick & Pasternak
- 30 **Principles of Gene manipulation:** Primrose and Old
- 31 **An Introduction to genetic Analysis** by Griffith, miller, Suzuki and Gilbert
32. **Genomes 2:** T. A. Brown