

UNIVERSITY OF MUMBAI

No.UG/ 247 of 2006

**CIRCULAR:-**

Attention of the Director/Heads recognized Science Institutions concerned and Principals of the affiliated colleges in the Faculty of Science is hereby invited to the Ordinances, Regulations and syllabi relating to the Master of Science (M.Sc. Parts I and II) vide pamphlet No.175 and they are hereby informed that the recommendation made by the Chairperson of the Board of Studies in Botany has been accepted by the Academic Council at its meeting held on 7<sup>th</sup> June,2006 vide Item No.4.14 and subsequently approved by the Management Council at its meeting held on 16<sup>th</sup> June,2006 vide Item No.13 and that in accordance therewith the M.Sc. degree course in Herbal Sciences has been instituted by the University from the academic year 2006-2007.

Further that in exercise of the powers conferred upon the Management Council under Section 54(1) and Section 55(1) of the Maharashtra Universities Act 1994, it has made the Ordinances 5654 and 5655 and Regulations 5544, 5545, 5546,5547,5548,5549 and 5550 including syllabus relating to the M.Sc. degree course in Herbal Sciences is passed as per Appendix and that the same has been brought into force with effect from the academic year 2006-2007.

MUMBAI-400 032

12<sup>th</sup> July, 2006

A.C./4.14/07.06.2006

M.C./13/16.06.2006

To,

The Director/Heads recognized Science Institutions concerned and the Principals of the affiliated colleges in Faculty of Science

*C. S. Pathak*  
for REGISTRAR

No.UG/ 247 -A of 2006, MUMBAI-400 032 12<sup>th</sup> July, 2006

Copy forwarded with compliments for information to :-

1. The Dean, Faculty of Science
2. The Chairperson, Board of Studies in Botany

*C. S. Pathak*  
for REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Personal Assistants to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Officer on Special Duty-cum- Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar, (PRO), the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and that no separate Action Taken Report will be sent in this connection. the Asst. Registrar Constituent Colleges Unit (2 copies), BUCT (1 copy), the Deputy Account, Unit V (1 copy) the In-charge Director, Centralize Communication Facility (1 copy), the Receptionist (1 copy), the Te



7/6/06

**UNIVERSITY OF MUMBAI**



**ORDINANCES, REGULATIONS,  
SCHEME AND SYLLABUS  
FOR  
M.SC. DEGREE COURSE IN  
HERBAL SCIENCES**

**(With effect from the academic year 2006-2007)**

### Objectives:

The main objective of the 2 year M. Sc. programme in Herbal Sciences is to develop trained human resources for the fast growing herbal industry in India and Abroad.

India is one of the 12 mega biodiversity centers having over 45,000 plant species which include 15,000 - 18,000 flowering plants, 23,000 fungi, 2,500 algae, 1,600 lichens, 1,800 bryophytes and 30 million micro-organisms. About 1,500 different plants with medicinal uses are mentioned in ancient texts and around 800 plant species have been used in traditional medicine.

Apart from potential source for biodynamic compounds useful to modern medicine, the traditional herbal medicine wisdom is now being recognized as critically useful, in providing effective primary health care to the poor world. Acknowledging its potential, World Health Organization (WHO) in 1977 urged the Countries of the world to develop programs to utilize these traditional herbal medicines. These herbal medicines of traditional origin find greater acceptance with local populations and are continued to be used even today.

About 80% of the world population depends on traditional medicines for primary health care. With increasing demand for herbal medicines, plant materials are collected and processed by several manufacturers and are further dispensed by different practitioners. Hence, there is a need for quality control at each stage so that every manufacturer produces drugs of same efficacy and quality. There is a dire need for standardization of herbal preparations which form a part of traditional medicines. This will ensure same quality of formulation being received by the end-user. This task requires trained work force with enough knowledge of Herbal Technology. Anticipating a need for such a professional course in the near future, we have decided to launch a 2 year M. Sc. programme in Herbal Sciences to be awarded by the University of Mumbai. The Course is sponsored by UGC under innovative programme during X<sup>th</sup> plan.

Introducing the Post Graduate Course in Herbal Science a career oriented professional course may cater to the needs of the students of the area and provide opportunity and Career Avenues to the students of Biological Sciences.

The proximity of Kalyan city to industrial belts of Mumbai, Thane, Navi Mumbai, Murbad etc., which have many small and medium sized Herbal based industries can be tapped by our College for Institute-Industry linkage for providing 'hands-on' training to the students in varied Herbal Technology. After completion of the course the students will be provided assistance in job placement or even in entrepreneurial ventures.

UNIVERSITY OF MUMBAI  
ORDINANCES, REGULATIONS AND SYLLABUS FOR  
M. Sc Degree Course in Herbal Sciences  
(Faculty of Science)

(O)---<sup>5654</sup>Title: M.Sc. Degree course in Herbal Sciences

(R)---<sup>5544</sup>Duration: Two Year Full Time Course

(R)---<sup>5545</sup>Total study hours and credits:

M.Sc. Part I:

Four theory papers, each of 90 contact hours

Total contact hours = 360 = 24 Credits

Four practicals, each of 90 contact hours

Total contact hours = 360 = 12 Credits

M.Sc. Part II:

Four theory papers, each of 90 contact hours

Total contact hours = 360 = 24 Credits

Two practicals, each of 60 contact hours

Total contact hours = 180 = 06 Credits

Project work:

Total contact hours = 180 = 06 Credits

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Total contact hours = 1080 = 72 Credits

<sup>5655</sup> ( 15hrs of theory=1 credit & 30 hrs of practical= 1 credit )  
(O)---Eligibility: Following candidates are eligible for admission

\* B. Sc. in any Subject of Biological Sciences / Biochemistry/  
Chemistry with any one Subject of Biological Sciences up to S. Y.  
level from any recognized University with 50% marks.

\*The admission will be granted on the basis of the marks obtained in  
the entrance examination conducted by the College and as per the  
guidelines of the University of Mumbai.

<sup>5546</sup>  
(R)---Intake Capacity : 25

<sup>5547</sup>  
(R)---Teacher's Qualification:

Core faculty: Ph.D. in Botany Or M.Sc. in Botany with minimum of 3 years  
post graduate teaching experience after acquiring recognition as post  
graduate teacher in Botany (Experience includes both theory and  
practicals)

Visiting faculty: Ph.D. in Botany/ Zoology/ Microbiology/ Bio-Chemistry/  
Pharmacognocoy

5548  
(R)---Examination Pattern:

M.Sc. Part I:

Four theory papers each of 75 marks and 3 hours duration

Four practicals, each of 50 marks and 6 hours duration.

M.Sc. Part II:

Four theory papers each of 75 marks and 3 hours duration.

Two practicals, each of 50 marks and 6 hours duration.

Project work: A project of 100 marks

Dissertation based on, INDUSTRIAL / INHOUSE PROJECT to be submitted at the time of final practical examination of M. Sc.(II). Students are expected to devote their full time attention to their project work under the guidance of the Research Supervisor.

For the purpose of calculating workload, the time devoted by the Research Supervisor/s in guiding the research project/s shall be treated equivalent to 8 periods of lectures per week. i.e. the total periods allotted for conducting 2 practicals.

5549  
(R)---Award of Grade

| Marks out of 100 | Grade            |
|------------------|------------------|
| 80-100           | A+ - Outstanding |
| 70-79            | A - Excellent    |
| 60-69            | B+ -Very Good    |
| 55-59            | B -Good          |
| 45-54            | C -Satisfactory  |
| 35-44            | D -Passing       |
| < 35             | F -Failure       |

5550  
(R)---Fee structure (Per year):

|                   |              |
|-------------------|--------------|
| 1. Tuition Fee    | 15,000       |
| 2. Laboratory Fee | 5,000        |
| 3. Project work   | 2,000        |
| 4. Other Fees     | <u>3,000</u> |
| Total             | 25,000       |

# M. Sc. in Herbal Science

## SYLLABUS FOR THEORY

### M. Sc. Part I:

#### Paper I : Plant Sciences

#### Lectures

30

##### Unit -I

Historical background, Present status and Scope of:  
Medicinal Botany, Pharmacognocny, Aroma therapy, Cosmetology etc. with  
special reference to literature.  
Pharmacopoeia of India.

30

##### Unit - II

Taxonomic structure, Classification of plants – general outline, major  
taxonomic groups, Taxonomic literature, Nomenclature,

30

##### Unit - III

Plant identification strategies

- Taxonomic evidences: Application of information from interrelated subjects.
  - a) Exomorphic characters
  - b) Endomorphic characters: Anatomical, Cytological, Palynological, &  
Embryological
  - c) Physico-chemical characters: Ash content, extractive values, qualitative  
chemical analysis, quantitative chemical analysis.

#### Paper II : Modern Plant Authentication Techniques

30

##### Unit-I

Chromatography: Principles, instrumentation, processes, applications - TLC,  
HPTLC, HPLC, GC

30

##### Unit-II

Electrophoresis- Basic protein chemistry, principles of separation,  
equipment and process, standardization of technique

Spectroscopy: Introductory principles; Principles & Instrumentation and  
application of UV and Visible, Turbidometry, IR, AAS, NMR, ICP and X-ray  
diffraction.

Genomics and Proteomics : DNA finger printing, molecular markers, Different analytical techniques used for purification and determining molecular size, shape, diffusion and sedimentation, Gel filtration, viscosity, light scattering, small angle scattering methods, capillary isoelectric focusing, electro spray, ionization, mass spectrometry (CIEF-ESI-MS), 2-D PAGE, ELECTROSPRAY MS/MS (NANOSPRAY and LC/MS/MS) MALDI-TOF-MS, BIOCHIPS (DNA CHIPS, PROTEIN CHIPS AND SENSOR CHIPS)

Bioinformatics: Protein sequence analysis, Protein structure analysis and applications, Microarray analysis and organization of data, Human genome analysis.

### Paper III : Cultivation practices.

#### Unit-I

30

Conventional (Reproductive and vegetative) and Biotechnological methods of plant propagation (Micropropagation, somatic embryogenesis and somaclonal variation. standardization of cultivation protocols of selected medicinal plants.

#### Unit-II

30

Polyhouse technology: Selection of site and type of polyhouse, construction, additional facilities in polyhouses maintaining temperature and humidity; Irrigation, soil management pest management.

#### Unit-III

30

Alternative method of secondary metabolite production: Organ culture, Cell culture. Biotransformations (microbial and plant cells)

Scale up : enhancement of product formation by elicitation, permeabilization of plant cells for product release,

### Paper IV : Phytoconstituents

#### Unit-I

30

Study of Chemical nature of following phytoconstituents- Alkaloids, Glycosides, Tannins and other phenolic compounds, volatile oils, turpines.

#### Unit-II

30

Carbohydrate Metabolism, Lipid Metabolism, Turpines, Phenolics

Enzymes:- Classification, IUB/EC Nomenclature, Michaelis-Menten Kinetics, L. B. Plot,  $K_m$  – definition and significance, enzyme inhibition – various types, allosteric enzymes, Isoenzymes – clinical significance.

## PRACTICALS

### M. Sc. Part I

#### Practical I : Plant Sciences

- a. Exomorphic features of medicinal plants from following Families and their uses.

|               |                |               |
|---------------|----------------|---------------|
| Malvaceae     | Plantaginaceae | Solanaceae    |
| Apocynaceae   | Papaveraceae   | Annonaceae    |
| Lamiaceae     | Apiaceae       | Myrtaceae     |
| Anacardiaceae | Sapindaceae    | Sterculiaceae |
| Mimosaceae    | Combretaceae   |               |

- b. Study of Following plants and Spot test for their active constituents.

#### (i) Medicinal plants

*Datura* (Tropane Alkaloids), *Anurographis* (diterpene lactose), *Curcuma* (curcuminoids), *Boerhaavia* (glycoside), *Ricinus* (fatty acids), *Terminalia* *belerica* (tannins), *Allium sativum* (sulphur compounds)

#### (ii). Cosmetics & Aroma therapy

*Vetiveria zizanioidis*, *Rosa sinensis*, *Jasminum* spp. *Pogostemon patcholi*

#### (iii). Food additives

*Bixa orellana*, *Beta vulgaris*, *Cinamomum tamala*, *Zingiber officinalis*, *Allium sativum*, *Curcuma longa*.

#### (iv) Nutraceuticals: *Spirulina*, *Chlorella*, Sea weeds (*Laminaria*)

- c. Physico-chemical studies of *Adhathoda* leaf w. r. t. ash content and extractive value (Water, Methyl alcohol, Acetone)

#### Practical II: Modern Analytical techniques

- a) Principles and applications of UV – Visible spectroscope and IR Spectroscope.
- b) Separation of Phytochemicals using different methods of Chromatography (Paper, TLC, HPTLC, GC, Column)

- c) Extraction and separation of Protein from the given raw material / products using PAGE
- d) Extraction and separation of Nucleic acid by Gel electrophoresis.
- e) PCR techniques (RAPD)
- f) Use of internet and WWW. Tools used in Bioinformatics related to Herbal technology – NCBI data model.

### Practical III: Cultivation practices.

#### A]. Methods of Propagation

- a) Effect of pH, Temperature, PGR and substratum on seed germination.
- b) Breaking of dormancy by chemical and physical methods.
- c) Study of viability of different seeds.
- d) Study of the growth pattern in stem cuttings, effect of PGR in stem cutting.
- e) Sterilization of glass wares and explants.
- f) Plant tissue culture: - Callus culture, Organ culture, Meristem culture, Cell suspension culture, Protoplast culture, Somatic embryogenesis and synthetic seed production.

#### B]. Plant cell culture

- a) Enhancement of phytochemicals in culture system using physical and chemical agents.
- b) Standardisation of micropropagation methods for selected medicinal plants.

#### C]. Polyhouse technology

- a) Types of polyhouses and uses.
- b) Determination of quantity of water needed for pot cultivation in polyhouse.
- c) Control of temperature and humidity in polyhouses.
- d) Pest management in polyhouse cultivation.
- e) Preparation of report w. r. t. (a) to (d).

### Practical IV : Phytoconstituents.

1. Estimation of Alkaloids.
2. Estimation of Reducing sugars.
3. Estimation of Fatty acids.
4. Determination of Saponification value.
5. Estimation of Proteins by (a) Biuret Method (b) Folin-Lowry Method.
6. Assay and determination of Km value of the following enzymes from the crude enzyme extract.
  - a. Amylase from germinating seeds.
  - b. Cellulase from fungi.

Paper V: Microbiology, Immunology, Human Body

Unit - I 30  
Study of the following forms with reference to their structure and pathogenesis:

*Mycobacterium*, *E. coli*, Retrovirus, *Herpes*, *Candida*, *Trichophyton*, *Entamoeba*, *Ascaris*, Guinea worm, Tape worm. Scabies.

Unit - II 30  
Human system: General view and broad outline of the following systems- Digestive, Circulatory, Respiratory, Excretory and Reproductive. Histology of skin.

Endocrinology: Organization of mammalian endocrine system, biosynthesis, storage, release, transport, physiological functions and degradation of the hormones of pituitary, hypothalamus, thyroid, adrenal gland, gonads, Pancreas, GI track, mode of hormone action, role of secondary messenger.

Unit - III 30  
Immunology:  
(i) Introduction- Phylogeny of Immune system, Innate and acquired immunity, Clonal nature of immune responses.  
(ii) Organization and structure of lymphoid organs.  
(iii) Antibody structure and functions. Antigen antibody interaction  
(iv) Regulation of immune response. Antigen processing and presentation, generation of humoral and cell mediated immune responses. Activation of B and T lymphocytes. Cytokines and their role in immune regulation. T cell regulation. MHC restriction. Immunological tolerance  
(v) Hypersensitivity. Autoimmunity. Immunity to infectious agents (intracellular parasites, helminthes and viruses. AIDS and immunodeficiencies.

Paper VI : Herbal Sciences – Commercial aspect

Unit - I: 30  
Collection, stabilization, Drying and Preservation of crude drugs. Detection of adulterants w. r. t. anatomical features.  
Quality assurance; Herbal Technology: Success stories with reference to cultivation practices, harvesting, packing and forwarding.

## Unit – II:

Entrepreneurship development: Definition; Characteristics and qualities of entrepreneur, concept of entrepreneurship, sources of finance, technical assistance.

Marketing and advertising, legal formalities and provisions, export and import policies with reference to herbal drugs

## Unit – III:

30

IPR, Patenting and Registration of New Drugs: WTO and its implications (for drugs), patents act with emphasis on Indian Patents Act, US and European patent regulations, requirements for filing patent, Patent protection and patent servicing, Issues in registering herbal drugs

**Paper VII : Herbal formulations**

## Unit – I:

30

Classical systems of medicine I: Ayurveda- Principles and practice, types of drug formulation, methods of manufacture- raw material to finished product.

## Unit – II:

30

Classical systems of medicine II: Siddha and Unani- Principles and practice, types of drug formulation, methods of manufacture- raw material to finished product.

## Unit – III:

30

Modern system of medicine: Principles and practice, evolution of new drug molecule, drug formulations, efficacy testing.

Other uses: Medicated oils and powders, toiletries.

**Paper VIII : Plant Biotechnology and Environmental Science**

## Unit – I:

30

Bioremediation and Phytoremediation : Detoxification of xenobiotics, chemical modification, compartmentation, superaccumulators.

Safety regulations in handling of genetically engineered organisms.

## Unit – II:

30

The quest for commercial production from plant cell scaling up of cell cultures, important factors for bioreactor design, Pneumatically agitated bioreactors, comparison of bioreactors, operating mode, batch, fed batch, semicontinuous, two stage operation, continuous cultivation, example : Shikonin production by *Lithospermum erythrorhizon*, cell cultures.

Commercial production of herbal tinctures. Herbal extracts by using solvents of different polarity.

### M. Sc. Part II (Practicals)

#### Practical V: Microbiology, Immunology, Human Body

- a) Simple and differential staining, Gram's staining, Endospore staining, Acid fast staining.
- b) Growth curve of *E. coli*.
- c) Production of Alcohol.
- d) Isolation of aerial microflora (Bacteria and Fungi).
- e) Maintenance of Fungal cultures.
- f) MIC of sugar.
- g) MIC of NaCl.
- h) Immobilization of Yeast and study of invertase activity.
- i) Preparation of Antigen. Slide and Tube agglutination using antigen and antibody.
- j) ELISA tests.
- k) Study of the Histological organization of various human organs with help of permanent slides/chart.
- l) Detection of liver disorders by means of SGOT, SGPT, bilirubin.

#### Practical VI: Herbal Technology Commercial Aspects.

- a) Preparation of project plan for establishing herbal industry with reference to finance, technical assistance, marketing strategy etc.
- b) Preparation of an advertisement for herbal products (any five)  
Collection of advertisements printed in print media (any five) and preview of the same.
- c) Preparation of report for Field visit to the Herbal Industry (three) w.r.t. manufacturing, packaging and forwarding of products.
- d) Microbiology of Products: (i) Identification and monitoring of microbial contamination in the herbal products – visual and Microbiological methods.  
(ii) Study of different storage methods suitable for the herbal products
- e) Filling of application forms for patent registration as per the Indian patent act, US and European patent regulation.

| HORTICULTURE |                                              |                    |             |      |         |           |
|--------------|----------------------------------------------|--------------------|-------------|------|---------|-----------|
| Sr.NO        | Title                                        | Author             | Publisher   | Year | Edition | Acc.No    |
| 1            | Text book of Horticulture                    | Maribhushan.Rao    | Mamlian     | 1995 |         | 14853 J/C |
| 2            | Allelopathy:Field Observations & Methodology | Narwal Shamsheer S | Scientific  | 1996 |         | 34221     |
| 3            | A Hand book of Practical Horticulture        | Banerjee, Utpal    | Mangal Deep | 2002 |         | 48582     |
| 4            | Horticulture of Science                      | Janick Jales       | Surjeet     | 1982 |         | 31165     |
| 5            | Principal of Horticulture                    | Damodams.C.R       | Heinemann   | 1984 |         | 19574     |
| 6            | Fundamentals of Horticulture                 | Edmond,J.B         | TMH         | 1985 |         | 19485     |
| 7            | Greenhouse Mang. For Horticulture Crops      | Prasad, S          | Agrobios    | 2001 |         | 43348     |
| 8            | Complete Home Gardening                      | Dey, S.C           | Agrobios    | 2001 |         | 44449     |
| 9            | Allelopathy in Crop Production               | Narwal Shamsheer S | Scientific  | 1994 |         | 34223     |
| 10           | Indian Vegetable Plantation                  | Gillian, VV        | Akash Deep  | 1989 |         | 12246 J/C |

#### IMMUNOLOGY

| Sr.NO | Title                              | Author        | Publisher   | Year | Edition | Acc.No |
|-------|------------------------------------|---------------|-------------|------|---------|--------|
| 1     | Essential Immunology               | Roitt, Ivan   | Oxford      | 1994 | 8th     | 32692  |
| 2     | Clinical Immunology                | Bradley Jhon  | Oxford      | 1997 |         | 35858  |
| 3     | Immunology Introductory            | Shetty, N     | New Age     | 2000 |         | 42702  |
| 4     | Immunology                         | Joshi, K.R    | Agro        | 1972 |         | 29045  |
| 5     | Immunology                         | Chakravarty   | TMH         | 1996 |         | 33740  |
| 6     | Immunology                         | Lydyand, P.M  | Viva        | 2003 |         | 48573  |
| 7     | Immunology                         | Diamond's E.P | Academic    | 1996 |         | 34935  |
| 8     | Immunology                         | Yadav, P.R    | Diccovery   | 2004 |         | 49865  |
| 9     | Immunology Essential, Fundamentals | Pathak, S.P   |             |      |         |        |
| 10    | Essential Immunology               | Roitt, Ivan   | Mosby       | 2004 | 6th     | 49041  |
| 11    | Immunology                         | Kuby, Janis   | W.H.Freeman | 1997 | 3rd     | 37351  |
| 12    | Immunology                         | Tizzard       |             |      |         |        |

#### Human Physiology

| Sr.NO | Title                                       | Author         | Publisher      | Year | Edition | Acc.No |
|-------|---------------------------------------------|----------------|----------------|------|---------|--------|
| 1     | Human Concepts of Anatomy & Physiology      | Van De Graaff  | wm.c.Brown     | 1995 | 4th     | 43043  |
| 2     | Human Physiology the Mechanisms of Body fun | Vander Aurther | wcb, microw-ll | 1998 | 7th     |        |
| 3     | Principal of Anatomy & Physiology           | Tortora, G.S   | John Wiley     | 2000 | 9th     |        |
| 4     | A text book of Medical Physiology           | Guyton & Hall  | Prism Book     | 1996 | 9th     | 34459  |
| 5     | Human physiology                            | Chatterji      | Central book   | 1972 | 8th     | 15142  |

| INDUSTRIAL MICROBIOLOGY |                                                   |                   |                |      |         |          |
|-------------------------|---------------------------------------------------|-------------------|----------------|------|---------|----------|
| Sr.NO                   | Title                                             | Author            | Publisher      | Year | Edition | Acc.No   |
| 1                       | Manual of Industrial Microbiology & Biotechnology | Denain Arnold     | ASM Press      | 1999 | 2nd     | 49402    |
| 2                       | Industrial Microbiology                           | Patel A.H         |                |      |         |          |
| 3                       | Industrial Microbiology                           | Cassida           |                |      |         |          |
| 4                       | Food Microbiology                                 | Jay James         |                |      |         |          |
| 5                       | Food Microbiology                                 | Frizier           |                |      |         |          |
| 6                       | Industrial Microbiology                           | Presscott & Durin | CBS            | 1999 |         | 42281    |
| 7                       | Industrial Microbiology                           | Standbury &       |                |      |         |          |
| MOLECULAR BIOLOGY       |                                                   |                   |                |      |         |          |
| Sr.NO                   | Title                                             | Author            | Publisher      | Year | Edition | Acc.No   |
| 1                       | Instant Notes Molecular Biology                   | Turner P.C        | Viva           | 2002 |         | 48220    |
| 2                       | Molecular cell Biology                            | Lodish            | W H Freeman    | 2004 |         | 48273    |
| 3                       | Essential of Molecular Biology                    | Freidler          | Narosa         | 1998 |         | 48279    |
| 4                       | Advanced Molecular Biology                        | Tryman            | Viva           | 2003 |         | 48575    |
| PLANT ANATOMY           |                                                   |                   |                |      |         |          |
| Sr.NO                   | Title                                             | Author            | Publisher      | Year | Edition | Acc.No   |
| 1                       | Plant Anatomy: Cell and Tissues part-1            | Cutter E.G        | Edward Arnold  |      |         | 2531 P/F |
| 2                       | Plant Anatomy: Experiment & Interpretation Part-2 | Cutter E.G        | Edward Arnold  |      |         | 2532 P/F |
| 3                       | Plant Anatomy: Experiment & Interpretation Part-2 | Cutter E.G        | Edward Arnold  |      |         | 14420    |
| 4                       | Plant Anatomy: Cell and Tissues part-1            | Cutter E.G        | Edward Arnold  |      |         | 1441     |
| 5                       | Applied Plant Anatomy                             | Cutter E.G        | ELBS           |      |         | 10787    |
| 6                       | Applied Plant Anatomy                             | Cutter E.G        | ELBS           |      |         | 17603    |
| 7                       | Anatomy and Activities of Plants A guide to the   | Clegg C.G         | John Murray    |      |         | 15123    |
| 8                       | An Introduction to Plant Anatomy                  | Eames A.J         | TMH            |      | 2nd     | 8252     |
| 9                       | An Introduction to Plant Anatomy                  | Eames A.J         | TMH            |      | 23rd    | 34855    |
| 10                      | An Introduction to Plant Anatomy                  | Eames A.J         | TMH            |      | 2nd     | 2557 F/F |
| 11                      | An Introduction to Plant Anatomy                  | Eames A.J         | TMH            |      | 2nd     | 2030 P/F |
| 12                      | An Introduction to Plant Anatomy                  | Eames A.J         | TMH            |      | 2nd     | 1885 J/C |
| 13                      | Plant Anatomy                                     | Chandurkar P.J    | IBM            |      | 4th     | 7191     |
| 14                      | Plant Anatomy                                     | Chandurkar P.J    | IBM            |      | 4th     | 10154    |
| 15                      | Plant Anatomy                                     | Fahn A            | Pergamon Press |      | 3rd     | 19488    |
| 16                      | Practical Plant Anatomy                           | Foster A.S        | East-West      |      |         | 31531    |
| 17                      | Practical Plant Anatomy                           | Esau Katherine    | Wiley Eastern  |      | 4th     | 17340    |
| 18                      | Practical Plant Anatomy                           | Esau Katherine    | Wiley Eastern  |      | 1st     | 4491     |
| 19                      | The Plant Community                               | Hamson H.C        | East-West      |      |         | 2832 P/F |
| 20                      | Plant Anatomy                                     | Tayal M.S         | Rastogi        |      | 4th     | 3458 J/C |
| 21                      | Plant Anatomy                                     | Tayal M.S         | Rastogi        |      | 4th     | 31138    |

|    |               |           |         |     |          |
|----|---------------|-----------|---------|-----|----------|
| 22 | Plant Anatomy | Tayal M S | Rastogi | 4th | 3457 J/C |
| 23 | Plant Anatomy | Loyal M S | Rastogi | 4th | 3222 J/C |

| PATHOLOGY |                                                 |                 |             |      |         |           |
|-----------|-------------------------------------------------|-----------------|-------------|------|---------|-----------|
| Sr.NO     | Title                                           | Author          | Publisher   | Year | Edition | Acc.No    |
| 1         | Text book of Pathology                          | Mohan Harsh     | Jaypee      | 1998 | 3rd     | 16282 J/C |
| 2         | Plant Pathology                                 | George H Agrios | Academic    | 1990 | 3rd     | 25610     |
| 3         | Recent Advances in Plant Pathology              | Akhil Hussain   | Print House | 1983 | 1st     | 17716     |
| 4         | Plant Pathology and Plant Pathogens             | Dickenson C.H   | Blackwell   | 1982 | 2nd     | 5141 J/C  |
| 5         | Biological Control of Microbial Plant Pathogens | Campt ell R     | Cambridge   | 1988 | 1st     | 2435      |

| Plant Biotechnology |                                                |                 |               |      |         |        |
|---------------------|------------------------------------------------|-----------------|---------------|------|---------|--------|
| Sr.NO               | Title                                          | Author          | Publisher     | Year | Edition | Acc.No |
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| 2                   | Plant Biotechnology & Molecular Markers        | Srivastava.P.S  | Anamaya       | 2004 | 1st     | 48576  |
| 3                   | Applied Plant Biotechnology                    | Iganasi Muthu   | TMH           | 1996 | 1st     | 34039  |
| 4                   | Biotechnology in Plant Science                 | N.C.Kumar       | Himalaya      | 1999 | 1st     | 38883  |
| 5                   | Cynaobacterial Algal Metabolism and Environ    | Falima Tasneem  | Narosa        | 1999 | 1st     | 38604  |
| 6                   | Laboratory Manual of Plant Biotechnology       | S.S. Purohit    | Agro Botinica | 1998 | 1st     | 35903  |
| 7                   | Agricultural Biotechnology                     | S.S. Purohit    | Agro Botinica | 1999 | 1st     | 41958  |
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| 9                   | Seeds Bioregulators nad Applied Plant Biotechn | Bora.K.K        | Pointer.      | 2002 | 1st     | 45708  |
| 10                  | Impact of Plant Biotechnology on Horticulture  | Prasad Surendra | Agro Botinica | 1996 | 1st     | 35904  |
| 11                  | Biotechnology and Plant Pathology: Current Tre | Aroa.D.K        | Printwell     | 2000 | 1st     | 42677  |

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| 2           | The Ethnobotany of Eastern Ghats in Andhra Pr | Rao, N R | Botanical, India | 1996 |         |        |
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| 2                 | Cell & Molecular Biology           | Rastogi S C  | Wage / New De   | 2003 |         | 47845  |
| 3                 | Essentials of Molecular Biology    | Freifelder D | Jones / Boston  | 1985 |         | 24386  |
| 4                 | Cell & Molecular Biology Vol - 1   | Dupraw E J   | Academic / Ne   | 1968 |         | 10157  |
| 5                 | Essential Molecular Biology Vol- 1 | Brown        | Oxford / London | 1991 |         | 28030  |
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| 7                | Molecular Cell Biology                        | Lodish           | W H Freeman      | 2004 |         | 48273    |
| 8                | Essential of Molecular Biology                | Freifelder       | Narosa           | 1998 |         | 48279    |
| 9                | Advanced Molecular Biology                    | Twyman           | Viva             | 2003 |         | 48575    |
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| 3                | A Text book of Plant Physiology               | Kachhar, P L     | Uma Ram / Del    | 1978 |         | 2384 P/1 |
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| 5                | Plant Physiology                              | Hess Dieter      | Brosa / New De   | 1975 |         | 10762    |
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| 7                | Plant Physiology Vol.III                      | Steward, F C     | ademic / New Y   | 1983 |         | 17574    |
| 8                | Plant Physiology                              | Mukherjee S      |                  | 1996 |         | 34854    |
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| 10               | Introductory Plant Physiology                 | Noggle, G Ray    | ice-Hall / New   | 1994 |         | 33078    |
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| 12               | Plant Physiology                              | Bidwell, R G S   | aw - Hill / New  | 1974 |         | 12559    |
| 13               | Plant Physiology                              | Kumar, J S       | Agrobips         | 2001 |         | 46101    |
| 14               | Plant Physiology                              | Purohit, S.S     | Student          | 2003 |         | 48188    |
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