



**TAMIL NADU STATE COUNCIL FOR  
HIGHER EDUCATION**  
CHENNAI 600 005

**Report of the Workshop on  
'Botany Education in the 21<sup>st</sup> Century'**

**August 2006**

## **Introduction**

Curriculum Development is a ceaseless process of searching for qualitative improvement in education in response to the changes taking place in the society. It is a total process in which different components such as formulation of a curriculum policy, curriculum research, curriculum planning, its implementation and then its evaluation play an important role.

The number of teachers playing an active role in designing the curriculum is obviously very small, although as its implementers they make a very vital contribution to the educational process. Teachers have to be an integral part of the curriculum development process and must include training in both the teaching methods and evaluation procedures.

Leaving teachers out of the design and development of curriculum change is most likely to result in little if any, real change in the scenario. Teacher involvement in curriculum development is desirable particularly because it can be a motivating factor for teachers in their profession, giving them a sense of ownership of the curriculum they have to transact.

This formed the basis for Tamil Nadu State Council for Higher Education in organizing a workshop on "Botany Education in the 21<sup>st</sup> Century" involving teachers from all autonomous colleges and universities in Tamilnadu. These teachers analyzed the existing curriculum and syllabus and introduced necessary changes on the basis of societal needs. Since the teachers of Botany prepared the syllabus, they have taken into account, what is desirable, which includes the employability of Botany graduates. All the teacher participants expressed the need for common core papers and selective optional papers according to regional requirements.

The Council believes that this curriculum and syllabus circulated among participants and institutions will be of use to all concerned and serve as a model in framing their curriculum and syllabus.

**TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION,  
CHENNAI 600 005**

**Workshop on “Botany Education in the 21<sup>st</sup> Century”  
27<sup>th</sup> and 28<sup>th</sup> January 2006**

**PROGRAMME**

27-1-2006

- 10.00 a.m. - Registration
- 10.30 a.m. - Inauguration
- Special Address : Prof. S. Swaminatha Pillai
- 11.30 a.m. - Tea
- 11.45 a.m. - Framing the Structure of the Curriculum
- 1.00 p.m. - Lunch
- 2.00 p.m. – 5.00 p.m. - Generation of Model Syllabi in groups

28-1-2006

- 10.00 a.m. – 11.15 a.m. - Generation of Model Syllabi in groups
- 11.15 a.m. – 11.30 a.m. - Tea
- 11.30 a.m. - Generation of Model Syllabi in groups
- 1.00 p.m. - Lunch
- 2.00 – 4.00 p.m. - Finalizing the Syllabi and Valediction

Valedictory Address : Thiru. K.S. Sripathi, IAS,  
Secretary to Government,  
Higher Education Department  
Vice-Chairman (i/c) &  
Member-Secretary (i/c), TANSCHÉ

- Vote of Thanks - Dr. S. Padmavathy,  
Research Officer, TANSCHÉ

# CURRICULUM DEVELOPMENT PROCESS

S. SWAMINATHA PILLAI

## COMPETENCIES TO BE DEVELOPED:

Knowing the form and function of a curriculum.  
Understanding the need for a curriculum.  
Following several steps in developing a curriculum.  
Evaluating a curriculum.  
Appreciating the role of curriculum in the social process of education.

## ABSTRACT:

*Curriculum is a contact document between the stakeholders of the educational process. It fulfils the need for directing, implementing and satisfying their role performance in the society. Being scientific in its approach a curriculum specifies all the required conditions for effective learning and teaching including testing, besides leading to continuous individual and social development. The philosophical foundations of an society is the basis for a curriculum; the practical and successful living is the result of well-developed curriculum. Economy of efforts, materials, manpower, time and money is achieved in the otherwise long, unwieldy and indirect process of education.*

## INTRODUCTION

The long and continuous social process of education is often offered in terms of specified periods. These periods are identified as stages of education viz., early childhood to university education. In each stage there may be several parallel forms or structures like general, special or professional education depending on the needs of the pursuers of education at that stage. To make them ready and interested in their direction of learning and teaching, it is required that both the teachers and the learners should have a clear idea about their plans and activities. This can be set by them if they are mature enough to draw the plan. Very often there arises a situation that quantitative expansion like population increase and transfer of persons like social mobility requiring some sort of uniformity or equality paving way for easy movement and comfort and confidence. Hence there is a need for a common source and plan to enable the younger generation to get the required education assuring a

sort of commonly recognized competencies at each stage of human development. This requirement is fulfilled by what is called curriculum.

## **WHAT IS A CURRICULUM?**

A curriculum seeks to answer questions like ‘What shall I teach or learn?’, ‘Why should I teach or learn?’, ‘How will I teach or learn?’, ‘What resources do I have at my disposal?’, and ‘How do I know if I have succeeded in my learning or teaching?’ Thus a curriculum is **a conceptual scheme** for joint implementation by teachers and learners in core, observed and appreciated by parents and users of the product/ learners in effect and valued and admired by other stakeholders as a result. It is in fact **a changing and living entity** in view of its need for continuous modification as demanded by the members of the society in view of the fast and dynamic changes around. It is obtained from **three sources** such as replacing the familiar environment of **family and friends to school and college**, moving from the **present scenario** to a predicted or even unpredicted **future situation** and making the implementers or beneficiaries **dependent or independent**, or balancing between **individuality and conformity**.

A curriculum is in fact **a programme of studies** or activities (curricular, co-curricular and extra curricular) and guidance. It can function as a scale of values providing a set of criteria. Arising from the **basic needs** and moving on to **social, cultural, individual and traditional needs**, the curriculum very often attempts to fulfil **the ideal needs also**, such as intellectual, moral, aesthetic and religious needs. Curriculum is frequently viewed as **a school/college/university function** for preserving and transmitting traditional cultures, for the transformation of culture, and primarily **for individual development** of the participants.

## **PRESSURES AND PRINCIPLES OF CURRICULUM DEVELOPMENT**

Curriculum is developed under **economic and social pressures**, caused by **knowledge explosion** and utilizing **research findings**. The principles of governing the development of a curriculum can be stated as follows:

*Curriculum should be **dynamic** enough to accommodate the changes in social environment; it should be specifically **goal-oriented** to move towards the accepted direction causing success; **scientific** method needs to be adopted in*

*developing a curriculum to make it reliable and successful; and curriculum has to be **evaluative** with a built-in mechanism of evaluation; and however it should be **comprehensive** enough to bring in clarity, brevity and surety in its success.*

Specifying the **objectives** in observable terms, describing a variety of alternative **learning experiences**, selecting the most appropriate **content** from the vast store of human knowledge, **organizing and integrating** the items into a homogeneous whole and providing for adequate and accurate measures of **evaluation** of the achievement of the state objectives so as to minimize, if not avoid, any loss or distortion of human development.

### **STAGES OF CURRICULUM DEVELOPMENT:**

There are several stages in the development of a curriculum. The following are the most identifiable and adoptable stages as practiced by the curriculum developers:

**PLANNING:** Observing the gaps, if any, between the educational achievements and the social development there should be a systematic attempt to identify the new needs of the society by adopting the techniques of need analysis. Considering the social forces, needs, goals and objectives, knowledge has to be treated for human development on the philosophical tenets of the society incorporating the learning process with the selection of proper instructional procedure decision is to be taken on the proposed curriculum.

**PREPARING:** Collecting the available data, identifying the relevant sources, organizing adequate and suitable manpower, debating several styles of learning and strategies of teaching, arranging for several materials useful to cull out specific content from, a curriculum developer has to be prepared for the process. Following a systemic approach the constituent subsystems need to be integrated to deal with the collected data yielding the relevant content to be selected, organized and assessment pattern to be specified.

**DESIGNING:** Levels, types and structure of educational institutions which are to adopt the proposed curriculum, precepts and practices of educational technology, humanistic approach, vocational possibilities and social

reconstruction contribute to the design of a curriculum. Even the concept of de-schooling or out-of-school or distance or on-line education will have a bearing process. The popular and prominent curriculum models of Tyler and Taba offer potentials of the curriculum development.

**DEVELOPMENT:** Curriculum development considers instructional development, learning materials and instructional media development besides strategies of teaching and techniques of testing. It is an integrated process taking into account all possible educational practices. Three different diagrammatic approaches are presented in the next section of this paper.

**IMPLEMENTATION:** The chief implementers of a curriculum are teachers and learners although other educational managers have assigned roles to play. Policy-makers, system managers, auxiliary manpower like technicians and other personnel and evaluators along with users like higher education system and employment organizations definitely play a secondary role in this regard.

**EVALUATION:** After implementing a curriculum it is essential to evaluate the same for its effectiveness, deficiencies and mishaps. There are several models of evaluation of a curriculum proposed by experts as in the case of Stufflebeam's model or CIPP model. In any case teacher evaluation of students followed by an analysis of the latter's performance, student evaluation of students followed by their experiences, materials evaluation of all concerned and evaluation of the testing techniques adopted and the examination pattern used form the basis for valid, reliable and acceptable evaluation of a curriculum.

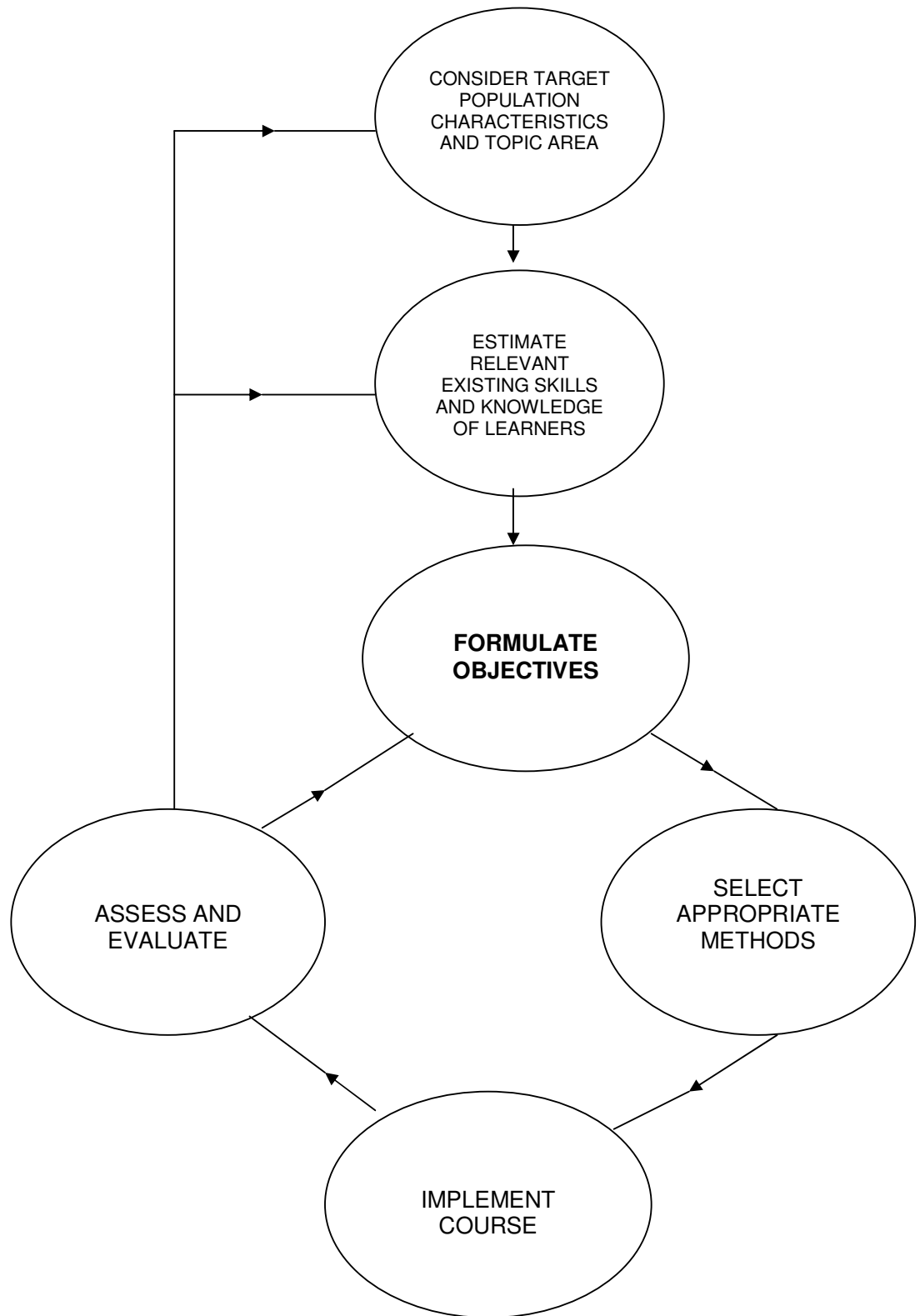
**REVIEW:** The after-effects of such evaluation will be the need and the mode of reviewing the developed and implemented curriculum periodically so as to make modifications in the relevant aspects of the curriculum. As per the present conditions the life of a curriculum is not even five years unlike in the past. Even annual review for making required changes in the curriculum makes it more dynamic, organizationally difficult though.

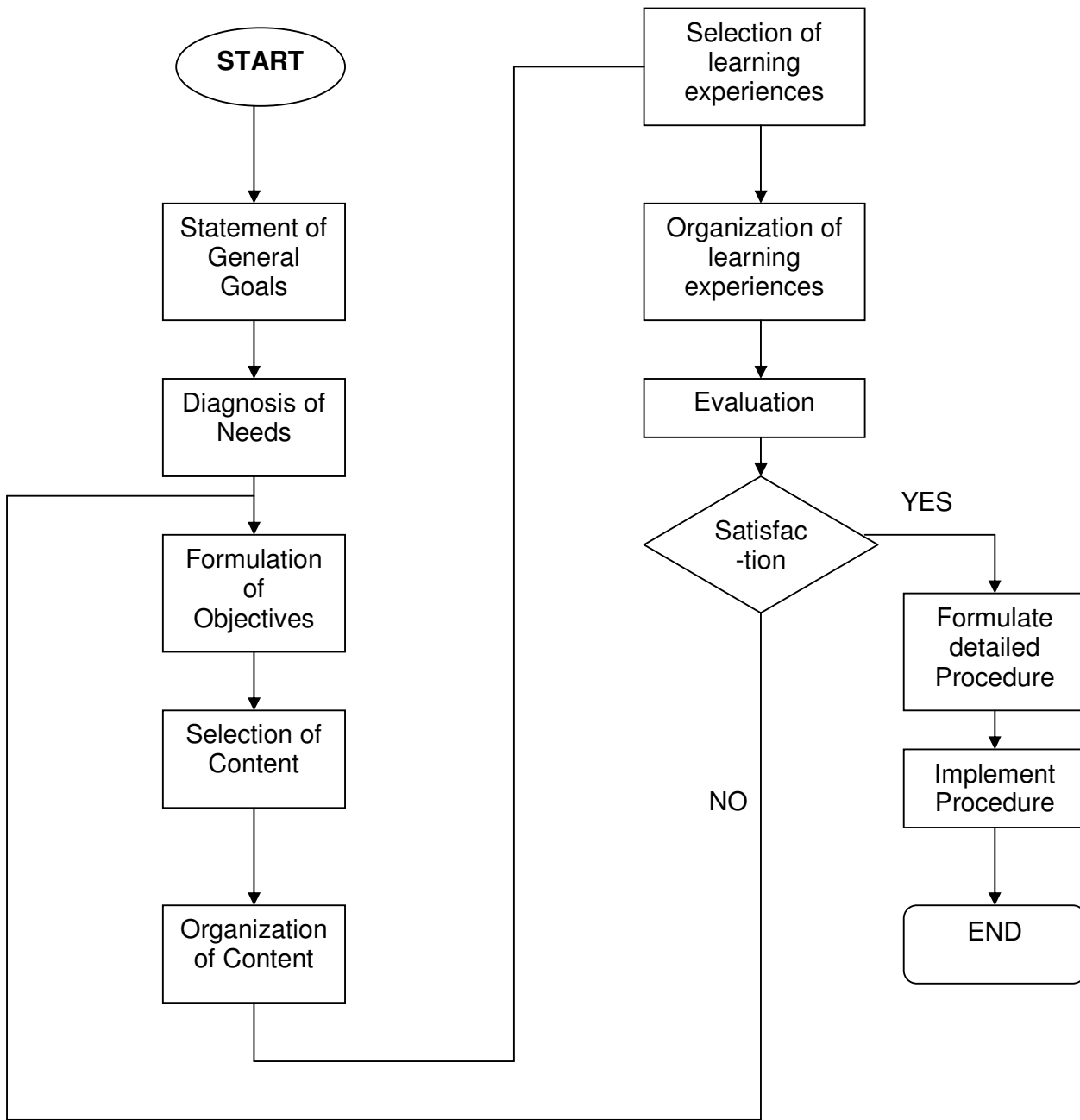
**IMPROVEMENT:** In order to improve a curriculum the process should have a re-look including restart from the scratch. Tinkering with a curriculum makes

it lopsided and takes its life away. Total revision is always a must. In view of the fast changes in the social milieu and of the human knowledge and experience the concept of rolling curriculum will yield better results. Anyway every five, or better, three years or period of duration of a course offered there is a need Curriculum improvement or revision or even reconstruction.

CURRICULUM DEVELOPMENT MODELS:

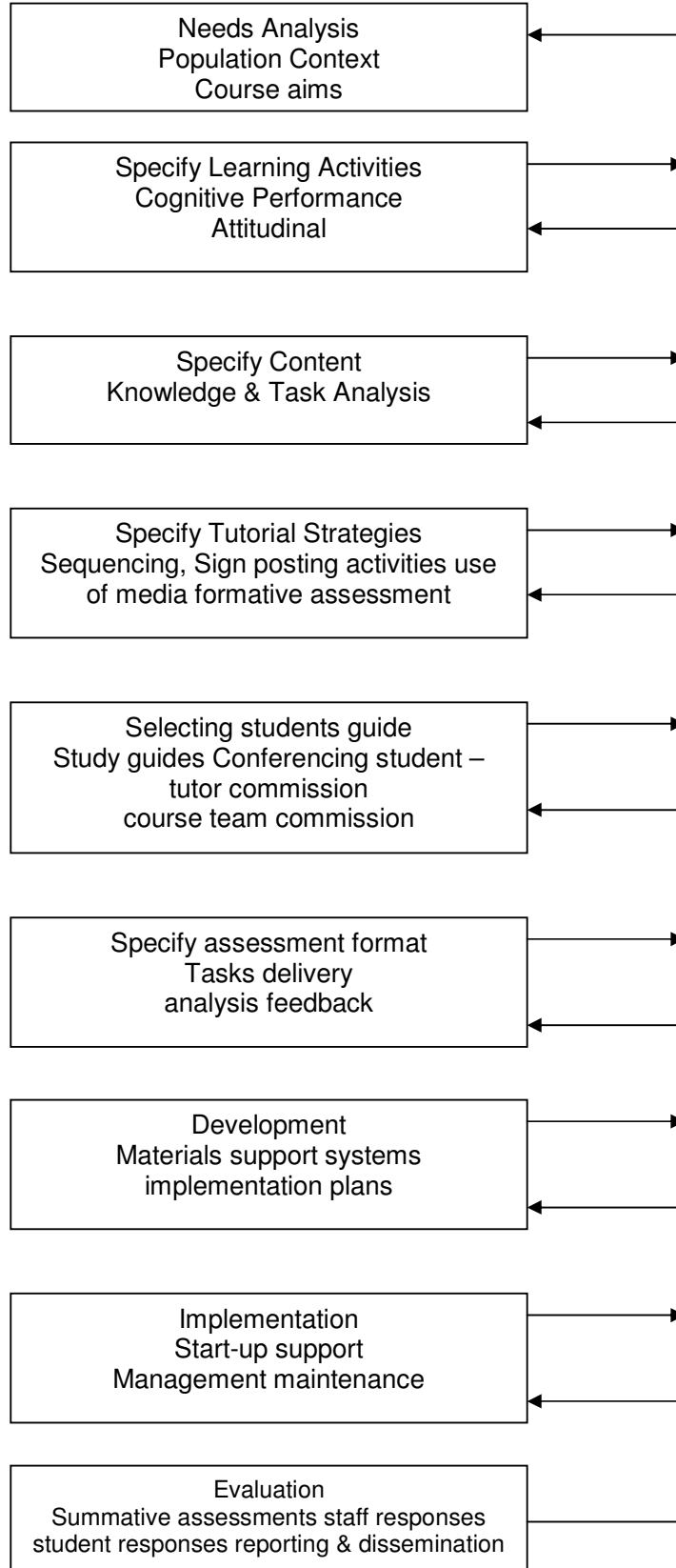
1. A SIMPLIFIED SYSTEMS APPROACH





**FLOWCHART REPRESENTATION OF TABA-TYLER CURRICULUM DEVELOPMENT MODEL**

### 3. THE COURSE DESIGN PROCESS



## **CURRICULUM & SYLLABUS STRUCTURE:**

### Structure of Curriculum

1. Introduction
2. Scope
3. Aims & Goals
4. Courses of Studies
  - Paper I
  - Paper II
  - Paper III
5. Methodology
6. Materials
7. Media
8. Evaluation
9. Outcome

### **Structure of Syllabus**

1. Linkage
2. Objectives
  - General
  - Specific (Competences)
3. Structured Content
4. Materials
5. Methods & Media
6. Testing

F.N.:-

Objectives

Competencies

Achieve Objectives

Demonstrate Competences

Able to -----

Can do / does -----

'Learning outcome'

'Performance descriptors'

skills

indicators

## **CURRICULUM CHANGES:**

National aspirations and needs, cultural change, social change caused by technological development, economic changes, political variations and changes in values, the value system in vogue, philosophical, sociological and psychological approaches tend to make changes in the curriculum. The National Framework for School Curriculum 2000 has now been revised as the National Framework for School Curriculum 2005. This is an example of curriculum change due to one or more of the above contexts affecting the same.

## **CONCLUSION:**

As an MOU between the participants in the curriculum process, any curriculum is subjected to a variety of pressures, forces and changes. The vital factor involved is the societal need arising then and there in any modern set-up. Speed on the one hand and economy on the other hand provide the essential impetus to the periodical development of different curricula of different stages of education. From a one-month programme to even a five-year programme several curricula need to be developed to supply the specifically needed manpower meeting the demands of a nation.

## **References**

Taba, Hilda (1988) Curriculum Development  
Tyler, Robert (1986) Curriculum Development Process  
(not available) (1990) The Course Design

## **PROPOSED MODEL CURRICULUM**

Prepared in a workshop organised at Chennai on 27<sup>th</sup> and 28<sup>th</sup> January 2006 and discussed in the meeting of the Tamil Nadu State Council for Higher Education on 11<sup>th</sup> August 2006.

Recommended to the Universities in Tamil Nadu offering B.Sc. - Plant Biology and Plant Biotechnology (Botany) Degree programmes and to all Autonomous Colleges for consideration in their Academic bodies and consequent implementation from a specified academic year.

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## **Aims and Objectives**

The new syllabus has been reconstructed and remodeled taking into consideration, the changes which have been incorporated at the +2 syllabus.

1. To restructure the syllabus and make it contemporary and on par with the emerging concepts of 21<sup>st</sup> century.
2. To construct the syllabus according to semester pattern and credit system.
3. To remodel the syllabus in order to have an inter-disciplinary approach.

The syllabus has focused to impart the latest concepts in Cell Biology and Molecular Biology keeping in mind the new developments and discoveries taking place around the world.

The syllabus has been developed to arouse the curiosity of the students and inculcate in them a sense of spirit, wonder and appreciation to the dynamics of nature.

An evolutionary link has been maintained throughout the subjects dealing with biodiversity from the first semester to the final semester.

The syllabus has been drafted to enrich the students with the identification of plants and phytodrugs; preparation of permanent microslides; cultivation of edible mushrooms.

The syllabus has been rewritten clearly and concisely so that the students should have knowledge to appreciate the environment, ecology and biodiversity aspects of plants when taken on a field trip.

A new paper has been introduced in the name of Herbal Botany in the core subject. It deals with the study of phytodrugs, their identification, assessing the adulterant and substitute plants in Indian System of Medicine (alternative systems of medicine). This study also enriches the Systematic Botany which can be utilized for botanical diagnosis of fragmentary crude drugs. This study will be useful in

identifying medicinal taxa; since the students are aware of systematic botany (Morphology and Taxonomy of flowering plants).

Question papers patterns were prepared in such a way that they should probe the subject depth of students and make them think and apply what they have learnt through the syllabus instead of relying on memory and rote knowledge.

The syllabus has been framed in such a way so that it gives a solid foundation with the lucid understanding of the subject for the post-graduate courses like Molecular Biology; Biotechnology; Microbiology; Medical Genetics; Horticulture and Plant Biology and Plant Biotechnology (Botany).

The enclosed syllabus includes 12 core subjects, four practicals for B.Sc., and the total number of optional papers (Application Oriented Subjects) offered is twenty (Out of which two have to be selected).

## **CORE PAPERS**

1. Algae and Bryophytes
2. Fungi, Plant Pathology and Lichenology
3. Anatomy, Microtechnique and Embryology of Angiosperms
4. Pteridophytes, Gymnosperms and Palaeobotany
5. Morphology, Taxonomy and Economic Botany
6. Cell and Molecular biology
7. Microbiology
8. Biochemistry, Biophysics and Biometrics
9. Plant Physiology
10. Biotechnology
11. Herbal Botany
12. Genetics and Plant Breeding

## **ALLIED PAPERS**

1. Allied Botany -I
2. Allied Botany - II

## **ALLIED PRACTICAL**

## **OPTIONAL PAPERS**

1. Bio-informatics
2. Forest Technology
3. Seed Technology
4. Remote sensing and Natural Resource Management
5. Biodiversity Conservation and Management
6. Nursery and Landscaping
7. Preservation of Fruits and Vegetables
8. Digital Taxonomy
9. Tissue Culture
10. Bio-Nano-Technology
11. Horticulture
12. Instrumentation

13. Laboratory Techniques
14. Molecular Taxonomy
15. Stress Physiology
16. Mushroom Cultivation
17. Microbial Technology
18. Environmental Biotechnology
19. Fermentation Technology
20. Renewable Energy Sources

S.No.	Semester	No. of papers	SUBJECTS	HOURS		Total hours/work	Credit
				Theory	Practical		
1.	I	1	Algae & Bryophytes	7	2	9	4
2.	II	2	Fungi, Plant pathology and Lichenology	7	2	9	4
3.		P-1	Practicals for papers 1 and 2	-	-		4
4.	III	3	Anatomy & Microtechnique and Embryology	7	2	9	4
5.	IV	4	Pteridophytes, Gymnosperms & Palaeobotany	7	2	9	4
6.		P-2	Practicals for papers 4 & 5	-	-		4
7.	V	5	Morphology & Taxonomy	5	2	30	4
8.		6	Cell and Molecular biology	5	2		4
9.		7	Microbiology	4	2		4
10.		8	Biochemistry, Biophysics & Biometrics	4	2		4
11.		9	Application oriented subject	4			4
12.	IV	10	Plant physiology	5	2	30	4
13.		11	Biotechnology	5	2		4
14.		12	Herbal botany	4	2		4
15.		13	Genetics & Plant breeding	4	2		4
16.		14	Application oriented subject	4			4
17.		P-3	Practicals for papers 6, 7, 8, 9, 10	-	-		4
18.		P-4	Practicals for papers 11, 12, 13, 14, 15	-	-		4
<b>Total</b>							<b>7</b>
							<b>6</b>
<p><b>(Theory papers – 14, Practical papers – 4)</b></p> <p><b>(Theory Papers = Core + Optional Papers)</b>  <b>(12 + 2 = 14)</b></p> <p><b>Credit Distribution</b></p> <p>Part – I Language - 16</p> <p>Part-II English - 16</p> <p>Major - 76 (72+4) Credits</p> <p>Allied - 16</p> <p><b>Total - 124 (Hours)</b></p>							

## A. Pattern of Question Paper

Time: 3 Hrs

Max. Marks: 80

### Section – A

(5 X 2 = 10)

Answer ALL questions

1. Question from Unit I
2. Question from Unit II
3. Question from Unit III
4. Question from Unit IV
5. Question from Unit V

### Section – B

(5 X 5 = 25)

Answer ALL questions

6. a (or) b (from Unit I)
7. a (or) b (from Unit II)
8. a (or) b (from Unit III)
9. a (or) b (from Unit IV)
10. a (or) b (from Unit V)

### Section – C

(3 X 15 = 45)

Answer ALL questions

11. a (or) b
12. a (or) b Minimum one question from each unit
13. a (or) b

**For all theory and practical papers**

End Semester Examination Marks	=	80
Continuous Assessment Marks	=	20
<b>Total</b>	=	----- 100 -----

## B. Total Marks in Major Subjects

Number of Theory papers	-	14	Core subjects - 12 papers
Number of Practical papers	-	4	Optionals - 2 papers
Total Number of Papers	-	18	14
External Evaluation Marks	18 X 80	-----	1440
Internal Evaluation Marks	18 X 20	-----	360
<b>Total Marks</b>			----- 1800 -----

**PROPOSED MODEL SYLLABI FOR CORE PAPERS**

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HOD of Botany,  
Arulmigu Palani Andavar  
Arts College for Women,  
Chinnakalayamputhur,  
Palani 624 615.

Dr. V. Ganesan,  
Reader in Botany,  
Ayya Nadar Janaki Ammal College,  
Sivakasi – 626 124.

Mrs. P. Selvarathy,  
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Sivakasi 626 123.

Dr. K. Natarajan,  
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Dr. A.E. Dulip Daniels,  
Lecturer in Botany (Senior Scale),  
Scott Christian College,  
Nagercoil – 629 003.

Mrs. Pon. Selvameena,  
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Lecturer S.G. in Botany,  
Sri G.V.G. Visalakshi College  
for Women,  
Udulmalpet – 642 128.

Dr. K. Kala,  
Reader in Botany,  
Government Arts College,  
Thanthonimalai,  
Karur - 639 005.

Thiru. S. Murugesan,  
Principal,  
Government Arts College,  
Salem – 636 007.

Thiru. C.S. Suryanarayanan,  
S.G. Lecturer in Botany,  
Member, Board of Studies  
in Botany,  
Periyar University,  
Salem – 636 011.

Thiru. A. Padmanabhan,  
SG Lecturer in Botany,  
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Dharmapuri 636 705.

Thiru. G. Dhoss,  
SG Lecturer in Botany,  
Arignar Anna Government  
Arts College for Men,  
Namakkal – 637 001.

Dr. P.R. Anbudurai,  
Reader & Head-in Charge,  
Department of Botany,  
The American College,  
Madurai – 625 002.

Thiru. S. Palaniappan,  
HOD of Botany,  
H.H.The Rajah's College,  
Pudukkottai 622 001.

Thiru. K. Mani,  
S.G. Lecturer & HOD of Botany,  
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Chennai 600 035.

## **CORE PAPERS**

1. Algae and Bryophytes
2. Fungi, Plant Pathology and Lichenology
3. Anatomy, Microtechnique and Embryology of Angiosperms
4. Pteridophytes, Gymnosperms and Palaeobotany
5. Morphology, Taxonomy and Economic Botany
6. Cell and Molecular biology
7. Microbiology
8. Biochemistry, Biophysics and Biometrics
9. Plant Physiology
10. Biotechnology
11. Herbal Botany
12. Genetics and Plant Breeding

## ALGAE AND BRYOPHYTES

Hours: (7 + 2)

### Aims and objectives

1. To have a general understanding about the major groups of algae and bryophytes.
2. To learn to identify the different groups studied.
3. To understand the evolution of plants.

**UNIT I:** General classification of algae based on Fritsch (1935-45). Habits and habitats of fresh water, marine and terrestrial forms. Economic importance of algae with reference to Agar, Alginate, Carageenan, diatomaceous earth, Oxidation ponds, Single cell protein, Biofertilizers and antibiotics.

**UNIT II:** Distribution, ecology, structure, reproduction and life-history of the following types (need not study the development of sex organs): *Oscillatoria, Chlamydomonas, Volvox, Coleochaete, Cladophora, Oedogonium.*

**UNIT III:** *Caulerpa, Chara, Vaucheria, Diatoms, Sargassum, Gracilaria.*

**UNIT IV:** General classification of bryophytes based on E.V. Watson(1981). Economic importance of bryophytes.

**UNIT V:** Distribution, ecology, structure, reproduction and life cycle of the following types (need not study the development of sex organs): *Marchantia, Porella, Anthoceros, Polytrichum.*

### Practicals

1. To make suitable micro preparations of the types studied.
2. To identify micro-slides relevant to the syllabus.
3. To identify types from algae mixtures.
4. To maintain a record note book.
5. Field trips.

### Books for Study

1. Parihar, N.S.,1967, An introduction to Embryophyta Vol.II Central Book Depot, Allahabad.
2. Prem Puri,1981, Bryophytes morphology, growth and differentiation. Atma Ram & Sons, Delhi. Lucknow.

3. Vashista Sinha B.R., Singh, V.P.,2002, A.R., Botany for Degree students, Alage 9<sup>th</sup> revised edition, S.Chand & Company Ltd., New Delhi.
4. Pandey B.P., 2000 Revised edition, Text Book of Botany Algae, S. Chand & Company, New Delhi.
5. Mukta Bhargava, 2003, The latest portfolio of theory and practice in Alage; Dominant publishers and distributors, New Delhi.
6. Sharma O.P.,1992, Text Book of Alage, Tata Mc.Gram Hill Publication Company Ltd., New Delhi.

### **Books for Reference**

1. Fritsch, F.E., 1935-45, The structure and reproduction alage. Cambridge University Press UK. Vols. I and II.
2. Smith, G.M., 1955, Cryptogamic Botany (Vol. I Alage, fungi & lichens) Tata McGraw-Hill book Co. New Delhi.
3. Ian Morris,1967, An introduction to algae. Hutchinson, London.
4. Round, F.E.,1973, Biology of algae – 2<sup>nd</sup> edition. Edward Arnold, London.
5. Chapman, V.J. & Chapman, D.J.,1973, The alage – 2<sup>nd</sup> edition. ELBS and Mac Millan.
6. Watson, E.V.,1981, British mosses and liverworts, 2<sup>nd</sup> edition. Cambridge University Press UK.

## FUNGI, PLANT PATHOLOGY AND LICHENOLOGY

Hours: (7 + 2)

### Aims and objectives

After studying this course the student will be able to appreciate the importance of Fungi in maintaining the CO<sub>2</sub> level in the atmosphere, as these are natural decomposers of the plant kingdom.

The student will be able to understand the symptomology of diseases; thereby gaining knowledge on prevention of diseases.

**UNIT I:** A study of general characteristics of Fungi – Classification by Alexopoulos & Mims (1978) – Isolation and culture of fungi – Economic importance of fungi with reference to edible fungi (*Pleurotus*), antibiotics (Penicillin), Bio-control (*Trichoderma*) and fermentation (Yeast), Micorrhizae (VAM).

**UNIT II:** A detailed study of the structure reproduction and life cycle of the following:

- |                          |                         |
|--------------------------|-------------------------|
| 1. <i>Plasmodiophora</i> | 3. <i>Pilobolus</i>     |
| 2. <i>Albugo</i>         | 4. <i>Saccharomyces</i> |

**UNIT III:**

5. <i>Neurospora</i>	7. <i>Puccinia</i>
6. <i>Peziza</i>	8. <i>Polyporus</i>
	9. <i>Fusarium</i>

**UNIT IV:** Organisms and causal factors responsible for plant diseases – A study of the following diseases with reference to causal organism, disease symptoms, disease cycle and control measures.

- |                            |                          |
|----------------------------|--------------------------|
| (a) Little leaf of Brinjal | (c) Citrus canker        |
| (b) TMV                    | (d) Red Rot of sugarcane |
| (e) Tikka of Groundnut     |                          |

**UNIT V:** Occurrence, distribution, classification, organisation, reproduction and economic importance of lichens – A detailed study of the life cycle of *Usnea*.

### Practicals

1. Detailed study of the examples specified in the theory part with suitable micropreparations and permanent slides.
2. Study of pathological specimens included in the syllabus.

### **Books for Study**

1. Vashista B.R., 1982, Botany for degree students – Fungi – S. Chand & Co. New Delhi.
2. Chopra G.L. A text book of fungi S. Nagin & Co. Meerut India.
3. Srivastava, J.P. Introduction to fungi Central Book depot, Allahabad.
4. Pandey B.P., 1997 College Botany Vol. I Fungi and Pathology.
5. Bilgrami K.S. and Dube H.C. A text books of plant pathology, Vikas, New Delhi.
6. Singh, R.S. Plant Diseases Oxford IBH.

### **Books for Reference**

1. Alexopoulos C.J., Mims C.W. and Black Well M., 1996, Introductory Mycology. John Wiley and Sons INC. Singapore.
2. Webster J.,1991, Introduction to Fungi.
3. Burnett J.H.,1968, Fundamentals of Mycology.
4. Ingold C.T.,1976, The biology of Fungi. Hutchinson, London.
5. Rangaswami, G. & Mahadevan A., 2002, Diseases of Crop plants in India, Prentice Hall of India (P) Ltd., New Delhi.
6. Mishra A and Agarwall, R.P., 1978, Lichens – A preliminary text. Oxford.

## **ANATOMY, MICROTECHNIQUE AND EMBRYOLOGY OF ANGIOSPERMS**

**Hours: (7 + 2)**

### **Aim and objectives**

1. To understand and appreciate the internal organization of various plant parts.
2. To acquire knowledge on the development of embryo in plant.
3. To train the students in handling microscopes and in taking sections.
4. Training the students in various staining techniques.
5. To study the embryo of live specimen.
6. To generate self-employment by training the students in preparing permanent slides in anatomy and embryology.

### **ANATOMY**

**UNIT I:** Plant tissues – Classification – Definition, dedifferentiation, redifferentiation. Meristems – classification based on distribution and origin of shoot, root apical organization – various concepts of apical meristem – Epidermal tissue system, stomatal types, vascular cambium – structure, function and seasonal activities. Brief account of secondary tissues – Transfer cells.

**UNIT II:** Primary and Secondary structures of dicot stem and dicot root. Structures of monocot stem and root. Structure of aerial root. Structures of monocot and Dicot leaves. Secondary xylem: Dendrochronology, heart wood, sap wood, Secondary/phloem – Anomalous secondary growth in Dicot stem – *Achyranthes*, *Boerhavia*, Secondary growth in *Dracaena* (Monocot) stem, Nodal anatomy – Uni, Tri and Multilacunar nodes.

**UNIT III:** Microtechnique: Principles of Microscopy – fixation – fixatives – embedding and sectioning. Staining – Maceration and clearing.

### **EMBRYOLOGY**

**UNIT IV:** Structure and development of anther, development of male gametophyte, Ultrastructure of pollen grain, structure and types of ovules – Development of female gametophyte, Monosporic – *Polygonum*, Bisporic – *Allium*, Tetrasporic – *Peperomia*.

**UNIT V:** A brief account on pollination, fertilization, Endosperm: Nuclear, Cellular, Helobial, Ruminant Endosperm haustoria. Development of Embryos in Dicot (*Capsella*) and Monocot (*Najas*). Polyembryony, Apomixis, Embryo culture.

## **Practicals**

1. Study of simple and complex tissues.
2. Study of primary structure of Dicot stem, Dicot root, Monocot root, Monocot stem.
3. Anatomy of Dicot and Monocot leaf.
4. Normal secondary thickening in Dicot stem and root.
5. Anomalous secondary structure – *Achyranthes Boerhavia* (Dicot), *Dracaena* (Monocot).
6. Types of stomata and Nodes.
7. T.S. of anther at various stages (Permanent slides).
8. Types of ovules (slides).
9. Stages in Microsporogenesis and Megasporogenesis (slides).
10. Male gametophyte, female gametophyte.
11. Embryo Mounting (*Tridax* or *Cucurbits*).

## **Books for Study**

1. Pandey, B.P., 1978, Plant Anatomy, S.Chand and Co., New Delhi.
2. Vasishta, P.C., Plant Anatomy.
3. John Johi Prakash, E., 1987, A text book of Plant Anatomy Emkany publication, New Delhi.
4. Bhojvani S.S. and Bhatnagar, S.P., 1978, The Embryology of Angiosperms.
5. Dwinedi, J.N., 1988, Embryology of Angiosperms, Rastogi and Co., Meerut.

## **Books for Reference**

1. Foster, A.S. Practical Plant Anatomy.
2. Esau, K. 1975, Plant Anatomy Wiley Eastern Private Limited, New Delhi.
3. Fahan, A. 1974, Plant Anatomy, Pergonam Press, Oxford.
4. Maheswari, P. 1971, An introduction to Embryology of Angiosperms. Tata McGraw Hill Publishing Co. Ltd, New Delhi.

5. Swamy, B.G.L. and Krishnamurthy, K.V. From Flower to fruit. Tata McGraw Hill Publishing Company Limited, New Delhi.
6. Johanson, D.A.,1946, Plant Microtechnique, Mc Graw Hill Book Company, New York.
7. Sass, J.E.,1958, Botanical Microtechnique (3<sup>rd</sup> Edn.) State College Press, Amer Iowa.

## PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY

Hours: (7 + 2)

### Aim and objectives

After studying this paper the students will be able to identify in the field the forms prescribed in the syllabus and appreciate their ecological importance.

Students will understand the plant diversity and importance of conservation.

Students will be able to understand the chronological events that have taken place in the history of Earth while studying palaeobotany.

### UNIT I: PTERIDOPHYTES

Occurrence – Distribution – General characters and classification (A.J. Eames 1936) – Stellar evolution – Homospory and heterospory – Apospory and apogamy.

**UNIT II:** Structure and life cycle of the following genera: *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, *Adiantum*, *Marselia*.

### UNIT III: GYMNOSPERMS

Occurrence – Distribution – General characters and classification (K.R. Sporne 1965)– Economic and Ecological importance.

**UNIT IV:** Structure and reproduction of *Pinus* and *Gnetum* (Developmental studies not to be discussed) - Evolutionary significance of *Gnetum*.

### UNIT V: PALAEOBOTANY

Geological time scale - Methods of fossilization and types of fossils (Impression, Compression, Cast, Mold, Amber and Petrified fossils) – Radio carbon dating. Brief study of the following type genera *Lepidodendron* – *Calamites* – *Williamsonia*.

### Practicals

Morphological and anatomical study of the types included in the syllabus (Excluding *Psilotum*).

### **Books for Study**

1. Parihar, N.S. (1967), An introduction to Embryophyta Vol.I & Vol.II, General Book Depot.
2. Smith, G.M. (1955), Cryptogamic Botany Vol.II Mc Grew Hill.
3. Sukla & Mishra, S.P., (1982), Essentials of Palaeobotany Vicas Publishing House.
4. Vasishta, P.C. (1976), Botany for Degree students Vol.IV S.Chand & Co.
5. Vasishta P.C. (1976), Botany for Degree students Vol.V - (Gymnosperms) S. Chand & Co., New Delhi.

### **Books for Reference**

1. Arnold, C.A. (1947), An introduction to Palaeobotany Mc Grew Hill Pub.
2. Chamberlain, C.J. (1986), Gymnosperms – Structure & Evolution CBS publishers and Distributors.
3. Eames, A.J. (1936), Morphology of Vascular Plants Mc Grew Hill Pub.
4. Sporne, K.R. (1976), Morphology of Pteridophytes B.I. Publishers.
5. Sporne, K.R. (1976), Morphology of Gymnosperms B.I. Publishers.

## MORPHOLOGY, TAXONOMY & ECONOMIC BOTANY

Hours: (5 + 2)

### Aims and objectives

1. To study the floral characters with an aim to identify the taxa authentically.
2. To prepare taxonomic keys with the help of morphological and floral characters.
3. To study the various types of floral distribution in Tamilnadu.

### UNIT I: MORPHOLOGY

Inflorescence: Racemose - Raceme, Corymb, Spike, Cymose - Monochasial & Dichasial, Special types-Cyathium, Hypanthodium & Verticillaster. Flowers: Description of typical dicot and Moncot flowers. Fruits: Simple; Aggregate and multiple fruits.

**UNIT II:** Principles: Classification types - Artificial Natural and Phylogenetic (Linneus; Benthum and Hooker; Engler and Prantle); merits and demerits. Botanical Nomenclature: Types, Citation of author, Priority and publication. Herbarium techniques - Collection, Drying, Mounting & Preservation; Floras; Keys. Modern trends in Taxonomy - Chemotaxonomy and Numerical Taxonomy.

**UNIT III:** Detailed study of the range of characters and economic importance of the following families; Nymphaeaceae, Capparidaceae, Sterculiaceae, Caesalpineae, Cucurbitaceae Apiaceae; Rubiaceae, Asteraceae, Apocynaceae, Convolvulaceae, Acanthaceae, Lamiaceae.

**UNIT IV:** Amaranthaceae, Cannaceae, Moraceae, Orchidaceae, Arecaceae, Poaceae.

**UNIT V:** Economic Botany  
Distribution, Methods of cultivation - Extraction and Morphology of the useful parts of the following plants.

Neem, Sugarcane, Tea, Cardamom, Rubber, Jatropha (Bio diesel)

### Practicals

1. Dissection and description of Inflorescences, Flowers and fruits with reference to syllabus.
2. Dissection, identification, observation and sketching the floral parts of the plants belonging to the families included in the syllabus.

3. Training in Key preparation.
4. Field study - The students are expected to go for field trip to different types of floristic regions for atleast four days under the supervision of the course teachers concerned submission of minimum 20 herbarium sheets along with field note book.
5. Submission of Record Note Book.
6. Spotters may given for practicals from Economic Botany.

### **Books for Study**

1. Naik V.K., Principles of Plant Taxonomy, IBH Oxford.
2. Vasishta P.C. 1994, Taxonomy of Angiosperms.
3. Dutta S.C., Systematic Botany.
4. Sungly Y and Jain D.K., Taxonomy of Angiosperms.
5. Sharma O.P., 1993, Plant Taxonomy.
6. Susheela M. Dass 2003, Plant Taxonomy.
7. Chopra G.L. 2004, Angiosperms (Systematics and Life Cycle), Pradeep Publications, Jalandar.

### **Books for Reference**

1. Lawrence H.W., 1969, Taxonomy of Vascular Plants.
2. Jeffrey C. 1976, An introduction plant taxonomy, Allied publication.
3. Rendle R.B., The classification of flowering plants Vol. I, II and III, Oxford-clarendon.

## CELL AND MOLECULAR BIOLOGY

Hours: (5 + 2)

### Aims and objectives

To enable the learners to:

1. Understand the modern concept of cell structure, components and function.
2. Know about the latest concept of prokaryotic and eukaryotic DNA structure and expression.
3. Apply the knowledge gained from plant molecular biology in agriculture.
4. Make venture in plant genomic research.

**UNIT I:** Structure of Prokaryotic and eukaryotic cells – Ultra structure of cell organelles – Plastids, Mitochondria, Golgibody, microbodies – peroxisomes and glyoxysomes – Ultra structure and functions of plasma membrane.

**UNIT II:** Nucleus – Nucleolus – Structure of euchromatin and heterochromatin. Special types of chromosomes – Lamp brush chromosome and polytene chromosome – Cell cycle and stages – Protein synthesis – an overview.

**UNIT III:** Genetic material – Properties and replication of genetic material – Structure - Hershey & Chase experiment. C-value paradox – organisation of DNA sequences – Satellite DNA, repetitive DNA sequences.

**UNIT IV:** Bacterial genome: Transcription and its control in prokaryotes, initiation, elongation and termination. DNA supercoiling (positive and negative). Bt toxin gene elements and Tn elements.

**UNIT V:** Chloroplast and mitochondrial genome – Semi autonomous organisation. Genetic transformation of plants through *Agrobacterium*.

### Practical for Cell and Molecular Biology

1. Observation of plant cells in the onion peeling and *Rheo* leaf.
2. Non-living inclusions: Raphides, cystolith and starch grains.
3. Cell division: Mitosis and Meiosis – Squash technique in *onion root tips* and *Tradescantia / Rheo flower bud* respectively.
4. Isolation of cell organelles through differential centrifugation.
5. Photographs: Ultra Structure.

### **Books for Study**

1. Sharma N.S. 2005, Molecular Cell Biology, International Book Distributors, Dehradun.
2. Verma P.S. and Agarwal V.K., 1986, Cell Biology and Molecular Biology (Cytology) S. Chand and Company, New Delhi.

### **Books for Reference**

1. Old, R.W. and Primrose S.B., 1994, Principles of Gene Manipulation Blackwell Science, London.
2. Grierson, D. and Convey S.N., 1989, Plant Molecular Biology, Blackie Publishers, New York.
3. Lea, P.J. and Leegood R.C., 1999, Plant Biochemistry and Molecular Biology, John Wiley and Sons, London.
4. Power C.B., 1984, Cell Biology, Himalaya Publishing Co. Mumbai.
5. De Robertis and De Robertis, 1998, Cell and Molecular Biology, K.M. Verghese and Company.

## MICROBIOLOGY

**Hours: (4 + 2)**

### **Aims and objectives**

The study will encourage the students to identify various types of plant diseases in the field.

**UNIT I:** Origin of Microbiology – Microbial diversity – General features of protozoa, Moulds, Yeasts, Bacteria, Viruses, Viroids, Prions.

**UNIT II:** Nutrition of bacteria, Culture, Growth, Cell structure, multiplication, Genetics of microbes.

**UNIT III:** Control of microorganisms – Use of physical & chemical agents – Antibiotics and chemotherapeutic agents.

**UNIT IV:** Host pathogen interaction. Importance of immunity of virulence factors in disease development. Brief account on antigens and antibodies.

**UNIT V:** Microbes & Biotechnology – Importance of microbes in food – Fermented foods, Probiotics & mycoprotein – Biological processes & products of industrial importance – Use of genetically engineered organisms – Use in medicine, industry & agriculture – Environment.

### **Practicals**

Media preparation, Sterilization techniques, Isolation and maintenance of cultures. Use of Gram stain. Identification of morphological types and diseases caused by Viruses and bacteria on the basis of the external symptoms.

### **Books for Study**

1. Dube H., 1978, A text book of Fungi, Bacteria and Virus, Vikas publishers.
2. Rangasamy G. Diseases of Crop Plants of India, Prentice Hall.

### **Books for Reference**

1. Prescott, Harley and Klein, 1996, Microbiology, McGraw Hill Publications - IV edn.
2. Ingraham J.L. and Catherine A. Ingraham Thomson, 2002, Introduction to Microbiology, Brooks and Cole – II edn.

3. Kathaleen Talaro and Arthur, 1976, Foundations in Microbiology, Brown Publishers – II edn.
4. McKane and Kannel, 1996, Microbiology, Essentials and Applications, Mc Graw Hill.
5. Pelazar, Chan and Reid, 1986, Essentials of Microbiology.
6. Adams M.R. and Moss M.O., 1995, Food Microbiology, New Age International Ltd.
7. A.K.Chattergi Prentice Hall, 2002, Introduction of Environmental Biotechnology.

## BIOCHEMISTRY, BIOPHYSICS AND BIOMETRICS

Hours: (4 + 2)

### Aims and objectives

This course aims at introducing the major biomolecules such as carbohydrates, lipids and proteins to the students. This course also introduces the catalysis of biochemical reactions by enzymes and their mode of action. Basic principles of energy production in biological systems are also dealt with. Students will also be trained in basic statistical methods used in interpreting scientific data.

**UNIT I:** Chemical basis of life – Atoms – Molecules – Bonds – Types of Bonds – Bond characteristics – Weak interactions – Water as an universal solvent – Structure of H<sub>2</sub>O – Laws of mass action – Concept of Ph, Pka – Ph measurements.

**UNIT II:** Carbohydrates – Structure and classification of monosaccharides – Distribution of various biological systems – Glycosidic bond – Polysaccharides – Structural analyses of starch and Glycogen – A brief analysis of plant cell wall.

Proteins – Aminoacids – basic characteristics – Peptide bond – Protein structure – Primary, secondary and tertiary structure. A brief description of protein complexes.

Fatty acids – Properties – Occurrence – Occurrence in plant and animal tissues and their significance – Fatty acid derivatives.

**UNIT III:** Energy of activation – Enzymes as biocatalysts – Classification of enzymes – Enzyme action – Analysis of Lineweaver Berk's plot – Significance of Km value with examples.

**UNIT IV:** Bioenergetics – Fundamentals of thermodynamics – Concept of free energy – Redox reactions – Conservation of free energy – Electron transport systems in mitochondria and chloroplast – Protein – Chemiosmosis – ATP production – H<sup>+</sup> translocation in bacterial systems – Bioluminescence.

**UNIT V:** Biostatistics – Sampling methods – Presentation and analysis of data – Frequency distribution – Analysis of averages – Probability analysing significance – Chisquare analysis – Student t-test – Straight line equation – correlation and correlation co-efficient.

### Books for Study

1. Gurumani, An Introduction to Biostatistics.
2. Palanichamy, Introduction to Biostatistics.

3. Dipak Kumar Kar and Soma Halder, 2006, Plant Breeding and Biometry, New Central Book Agency (p) Ltd., Kolkata.
4. Daniel, 2005, Basic Biophysics for Biologist, International Book Distributors, Dehradun.

### **Books for Reference**

1. Conn and stumpf, 2000, Outlines of Biochemistry, 5<sup>th</sup> Edn., John wiley & Sons, Singapore.
2. Berg, J.M. Tymoczko J.L. and Stryer L., 2002, Biochemistry, 5<sup>th</sup> Edn. W.H. Freeman and company, New York.
3. Rastogi S.C., 2003, Biochemistry, 2<sup>nd</sup> Edn., Tata Mac Grew Hill Publication, New Delhi.

## PLANT PHYSIOLOGY

Hours (5+2)

### Aims and objectives

1. To study the organization and physiology of plants.
2. To understand the working mechanism in plant-Metabolic events such as photosynthesis, respiration and transpiration.
3. To facilitate the study of integrated activities of the plants.

**UNIT I:** Water relations in plants – physical phenomena – water potential and its components, Apoplast, Symplast – Absorption of water – absorbing organs - Mechanism of water absorption – Active osmotic - Active non-osmotic, Passive, Factors affecting ; Water absorption – Ascent of sap – Path and Mechanism – Vital Force theory – Root pressure theory, physical force theory – Dixon’s cohesion theory – SPAC – Soil – Plant – Atmosphere. Transpiration – Types of transpiration – Stomatal, Cuticular and lenticular; Mechanism of Stomatal Movement – Starch – Sugar hypothesis, Steward’s hypotheses and theory of potassium transport, Factors affecting transpiration, Guttation.

**UNIT II:** Solute Relation Hydroponics – Macro & Micro elements – Role and deficiency symptoms – Mineral salt absorption – Mechanism passive – Donnan equilibrium and Ion exchange active – carrier concept; Translocation of organic solute – Path and Mechanism – Protoplasmic streaming, pressure flow hypothesis.

**UNIT III:** Metabolism – Photosynthesis – Mechanism - Radiant energy - Structure of photosynthetic pigment systems – Light – Cyclic & Non-cyclic – Carbon Assimilation – C<sub>3</sub> and C<sub>4</sub> Cycles.

**UNIT IV:** Respiration – Respiratory quotient – Anerobic Respiration – Glycolysis – Krebs's cycle, Electron transport system – Photorespiration; N<sub>2</sub> Metabolism – Sources of N<sub>2</sub> – N<sub>2</sub> Cycle, Aminoacid Biosynthesis, C/N Ratio.

**UNIT V:** Growth – definition, Phases of growth, Factors affecting growth, Plant growth regulators – occurrence, structure, physiological effects of auxins, Gibberellins, Cytokinins, ABA & Ethylene – Photoperiodism and vernalisation – Seed dormancy and seed germination – Circadian rhythm – Role of isotopes in physiology.

### Experiments for demonstration only

To set up the following experiments and explain the working method with suitable diagrams, observations and interpretations.

1. Effect of temperature on cell permeability.
2. Effect of alcohol on cell permeability.
3. Determination of water potential by chadrakou’s method.

4. Rate of Transpiration – Ganong’s Potometer Method and different condition.
5. Light screen experiments.
6. Mohl's half leaf experiments.
7. Determination of RQ of different germination seeds using Ganong’s respirometer.
8. Measurement of growth using Lever Auxanometer.

### **Experiments to be carried out by the students**

1. Determination of solute potential by plasmolytic method.
2. Effect of organic solvents on membrane permeability.
3. Study of relative rates of transpiration in different plants.
4. Study of relative rates of photosynthesis in *Hydrilla* under different qualities of light and carbon dioxide concentrations.
5. Separation of plant pigments by paper chromatography.
6. Determination of seed viability using tetrazolium chloride.
7. Rate of respiration - Ganong's respirosopes.

### **Books for Study**

1. Jain V.K. Fundamentals of Plant Physiology, S. Chand and Co., New Delhi.
2. Rao K.N. and others, The functioning of plants. Viswanathan publishers.
3. Kumar, 2005, Plant Physiology Fundamentals and Applications, International Book Distributors, Dehradun.

### **Books for Reference**

1. Frank B. Salisbury and Celon W. Ross, Plant Physiology, GBS Publishers and Distribution, New Delhi.
2. Ray Noggle G. and George J. Frits, Introductory Plant Physiology, Prentice Hall of India P. Ltd., New Delhi.
3. Bidwell R.G.S., Plant Physiology, Macmillan publishing Co., New York.
4. Devlin and Barker, Photosynthesis, Affiliated West press Pvt. Ltd., New Delhi.
5. Robert M. Devlin, 1981, Plant Physiology, Affiliated East West Press Pvt. Ltd., New Delhi.

## **BIOTECHNOLOGY**

**Hours: (5 + 2)**

### **Aims and objectives**

1. To provide an opportunity to acquire more knowledge in Biotechnology.
2. To enable the students to pursue higher studies and research work in Biotechnology.
3. To provide an opportunity to get employment in Biotechnology industries and laboratories.

### **UNIT I: Recombinant DNA technology**

Cloning Vehicles: Plasmids, Cosmids & Phages. Brief account of shuttle vectors & transposons - Enzymes involved - Types of Restriction endonucleases and ligases - Brief account of genomic and cDNA libraries - Polymerase chain reaction (PCR) - Strategies of gene cloning in Bacteria and Yeast - Brief account of Southern and Northern blotting - Application of Genetic engineering.

### **UNIT II: Plant Biotechnology**

Types of medium - Sterilization techniques employed in tissue culture - Cell culture and organ culture - Production of haploid plants and its significance - Biotechnology and plant breeding: (i) Non-recombinant approach - somoclonal variation and protoplast fusion, (ii) Recombinant approach - Production of secondary metabolites.

### **UNIT III: Agricultural Biotechnology**

Biofertilizers - Biological nitrogen fixation - Biochemistry and genetics of nitrogen fixation - Bioinsecticides - Transgenic plants for herbicide, Pest, fungi and viral resistances.

### **UNIT IV: Industrial Biotechnology**

Production of Ethyl alcohol, Production of organic acid - Citric acid, Production of antibiotics - Penicillin & Streptomycin, Production of Vitamin - Riboflavin - Immobilization of enzymes.

### **UNIT V: Environmental Biotechnology**

Production of Biogas - Biological treatment of sewage - Biological processing of industrial wastes; Dairy & tannery - Microbial leaching.

### **Practicals**

1. Sterilization techniques.
2. Preparation of culture media.
3. Visit to tissue culture and microbiology divisions of sugar factory.

### **Books for Study**

1. Kumar H.D., 1993, A text book of Biotechnology, Affiliated East, West press (p) Ltd., New Delhi.
2. Ignacimuthu S., Plant biotechnology.
3. Ignacimuthu S., Applied biotechnology.
4. Dubery R.C., A text book of Biotechnology.
5. Purohit and Mathur S.K., Biotechnology.
6. Gupta P.K., Elements of Biotechnology.

### **Books for Reference**

1. Old K.W., and Primrose S.B., 1996, Principles of Gene manipulation – An introduction to genetic engineering.
2. Trehan M.P., Biotechnology – the biological principles.
3. Trivedi P.C., 2006, Plant Biotechnology, Perspectives and Prospects, International Book distributors, Dehradun.

## HERBAL BOTANY

Hours (4 + 2)

### Aims and objectives

1. This study enriches the systematic Botany which can be utilized for botanical diagnosis of fragmentary crude drugs.
2. This study will be useful in identifying medicinal taxa.
3. This study also help in knowing the preliminary phytochemistry of plant organs.
4. The present study aims at microscopic features of selected plants for understanding systematic anatomy.

**UNIT I:** Importance and Relevance of Herbal drugs in Indian system of Medicine. Pharmacognosy – Aim and scope; Brances of pharmacognosy – Phytochemicals – Reserve materials; Secretary materials; Excretory materials.

**UNIT II:** Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening – Poisonous plants – Types of plant poison; action of poisons; treatment for poisons; some poisonous plants; their toxicity and action.

**UNIT III:** Adulteration of crude drugs and its detection – methods of adulteration; types of adulteration. Medicinal plants of export values; Rejuvenating herbs; Medicinal uses of Non-flowering plants.

**UNIT IV:** Botanical description and active principles of Root drugs; Rhizomes woods and bark drugs (Two examples for each plant organs).

**UNIT V:** Botanical description and active principles of leaves; Flowers; Fruits seed and entire plants as drugs. Taxonomic study of some selected herbals (Two examples for each plant organs).

### Practicals

1. Detecting original drugs from the adulterants; Anatomical studies of plant organs.
2. Leaf; petiole; stem; root; rhizome; bark and wood drugs.
3. Posionous Plants; Taxonomic description with special reference to the poisonous parts.

Eg. Cleistanthus collinus. Visit to herbal gardens. Submission of 5 Herbarium sheets. (Medicinal plants).

### **Books for Study**

1. Somasundaram S. 1997, Medicinal botany (Maruthuvath Thavaraviyal) - (Tamil Medium Book).
2. Wallis, T.E., 1967, Text Books of Pharmacognosy.
3. Jain S.K., Medicinal Plants.
4. Srivastava A.K., 2006, Medicinal Plants, International Book Distributors, Dehradun.

### **Books for Reference**

1. Agarwal, O.P. 1985 Vol.II Chemistry of organic – natural products.
2. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency of Madras Volumes.
3. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.
4. Nair N.C. and Henry A.N., 1983, Flora of Tamil Nadu, India, Botanical Survey of India.
5. Chopra R.N., Nagar S.L. and Chopra I.C., 1956, Glossary of Indian Medicinal Plants.
6. Chopra R.N., Chopra I.C., Handa K.L and Kapur L.D., 1994, Indigenous drugs of India.
7. Chopra R.N., Badhuvar R.L. & Gosh G., 1965, Poisonous plants of India.

## GENETICS AND PLANT BREEDING

Hours: (4 + 2)

### Aims and objectives

1. Gives them an insight into the science of heredity.
2. Helps them to understand the basic concepts applied to Biotechnology and Molecular Biology.
3. Helps students from rural background to develop entrepreneurship (farm houses, nurseries etc.)
4. Guides students to diversify into specialised programmes in higher studies like Medical Genetics, Biotechnology, Molecular Biology and Horticulture.

**UNIT I:** Mendelian Genetics – Mono and Dihybrid Ratios, Laws of Mendel, Test and Back crosses; Non-Mendelian Principles – Incomplete & codominance, Lethality Gene Interaction – Simple, Complementary, Supplementary, Inhibitory, Duplicate, Epistasis, Polymeric.

**UNIT II:** Multiple alleles – in Rabbits & Self sterility in tobacco; Multiple genes in Maize & Wheat; Linkage and crossing over in Sweet Pea, Types, Phases, Mechanism of crossing, Proof for crossing over -Mcclintock's experiment in Maize – Sex determination in plants – Sex linkage in *Drosophila* and Man; Cytoplasmic inheritance. Plastid inheritance in *Mirabilis* and Male sterility in corn.

**UNIT III:** Gene concept (Cistron, Recon and Gene Action (operon Concept)). Types of aberrations and their genetic effects. Mutations – Causes, types and effects, Polyploidy – Types, Synthetic polyploids, Role of Mutations and polyploidy in Breeding.

**UNIT IV:** Objectives of plant breeding

Conventional methods – Introduction, Selection – Mass, Pure and clonal, Hybridization – Technique, Types, Heterosis – Causes and effects - Modern methods – Protoplast fusion, Anther and Embryo culture.

**UNIT V:** Breeding for disease and drought resistance. Achievements in crop breeding in India with reference to Rice, Wheat, Maize, Cotton and Sugarcane.

### Practicals

Working at problems in Mono and dihybrid crosses, Interactions and chromosome mapping. Application of chi-square method.

### **Books for Study**

1. Gupta P.K., Genetics.
2. Sandhya Mithra, Genetics.
3. Karvita B. Ahhewdia, Genetics.
4. Verma P.S. and Agarwal V.K., Genetics.
5. Choudhere H.K., Principles of Elementary Plant Breeding.
6. Sharma J.R., Principles of Practice of Plant Breeding.
7. Dipak Kumarkar and Soma Halder, 2006, Plant Breeding and Biometry, New Central Book Agency (P) Ltd., Kolkata.

### **Books for Reference**

1. Gorolener F.J., Principles of Genetics.
2. Sarin, Genetics.
3. George W. Bions, The science of Genetics.
4. Vijendra Das, Plant Breeding.
5. Gardner, Hickey G.I. and Fletcher H.L., Winter, 1999, Principles of Genetics, Viva Books Ltd., Chennai.

**PROPOSED MODEL SYLLABI FOR ALLIED PAPERS**

**List of Participants who prepared the Proposed model syllabi for Allied papers**

Dr. S. Amerjothy,  
Reader,  
Dept. of Plant Biology and  
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Thiru. A. Muneeswaran,  
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Nadar Mahajana Sangam,  
S.Vellaichamy Nadar College,  
Nagamalai,  
Madurai 625 019.

## **ALLIED PAPERS**

1. Allied Botany - I
2. Allied Botany - II

## **ALLIED BOTANY - I**

**Hours (4 - Theory + 2 - Practical)**

### **Aims and objectives**

To make the students more competent in Plant Science and acquire skills to engage themselves in self-employment especially in different fields like Horticulture and Mushroom Culture. To expose various avenues of opportunities in the field of Plant Biotechnology which is growing phenomenally.

**UNIT I:** General outline of Bentham and Hooker's System of classification study of the range of characters and economic importance of Annonaceae, Rutaceae, Rubiaceae.

**UNIT II:** Apocyanaceae, Solanaceae, Euphorbiaceae, Poaceae.

**UNIT III:** Types of tissues, Primary structure of dicot stem, root and leaf. Secondary thickening in dicot stem. Structure of mature anther and ovule, fertilization, development of dicot embryo.

**UNIT IV:** Elementary knowledge of bacteria. Classification. Ultrastructure of E.Coli. Economic importance of bacteria. General account of plant viruses.

**UNIT V:** Horticulture, scope and importance; Propagation methods (Cuttage, Layerage and Air layering; Grafting techniques; Gardening and Landscaping, Irrigation methods; Manures, Lawns, Indoor plants, Bonsai techniques; Flower beds and Orchards).

### **Books for Study**

1. Ganguly A.K., 1971, General Botany, Vol.I, The New Book Stall, Calcutta.
2. Rao K.N., Krishnamurthy K.V., and Rao G., 1979, Ancillary Botany, Viswanathan Private Ltd.
3. Dutta A.C., College Botany, Vol.I & II.
4. Kumar N., 1999, Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.

## ALLIED BOTANY - II

**Hours (4 - Theory + 2 - Practical)**

**UNIT I:** Classification of cryptogams. Study of *Nostoc*, *Chlorella*, *Oedogonium*, *Ectocarpus*, *Polysiphonia*, *Albugo*, *Yeast*.

**UNIT II:** *Penicillium*, *Polyporus*, *Polytrichum*, *Lycopodium*, *Cycas*.

**UNIT III:** Absorption of water, Photosynthesis, Respiration, Plant movements.

**UNIT IV:** Biotechnology, definition, principles of genetic engineering, rDNA technology, tissue culture.

**UNIT V:** Mushroom cultivation, Introduction, Nutritive value and importance of mushrooms. Cultivation of Button mushroom, Milk mushroom and Oyster mushroom, Spawn preparation, Preservation of mushrooms, Recipes made from mushrooms.

### **Books for Study**

1. Ganguly A.K., 1971, General Botany, Vol.II, The New Book Stall, Calcutta.
2. Rao K.N., Krishnamurthy K.V., and Rao G., 1979, Ancillary Botany, Viswanathan Private Ltd.
3. Dutta A.C., College Botany, Vol. I & II.
4. Gupta P.K., Elements of Biotechnology Rastogi and Company.
5. Suman B.C., and Sharma V.P., Mushroom Cultivation and uses Agrobios (India), Jodhpur.

**ALLIED PRACTICAL**

## **ALLIED PRACTICAL**

(Covering the syllabus of Allied Paper I & II)

1. To describe plants in technical terms and to identify the family by the observed morphological characters of vegetative and floral parts.
2. To dissect flower and to construct the floral diagram.
3. To make suitable micro preparations of algae, fungi, bryophytes, pteridophytes, gymnosperms and to describe and identify the same.
4. To make suitable micro preparation of the stem, root and leaf of dicot and to identify the same giving reasons.
5. To identify the habitat of the given plant by observing morphological and anatomical features.
6. To critically comment simple experimental set - ups in Plant physiology section of the syllabus.
7. To demonstrate any one of horticultural techniques of propagation.
8. To identify the horticultural implements/tools.
9. To acquire practical knowledge in mushroom cultivation.

**PROPOSED MODEL SYLLABI FOR OPTIONAL PAPERS**

**List of Participants who prepared the Proposed model syllabi for Allied papers**

Dr. T. Mani,  
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Government Arts College,  
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Ms. Beulah Vijayakumar,  
S.G. Lecturer of Botany,  
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Chennai – 600 086.

## **OPTIONAL PAPERS**

1. Bioinformatics
2. Forest Technology
3. Seed Technology
4. Remote sensing and Natural Resource Management
5. Biodiversity Conservation and Management
6. Nursery and Landscaping
7. Preservation of Fruits and Vegetables
8. Digital Taxonomy
9. Tissue Culture
10. Bio-Nano Technology
11. Horticulture
12. Instrumentation
13. Laboratory Techniques
14. Molecular Taxonomy
15. Stress Physiology
16. Mushroom Cultivation
17. Microbial Technology
18. Environmental Biotechnology
19. Fermentation Technology
20. Renewable Energy Sources

## 1. BIOINFORMATICS

### Aims and objective

This subject was initiated with an aim to have basic knowledge in computer operating. Nowadays it is necessary to go to the websites and internet for future research work.

**UNIT I:** Introduction to computers and Bioinformatics. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www. Internet.

**UNIT II:** Biological Research on the web:- Using search engines, finding scientific articles, public biological databases searching biological databases. Use of nucleic acid and protein data banks - NCBI, EMBL, DDBJ, SWISSPORT multiple sequence alignment.

**UNIT III:** Sequence analysis, pair wise alignment and Database search. Phylogenetic analysis, profiles and motifs. Protein structures-visualizing, predicting and function from a sequence.

**UNIT IV:** Chemical composition - Biomolecules. DNA, RNA. Structure of DNA, development of DNA sequence methods. Genefinder and feature detection in DNA.

**UNIT V:** Gene finding, pairwise sequence compare, sequence queries in biological databases - drug designing.

### Practicals

1. Use of computers to access different Biological databases using variety search engines.
2. Similarity search
3. Structure prediction – protein.
4. Gene finding
5. Molecular visualization.

### Books for Study

1. Baldi P. and Brunak, Bioinformatics, A machine approach, MIT press.
2. Khan imtiyaz Alam, 2006, Elementary Bioinformatics (HB), Dehradun.

### Books for Reference

1. Gibas and Jamback, Developing Bioinformatics computer skills, O' Reilly Associates.
2. Misenes S and Cravete S.A., Methods in molecular biology Vol 132, Bioinformatics methods and protocols.
3. Harshitha D., 2006, Techniques of Teaching Computer Science, International Book Distributor, Dehradun.

## 2. FOREST TECHNOLOGY

### Aims and objectives

The study will enable the students to understand forest management, timber yielding plants, preservation of sanctuaries, silvi culture.

**UNIT I:** Forestry - Definition, Classification, scope of forestry, forest utilization, major and minor forest products, commercial Timber yielding plants of South India. Forest types of India, social forestry, village forestry, farm forest, avenues.

**UNIT II:** Principle and scope of forest management, elements of mensuration, sampling use of diameter (Girth) height and area spacing rotation, concept of sustained yield conservation and conservation strategies, sustainable development. Wild life -important animals of South India, preservation, sanctuaries endangered species causes for destruction and need for protection - wild life protection act.

**UNIT III:** Elements of silviculture – silviculture of the following species: - a) *Tectona grandis* b) *Casuarina equisetifolia* c) *Eucalyptus* d) *Bamboosa* sp e) *Santalum album*. Silvicultural systems - clear felling, simple coppice and selective felling.

**UNIT IV:** Wood Structure, physical, chemical and mechanical properties of wood. Wood preservation, wood seasoning and wood preservatives.

**UNIT V:** Tree Improvement - Genetic variation, geographic variation, genotype and phenotype. Tree improvement methods - species introduction, hybridization, individual tree selection, vegetative propagation, grafting, biotechnology for forestry.

### Practicals

1. Measurement of Tree diameter and girth – instruments - the foot rule, calliper, tape, dendrometers.
2. Methods of studying the form : By comparison of standard formations – form factor.
3. Wood preservatives: - oilborne, waterborne - non fixed water soluble type and fixed water soluble type.
4. Wedge prism - calculation of leaf area and canopy coverage.

### Books for Study

1. Chacho, 1985, Sampling Techniques.
2. Vinod Kumar, 1995, Nursery and plantation practices.
3. Nautiyal S., Non Timber Forest Products of India.

### **Books for Reference**

1. Champion H.G and Griffith, 1967, General Silviculture.
2. Troupe, 1975, Silviculture of Indian Trees.
3. Sudhir M, 2000, Applied biotechnology and plant genetics.
4. Shrivastava M.B., 1998, Introduction to Forestry.
5. Agarwal A. Forest of India.
6. Tewari D.N., Tropical Forestry in India, International Book Distributors, Dehradun.
7. Ward H.M., 2001, Trees A Handbook of Forest Botany, International Book Distributors, Dehradun.

### **3. SEED TECHNOLOGY**

#### **Aims and objectives**

This study aims to improve the knowledge of students about storing seeds; seed testing and seed certification.

**UNIT I:** Seed - Classification based on structure - calcitrent and non-calcitrent seeds - seed maturation - storage polysaccharides of seeds.

**UNIT II:** Seed Germination - metabolic changes during germination - physiology of seed Germination -seed Dormancy - Types of dormancy - metabolism during dormancy - factors affecting dormancy

**UNIT III:** Seed longevity - Factors affecting seed longevity - seed storage - dry storage - aeration – cold storage – Cryopreservation - seed storage structures and containers.

**UNIT IV:** Seed Testing: seed sampling - determination of density - hetrogeneity of seed lots and tolerance – Determination of purity and genuiness of varieties.

**UNIT V:** Seed Viability, vigour, health and moisture. Seed certification, standard inspection, legislation and seed law enforcement - Quarantine.

#### **Practicals**

1. Analysis of seed purity.
2. Determination of seed moisture.
3. Study the seed viability by tetrazolium chloride test.
4. Study the germination percentage of various seeds.
5. Break the dormancy of seeds by using some chemicals / hotwater.

#### **Books for Study**

1. Ramamurthy, 2006, Seed Technology - Ready Reckoner, International Book Distributors, Dehradun.

#### **Books for Reference**

1. Agarwal R.L, 1996, Seed Technology Oxford IBH Publishing Co P Ltd.
2. Khan A.A, 1977, Physiology and Biochemisty of seed dormancy and germination.
3. Donald Mc and Copeland,1964, Seed Science and Technology.

## **4. REMOTE SENSING AND NATURAL RESOURCE MANAGEMENT**

### **Aims and objectives**

The present study aims at the study of satellite data products; forest mapping and marine resource management.

**UNIT I:** Natural resources -Terrestrial and aquatic (forest and marine) resources – biodiversity –concept - conservation strategies (In situ and ex situ) - protected areas - Biosphere reserves - National parks and wildlife sanctuaries - Botanical garden - IUCN Species status.

**UNIT II:** Remote sensing – concept - platforms for remote sensing - satellites, sensors and satellite data products - Interpretation of remotely sensed data - visual interpretation and digital analysis.

**UNIT III:** Remote sensing and vegetation studies - forest mapping - land cover classification -change detection studies.

**UNIT IV:** Remote sensing for marine resource management - ocean colour monitoring - coastal vegetation surveys - marine pollution monitoring.

**UNIT V:** Recent trends in remote sensing techniques - role of GIS (Geographical Information System) and GPS (Global positioning System) – National and International remote sensing agencies and their achievements.

### **Practicals**

1. Collection of ground truth information from terrestrial and aquatic environment.
2. Visual Interpretation for a satellite imagery (FCC).
3. Mapping Indian Forest using Remote sensing techniques (Report on case studies).
4. Role of Remote sensing in pollution monitoring (Report on case study).
5. GIS – Demonstration.
6. GPS –Demonstration.

### **Books for Study**

1. Saumitra Mukherjee, Text Book of Environmental Remote Sensing.
2. Ramasamy S.H., 2006, Remote Sensing in Geomorphology, International Book Distributors, Dehradun.
3. Anji Reddy, 2006, Text book of Remote Sensing and GIS, 3<sup>rd</sup> Ed., International Book Distributors, Dehradun.

### **Books for Reference**

1. Agarwal K.C., Biodiversity.
2. Solbris Van Embden and Vandordf, Biodiversity and global changes.
3. Thomas Eugene Avery and Graydon Lennis Berlin, Fundamentals of Remote sensing and Airphoto Interpretation.
4. Clevers J.G. P.W., 2006, Application of Remote Sensing to Agricultural Field Trials, International Book Distributors, Dehradun.

## 5. BIODIVERSITY CONSERVATION AND MANAGEMENT

### Aims and objectives

The aim of the study of Biodiversity conservation is to protect the existing flora and fauna for enhancing the beauty of our Planet Earth Mother and to pass it on for our future generation with all the conserved resources for maintaining environment friendly sustainable development.

**UNIT I:** Biodiversity – Definition - Types of Biodiversity - Protected areas - Biosphere reserves -National parks and wildlife sanctuaries.

**UNIT II:** Biodiversity assessment and inventory programs - Morphological and molecular characterization of biodiversity - Methods for species identification and classification.

**UNIT III:** Conservation of biodiversity - National and international initiatives - IUCN categories-Endangered, Threatened, Vulnerable and extinct species.

**UNIT IV:** Biodiversity informatics - Documenting biodiversity - Biodiversity databases - Red book - Blue book and green book – Biodiversity registers.

**UNIT V:** Global biodiversity information System - species 2000 and Tree of life - Overview of the UNEP/GEF biodiversity data management project (BDM) - CBD and bioethics.

### Practicals

1. Biodiversity assessment in a selected environment (species, Genetic and ecosystem diversity).
2. Species identification and classification.
3. Mapping protected area of India.
4. Preparation of checklist of Indian flora by referring to IUCN categories.
5. Listing Biodiversity databases.
6. Species 2000 Demo in Internet.
7. Tree of life - Demo in Internet.

### Books for Study

1. Agarwal K.C., Biodiversity.
2. Kumar, 2005, Biodiversity Principles and Conservation, International Book Distributors, Dehradun.

### **Books for Reference**

1. Kevin J. Canton and John I Spicer, An introduction of Biodiversity.
2. Global Biodiversity, 1992, Status of the Earth Living Resources, Water Conservation and monitoring Center, Chapman hall, London.
3. Forey.P L, Humphries C.J. and Vane R.I., Wright (eds, 1994, Systematics and Conservation Evolution.
4. Hawksworth D.I., 1995, (ed), Biodiversity, Measurement and Estimation, Chapman and Hall, London.
5. Kandya A.K., 2007, Biodiversity Conservation and Legal Aspects, International Book Distributors, Dehradun.

## 6. NURSERY AND LANDSCAPING

### Aims and objectives

The course will provide an adequate hand on experience for the students to develop their skill. Subject content is so designed and hence the students can become an entrepreneur by himself/herself.

**UNIT I:** Introduction, prospects and scope of Nursery and landscaping. Climate factors, edaphic factors. Nutritional need for Nursery cultivation, pruning methods.

**UNIT II:** Methods of Propagation - cutting, layering, grafting, budding. Floriculture - Rose, Chrysanthemum, Jasmine - cultivation.

**UNIT III:** Gardening - formal garden, informal garden, vegetable garden, landscaped layout designing - formation and maintenance of lawn.

**UNIT IV:** Nursery structures – Green house, shade house, Mistchamber - topiary, Bonsai culture

**UNIT V:** Manures, composting - vermicomposting, use of Hormones, pest and disease management, storage and marketing.

### Practicals

1. Cutting, Layering methods.
2. Grafting - various methods.
3. Potting , depotting, repotting.
4. Preparation of potting mixture.
5. Preparation of land for Lawn.
6. Pruning, Training Methods.
7. Knowledge of garden implements.
8. Preparation for kitchen Gardening, Landscaping.

### Books for Study

1. Kumar N. Introduction to Horticulture Raja Lakshimi Publication, Nagercoil, India.
2. Edmond Musser and Andres Fundamentals of Horticulture McGraw Hill Book co.,
3. Amarnath V., 2006, Nursery and Lanscaping, M/S. IBD Publishers, New Delhi.
4. Manibushan Rao K. TextBook of Horticulture, MacMillon India Ltd.

### **Books for Reference**

1. Edmond Muser and Andres. Fundamentals of Horticulture McGrawHill Book co.,
2. Gardener. Basic Horticulture MacMillon N.
3. Lex Lauries and victor H. Rise. Floriculture Fundamentals and practices. McGrawhill publishers.
4. Mukherjee D. Gardening in India,. Oxford IBH publilshing co, NewDelhi.
5. Randhawa. Ornamental Horticulture in India Today and Tommorow publishers, NewDelhi.
6. Sandhu M.K , plant propogation, willey Easter ltd, NewDelhi.
7. Sundararajan J.S., Muthuswamy J, shanmugavelu K.G. and BalaKrishnan R., A Guide to Horticulture, Thiruvenkadam printers, coimbatore.

## 7. PRESERVATION OF FRUITS AND VEGETABLES

### Aims and objectives

1. To understand the scientific principles in spoilage and preservation of fruits and vegetables.
2. To develop skill in preservation of wide variety of fruit and vegetable products.

**UNIT I:** Principles of preservation, Methods of preservation - refrigeration, freezing, canning, drying and dehydration, chemical preservatives.

**UNIT II:** Food spoilage - causes and factors. Causes - physical, chemical and biological factors- pH, temperature, available moisture.

**UNIT III:** Canning of Fruits: Mango, apple and banana. Canning of vegetables: bean, carrot and tomato.

**UNIT IV:** Drying of fruits: Banana, dates, grape, fig and mango.

**UNIT V:** Containers for packing: Tin and glass containers.

### Practicals

1. Preparation of Jam, Jelly and Marmalade Mixed Fruit Jam, Guava jelly and orange marmalade.
2. Preparation of syrup, crush and squash. Lime Syrup, Grape crush, Mango squash.
3. Preparation of preserves: Ginger preserves.
4. Preparation of pickles: Lime and Mixed Vegetables.

### Books for Study

1. Siddappa, G.S and Tandon. G.L ., 1998, Preservation of Fruits and vegetables Lal G., Indian council of Agricultural research, NewDelhi.
2. Preservation and Canning of Fruits and Vegetable, (EIRI), 2006, M/S. IRD Publishers, New Delhi.

### Books for Reference

1. Frazier W.C. and west Holf D.C., 1995, Food Microbiology, Tata McGrawHill publishing co ltd., NewDelhi.
2. Kulshrestha S.K, 1994, Food preservation, vikas publishing House, NewDelhi.
3. Swaminathan M., 1992, HandBook of food Science and Experimental Foods, the Bangalore printing and publishing co., Ltd., Bangalore.

## 8. DIGITAL TAXONOMY

### Aims and objectives

This study was initiated with an aim to identify some taxa with Digital Data facilities. This study enriches the systematic Botany which can be utilized for Botanical diagnosis of plants.

**UNIT I:** Computer Aided Taxonomy (CAT)- Introduction the use of computer technology in biology- major softwares- Data retrieval systems- www, numerical statistical analysis, and computer taxonomy.

**UNIT II:** Phonetic Taxonomy: Objectives and hypothesis, selection of operational taxonomic units, character class and character stage, degree of overall similarity and dissimilarity, cluster analysis and other statistical procedures, manual and computer analysis.

**UNIT III:** Cladistic taxonomy: use of morphological , phytochemical and molecular data in cladistic molecular systemation- use of molecular markers in phylogeny, chloroplast and nuclear genome in angiosperm.

**UNIT IV:** The tree of life- TreeBase: Database on phylogenetic knowledge- Intergency Taxonomic Information system- Botanical authors databases.

**UNIT V:** Database at the Royal Botanical Garden on-line herbaria-ETI database- Taxonomic softwares: Linnaeus, Darwin, species 2000.

### Practicals

1. Identification of plants using any two softwares.
2. Taxonomic Data retrieval system- Demo
3. Phonetic Taxonomy.
4. Cladistic Taxonomy.
5. Virtual visit to Royal Botanical garden, Kew-London.
6. Accessing on line herbaria.

### Books for Study

1. Misener: 2006, Bioinformatics Methods and Protocols, IRD, publish, New Delhi.
2. Khanimtiyaz Alam, 2006, Elementary Bioinformatics, International Book Distributors, Dehradun.

## 9. TISSUE CULTURE

### Aims and objectives

This syllabus was initiated with an aim to upgrade the contents of under graduate to accommodate recent developments in Plant Biotechnology.

**UNIT I:** Introduction: Tissue culture-A process occurring naturally (invivo) as in wound healing,graft union.Duplicated artificially (invitro)need for T.C:advantage like little space.Taster multiplication can cause desirable mutations,gentic manuplation,improvement of geome. Requirements: Tissue culture lab-any commonly approved designed Facilities-air slerilization/water distillation and sterilization glasswares sterilants nutrients – inorganic, organinc, hormonal, antibiotics etc. laminar floor chamber inoculating gadgets lighting phytotnoms space for hardening, green house. Growth media-basal supplemented for special purpose liquid, semisolid, and solid types designing the media wide deep slant etc.

**UNIT II:** Sterlization of glasswares constitution of basal and special media preparation and media sterilization selection of explant, surface sterilization, inoculation callus induction Multiplication of callus differentiation root and shoot induction. Plantlet hardening transfer to green house.

**UNIT III:** Culture of single cells, protoplast preparation protoplast fusing-Products of somatic hybridization cloning of both Anther culture source of both diploid and haploid call. Pollen culture archeogenetic haploids uses.

**UNIT IV:** Micropropagation- needs, requirements single node meristem culture regeneration of shoots, micro rooting problems and solvings in micropropagation llike contamination of browning, recalcitrant etc. Micropropagation of commercial plants Eucalyptus, sugarcane, Banana, rose.

**UNIT V:** Application of tissue culture in various field like floriculture, olericulture breeding man made mutatime disease resistance food biotechnology, medicine anomaly plause conservation of endangered and rare species.

Floriculture: Involved in promoting their time of business.

### Practicals

Sterilixation, Media preparations surface sterilization, callus induction, Plantlet-hardening.

**Books for Study**

1. Gamborg O.L, Phillips G.C., 2005, Plant cell, Tissue and Organ Culture, Fundamental Methods, Narosa Publishing House Pvt. Ltd., Chennai.
2. Kumar U., 2005, Methods in Plant tissue culture, 2<sup>nd</sup> Ed., M/S. IBD Publisher and Distributors, New Delhi.

**Books for Reference**

1. Dwivedi P., 2005, Plant Tissue Culture, International Book Distributors, Dehradun

## 10. BIONANOTECHNOLOGY

### Aims and objectives

To make the students more competent in Plant Science and acquire skills to become employable by learning this cutting edge technology.

**UNIT 1:** Bionanotechnology - Introduction - cellular machines. Introduction to nanomaterials (nanoparticles, nanotube, nanowire and nanocrystals) and biomacromolecules (Nucleic acid and protein structures).

**UNIT II:** Sensors-optics-ion selective electrodes gas , enzyme based and protein based sensing principles-DNA Amplification, DNA probes and arrays, DNA application and liposomes, fluidics Biomems-Biochips.

**UNIT III:** Fabrication techniques, imaging and manipulation tools at the nanoscale-nanoscale devices and circuits (e.g) carbon nanotubes, FETs, Quantum dots).

**UNIT IV:** Nanomedicine and its importance in medical diagnostics molecular therapeutics nanoelectronic-nano optical-nano chemical.

**UNIT V:** Molecular manufacturing-nano/molecular communication-nano navigation-nano scale manipulation and control nano robots for medical application.

### Practicals

1. Cell as a machine
2. Preparation of nanomaterials.
3. Nucleic acid –structure studying
4. Protein structure-analysis.
5. Preparation of Biosensors
6. Preparation of electrodes.
7. Biochip fabrication-Demo
8. Molecular therapeutics-some examples.
9. Nanorobots-principles.

### Books for Study

1. Sulabha K.K., 2006, Elements of Nanotechnology, M/S. IBD Pub. Dist., New Delhi.
2. Misener Bioinformatics, Methods and Protocols, IBD Publishes, New Delhi.

## 11. HORTICULTURE

### Aims and objectives

This course is designed to provide theoretical and practical aspects of gardening to enable them to be self reliant knowledge and self employment.

**UNIT I:** Introduction-scope and division of Horticulture History of Gardening-some famous gardens in India Types of Garden- Indoor garden, public garden, kitchen garden. Garden implements and accessories.

**UNIT II:** Nursery structures-Nursery beds, propagating frames, hot beds, green house and glass house.

Nursery Management-cuttage, layerage, graftage pots, potting and repotting. Preparation of soil mixture. Organic farming-vermiculture and composting.

**UNIT III:** Garden operations : planting and transplantation, pinching , disbudding, defoliation, staking, pruning watering, mulching, topiary.

**UNIT IV:** Terrace garden, rock garden, hydroponics, terrarium, arches, pergolas, Bonsai and lawn.

**UNIT V:** Cut flowers, Flowers arrangements, commercial floriculture cultural practices of rose and jasmine.

### Practicals

Layering - Grafting - Budding - Potting - Terrarium.

### Books for Study

1. Kumar N., 1990, Introduction to Horticulture , Rohini agencies Nagercoil.
2. Prasad, 2005, Principles of Horticulture, International Book Dist., Dehradun.

### Books for Reference

1. Chauhan, D.V.S., 1968, Vegetable production in India. Ram Prasad sms Agra.
2. Edmund J.B. Senn T.L Andrews F.S and Halforce R.G., 1990, Fundamentals of Horticulure 14<sup>th</sup> ed) Tata McGraw Hill pvt co London.
3. Gopaldaswami Iyengar K.S., 1970, complete Gardening in India, Kalyan press, Banglaore.

4. Jules J. Janick J., 1982, Horticulture science, 3<sup>rd</sup> edition surjeet Publication, New Delhi.
5. Nayak K.,1963, South Indian fruits and their culture, P. Varadaraj and co,. Madras.
6. Randhawa G.S., 1973, Ornamental Horticulture in India, Today and tomorrow printers and publishers NewDelhi.
7. Percy Lancaster, 1979, Gardening in India. Mohan makhijani and Rekha printers NewDelhi.

## 12. INSTRUMENTATION

### Aims and objective

To infuse the practical knowledge of using various instruments into the vast array of techniques in plant science.

**UNIT I:** Microscopy-principle, phase contrast, polarizing; Differential interference, Dark field, Fluorescence, working methods types of microscopes-TEM, SEM, Confocal and 3D microscopy.

**UNIT II:** Micrometry-ocular and stage, Microtomy- Types and working principles and applications, Microinjection.

**UNIT III:** Chromatography-paper,TLC,ELC,HPLC, principle working and application of paper, TLC, GLC, HPLC.

**UNIT IV:** Colorimetry-Beer-Lambert law, single and double beam photo colorimeter, colorimeter, and spectrophotometer application.

**UNIT V:** Centrifuges-ultra centrifuge, density gradient, principle, application Radio active techniques- radioisotopes-alpha, beta, gamma rays half life principle and working of scintillation counters. Application of Lacer techniques in plant science research. Autoradiography.

### Practicals

1. Use of microscopes-principles, working and application.
2. Use of micrometry in calibration and camera lucida for diagram (mirror and prism type) and use of microforner.
3. Use of centrifuges for separation and purification of extracts.
4. Use of chromatography for - separation of chloroplast pigments by paper chromatography method; -separation of flavonoids by TLC.

### Books for Study

1. Rana S.A., Biological Instrumentation.
2. Jayaraman J, 1988, Techniques in Biology- A college study.

### Books for Reference

1. Skoog D.A., Instrumentation methods of analysis .
2. Sass J.E., Botanical Microtechniques, 1958, State College Press, Amer, IOWA.

3. Braithwaits A and Smith F.J., 1988, Chromatographic methods- Braithwaits.
4. Harborne A.L., Phytochemical Methods: A guide to morden Techniques of Plant Analysis, International Book Dist., Dehradun.
5. Brawn, Introduction to Instrumental Analysis, M/S. IBD publishers, New Delhi.

## 13. LABORATORY TECHNIQUES

### Aims and objectives

To make the students to understand the various techniques and engage themselves in self-employment.

**UNIT I:** Preservation of plant materials- Fixation, stains, preparation of medium for culture. PDA, MS Media.

**UNIT II:** Sectioning of plant material - Hand sectioning, microtome sectioning. Double staining. Permanent and semi permanent mounts.

**UNIT III:** Extraction and purification methods- Batch extraction, solvent extraction, filtration. Electrophoresis –principles and techniques PAGE, SDS-PAGE

**UNIT IV:** Cytochemical test for identification of proteins lipid, starch sugar in plant tissues.

Preparation of culture suspension callus, use of rotary shakers.

**UNIT V:** Biostatistics-mean, Median, mode, standard deviation, standard error, student test chi square test.

### Practicals

1. Preparation of permanent and semi permanent mounts of stem, leaf, reproductive structures. Preparation of maceration, leaf clearing.
2. Extraction and purification –SCP  
Separation of proteins by electrophoresis.
3. Cytochemical test: Test for lipid, protein, reducing sugar.
4. Using random sample calculation of mean median mode std deviation.

### Books for Study

1. Berlyn, G.P., Botanical Microtechnique and Cytochemical, M/S. IBD Publisher and Distributors.
2. Khanirjan A., Fundamentals of Biostatistics, M/S. IBD Publishers, New Delhi.
3. Srivastava Meena, 2007, Principles of Laboratory Techniques and Methods, IBD Publishers, New Delhi.
4. Jayaram J., 1988, Techniques in Biology - A college level study.

### **Books for Reference**

1. Johansen, Laboratory Techniques.
2. Jensen W.A., Botanical Histochemistry, Tata Mc GrawHill.
3. Harborne J.B., Phytochemical Methods, International Book Dist., Dehradun.
4. Sass J.E., 1958, Botanical Microtechnique, State College Press Amer. IOWA.

## 14. MOLECULAR TAXONOMY

### Aims and objectives

This study was initiated with an aim to identify taxa authentically with the help of molecular biomethods.

**UNIT I:** Principles of Taxonomy- Relationships between plants-secondary substances- alkaloids- flavonoids- Terpenoids phenols free amino acids and their chemical structures.

**UNIT II:** Classification of Alkaloids chemical structures and their biosynthesis- distribution of alkaloids in the families flowering plants. Inter relation of families based on alkaloid distribution.

**UNIT III:** Classification of flavonoids-chemical structures and their biosynthesis- distribution of flavonoids in the families of flowering plants. Interrelation of families based on flavonoids distribution.

**UNIT IV:** Classification of terpenes, phenols and free amino acids chemical structures and their biosynthesis and distribution Interrelation of families based on terpenoids phenols and amino acid distribution.

**UNIT V:** Seed and leaf protein analysis- Genomes- whole plant DNA extraction restriction digestion –RAPD-RFLP- chromosome fingerprinting application of these techniques in plant Taxonomy.

### Practicals

1. Differentiating three general using free amino acids
2. Qualitative identification of alkaloids in three different species.
3. Separation of flavonoids using Thin layer chromatography.
4. Differentiating two species using RAPD.
5. Differentiating two varieties using RFLP.

### Books for Reference

1. Harborne, Phytochemical methods - A guide to modern techniques of plant analysis, International Book Dist., Dehradun.
2. Goodwin, T.W and Mercer E.I., Introduction to plant biochemistry Pergamon Press.
3. Rapley R. Walker J.M., 1998, Molecular Biomethods Handbooks New Jersey.
4. Esser K., 2000, Progress in Botany Genetics physics systematics and Ecology Springer Verlag.
5. Raaman N., 2006, Phytochemical Techniques, M/S. IBD Pub. and Distributors, New Delhi.

## 15. STRESS PHYSIOLOGY

### Aims and objectives

To study the physiological activities in relation to stress on plants.

**UNIT I:** Stress Definition components of stress abiotic and biotic stresses causes of stresses, environment and man made stresses consequences of stress.

**UNIT II:** Water stress-Water Deficit-Water use efficiency- role of stomata –adaptation to water stress- role of growth regulators in water stress-Antitranspirants –metabolism of plants during water stress.

**UNIT III:** Flooding- effect of flooding on growth and development-Adaptation of plants to flooding. Salt stress- saline and alkaline soils-salt stress injury- mechanism of salt tolerance.

**UNIT IV:** Temperature stress-high temperature- heat shock protein-chilling and frost injury-Anti freeze agents-mechanism of temperature stress tolerance

**UNIT V:** Light and oxidative stress metabolism during stress-production of osmoregulators-proline, Glycine betaine-production of antioxidants-general aspects on genes regulating various stresses.

### Practicals

1. Estimation of proline content.
2. Estimation of Glycinebetaine.
3. Effect of temperature on protoplasmic membrane.

### Books for Study

1. Kumar, 2005, Plant Physiology Fundamental and Applications, M/S. IBD Publishers, New Delhi.
2. Purohit, 2006, Plant Physiology, International Book Distributors, Dehradun.

### Books for Reference

1. Lincoln Taiz and Eduardo Zeiget, 1998, Plant physiology, sinauer Associates, Inc publ sunderland Massachuslts.
2. Hopkons W.G., 1995, Introduction to plant physiology, John wiley and sons Inc
3. Salrisbury F.B and Cleon Ross, 1994, Plant physiology.
4. Levit J., 1984, Response of plants to environmental stresses.

## 16. MUSHROOM CULTIVATION

### Aims and objectives

This syllabus is designed to impart sufficient academic and practical experience to the learners and motivate them to become self employed in the mushroom venture.

**UNIT I:** Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, lifecycle of common edible mushrooms.

**UNIT II:** Scenario of Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.

**UNIT III:** LifeCycle of *Pleurotus spp.*, *Agaricus spp.*, *Volvariella spp.*, *Calocybe spp.*, and *Lentinus spp.*, breeding and genetic improvement of mushroom strains.

**UNIT IV:** Cultivation - Conditions for tropical and temperate countries, isolation, spawn production, growth media, spawn running and harvesting of mushrooms.

**UNIT V:** Diseases and post harvest technology Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.

Post harvest technology: Harvesting Freezing, dry freezing, drying, packaging, Marketing recipes form Mushrooms.

### Practicals

1. Identification of edible and poisonous mushrooms.
2. Microscopical observation of Mushrooms.
3. Isolation and purification –spawn preparation
4. Construction of mushroom cultivation sheds.
5. Cultivation of mushroom : Tropical and temperate types using compost / paddy straw agriculture wastes/sugarcane wastes etc. spawn running and harvesting.
6. Determination of Nutritional value: (protein, sugars, lipids crude fibre, vitamins an mineral content).
7. Identification of antimicrobial components (Flavonoid).

### Books for Study

1. Handbook of Mushroom Cultivation , 1999, TNAU publication.
2. Nita Bahl, 2002, Handbook on Mushroom 4<sup>th</sup> edition vijay

primlani for oxford & IBH publishing co. Pvt. Ltd. NewDelhi.  
Dr. C. Sebastian Rajasekarn Reader in Botany Bishop Heber college  
Trichy 17.

3. Suman, 2005, Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
4. Sing, 2005, Modern Mushroom Cultivation, International Book Distributors, Dehradun.

### **Books for Reference**

1. Bahl N., Handbook on Mushroom, Oxford and IBM, New Delhi..
2. Dey S.C., Mushroom growing, Agrobios(India), Jodhpur.
3. Handbook of Edible Mushroom Today and Tommorrow's printers and publishers.
4. Kapoor J.N., Mushroom cultivation, KrishiBhavan, NewDelhi.
5. Manibushan Rao K., TextBook of Horticulure, Mac Millan India ltd.
6. Parthiban, Malathi and BalaMohan, Mushroom culture(Tamil).
7. Pathak V.N., yadav N. and Gaur M., Mushroom production and processing Technology Agrobios (India), Jodhpur.
8. Sharma O.P., Textbook of Fungi, Tata McGrawHill Publishing Co., NewDelhi.
9. Sharma V.P., 2006, Diseases and Pests of Mushrooms, M/S. IBD Publishers and Distributors, New Delhi.

## 17. MICROBIAL TECHNOLOGY

### Aims and objectives

The course deals about industrial products from microbial fermentations. Information is provided on the fundamentals of the fermentation process, strain improvement and culture. Using different microorganisms for a variety of industrial products is dealt with.

**UNIT I:** Introduction – general information on microbial – based industries – substrates for industrial fermentation – strain improvement – mutant selection – an outline on fermentation and product recovery.

**UNIT II:** Food, dairy and beverage industries – Single cell proteins (SCP)-SCP from sewage, alkanes and Wood-SCP as food and feed – mass cultivation of *spirulina*. Lactic acid production, Yogurt and cheese production. Alcoholic beverages: Beer and wine fermentation.

**UNIT III:** Pharmaceutical and related industries

Antibiotics – sources and types – production of penicillin and streptomycin. Recombinant drugs and vaccines – insulin and Hep B vaccine. Principles of biotransformation – transformation of steroids. Vitamins – Production of B<sub>12</sub> and  $\beta$  – carotene.

**UNIT IV:** Enzymes, Amino acids and Organic acids

Microbial enzymes – amylase, protease, pectinase, lipase. Microbes used for amino acid production – commercial production of L – glutamic acids, L-tryptophan. Organic acids – citric acid, acetic acid production

**UNIT V:** Biofertilizers, Biopesticides and Future prospects

Biofertilizers – mass production of phosphate solubilizing bacteria – BGA and mycorrhizae. Biopesticides – Principles, production and application. Exopolymer production. Production of gasohols. Future prospects.

### Practicals

To demonstrate anaerobic fermentation, isolation and preservation of industrially important micro-organisms. Demonstration of SCP - production - *Spirulina*. To demonstrate production of amylase protease lipase.

### Books for Study:

1. Crueger F. and Anneliese Crueger, 2000, Biotechnology: Industrial Microbiology Panima Publications.
2. Adams M.R. and Moss M.O., 1995, Food Microbiology Tata McGraw Hill.
3. Ratledge and Kristenson, 2001, Basis Biotechnology Oxford University Press.

4. Agarwal, 2006, Industrial Microbiology: Fundamentals and Application, M/S. IBD Publishers and Distributors, New Delhi..
5. Purohit, 2005, Microbiology Fundamentals and Applications 6<sup>th</sup> edition, International Book Distributors, Dehradun.

**Books for Reference**

1. Glazer A.Z. and Nikaido H, 1994, Microbial Biotechnology, W.H. freeman and Co.
2. Prohit, 2006, Pharmaceutical Microbiology, F/S. IBD Publishers and Distributors, New Delhi.
3. Raja K.,2005, Microbial Biotechnology for sustainable Development and Productivity, M/S. IBD Publishers and Distributors, New Delhi.

## 18. ENVIRONMENTAL BIOTECHNOLOGY

### Aims and objectives

To give an insight into environmental pollution and microbial processes in the environment. The paper is also mainly focused to provide knowledge on the use of microbes for a safe of environment and to treat hazardous waste using biotechnological processes.

#### UNIT I: Introduction

The environment-soil, water and air. Pollution and its causes(outline only).- Nonconventional energy sources-biogas production, methane and hydrogen production.Recycling of waste products-composting and silaging.

#### UNIT II: Source and treatment of polluted waters and effluents

Biological treatment of sewage-characteristics of sewage and objectives in sewage treatment-Activated sludge process-Trickling filters-Anaerobic digestion.Treatment of industrial effluents using bioreactors.Pollution of water bodies by heavy metals and pesticides-removal of heavy metals and pesticides by Biosorption. Removal of oil spills by using microbes.

#### UNIT III: Soil and air pollution and their treatment:

Soil pollution by xenobiotics.Degradation of xenobiotics-pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation. Purification of polluted air.

#### UNIT IV: Bioremediation

Introduction to bioremediation, *exsitu* and *insitu* bioremediation.Types of reactors used in bioremediation.

#### UNIT V: Biometallurgy and related topics

Biomineralization-bioleaching-Mental transformation - biofilms and biocorrosion.Pollution by radionuclides-uptake of radionuclides from polluted sites.Future prospects.

### Practicals

1. Estimation of BOD.
2. Conversion of nitrate to ammonia.
3. Conservation of nitrate to nitrogen.
4. Effect of heavy metals on microorganisms.
5. Isolation of hydrocarbon degrading bacteria.
6. Hydrogen production by cyanobacteria.
7. Field visit to sewage treatment plants.

**Books for Study:**

1. Alan Scragg, 1999, Environmental Biotechnology. Pearson Education Limited.
2. Dubey R.C. 2004, A text book of Biotechnology aspects of microbiology, British Sun Publication.
3. Joseph C. Deniel, 1996, Environmental aspects of microbiology, British Sun Publication.
4. Keeshav Thehan, 1997, Biotechnology, New age international (P) Limited, New Delhi.
5. Sharma P.D, 2005, Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi.

**Book for reference**

1. Raina Maier M., Iran Pepper L., Charles P.Gerba, 2000, Environmental Microbiology, Academic press UK.
2. Alexander N. Glazer and Hiroshi Nikaido, 1994, Microbial Biotechnology.
3. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. vol. 41(9). National Institute of science communication and Information Resources, CSIR New Delhi.

## 19. FERMENTATION TECHNOLOGY

### Aims and objectives

The course deals about the fermentation processes and their importance in industries in order to obtain the useful products, fermentation processes, strain improvement and culture. Emphasis is laid on processes and their control. The recovery of useful products after fermentation is also dealt with. The laboratory exercises will train students in understanding and applying the protocols for primary fermentation processes.

#### **UNIT I:** Introduction to fermentation Technology.

Chronology and components of fermentation processes- A general account on microbial biomass, enzymes, metabolites and recombinant products- Range of fermentation processes Transformation processes.

#### **UNIT II:** Strain Improvement, media and growth kinetics

Isolation, preservation, optimization and improvement of industrially important microorganisms- media for industrial fermentation and their sterilization-Microbial growth kinetics in batch, fed batch and continuous cultures.

#### **UNIT III:** Design of fermentor

Fermentor – basic function-body construction-aerators, agitators (impellers and spargers) asepsis- containment –valves and steam traps-types of fermentors.

#### **UNIT IV:** Bioprocess control

Methods of measuring process variables-temperature, pressure and flow rate control-online analysis of chemical factors and control systems(pH, DO,foaming etc)- computerized control systems biosensors.

#### **UNIT V:** Down stream processing-recovery and purification of fermented products

Foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography membrane process, drying, crystallization, whole broth processing and effluent treatment.

### Practicals

1. Isolation and preservation of industrially important microorganisms.
2. Shake flask-batch cultures-citric acid production.
3. Still culture-ethanol production.
4. Glutamic acid production.

5. Production of amylase.
6. SCP production-*Spirulina* and *Chlorella*.
7. Demonstration of fermentor-batch and continuous cultures.
8. Industrial visit.

### **Books for Study**

1. Balasubramanian D., Bryce C.F.A., Dharmalingam K., Green J. and Kunthala Jayaraman, 1998, Concepts in Biotechnology, Consist Publication, India.
2. Agrawal, 2006, Industrial Microbiology: Fundamental and Applications, M/S. IBD Publishers and Distributors, New Delhi.

### **Books for Reference**

1. Stanley P. F. A., Whilttaker and S.J Hall, 1995, Principles of Fermentation Technology, 1995, I Edn, Pergamon Press U.K.
2. Alexandar N. Glazer and Hiroshi Nikaido, 1994, Microbial Biotechnology, Fundamentals of Applied microbiology W.H.Freeman and Co., New York.
3. Rajak, 2005, Microbial Biotechnology for sustainable Development and Productivity, M/S. IBD Publishers and Distributors, New Delhi.

## 20. RENEWABLE ENERGY SOURCES

### Aims and objectives

The curriculum is designed and developed with the following prime objectives:

To make the students more competent in Plant science and acquire skills to engage themselves in self-employment especially in different fields like Biofuels managements and Bio-energy resources.

**UNIT I:** Definition – Introduction – Present energy scenario – Available Energy sources for future – Renewable Energy sources – Energy crisis – Energy requirement in relation to population and industrial growth – Need to tap more energy from various non-conventional sources.

**UNIT II:** Non-conventional energy sources – Solar Energy – Wind energy – Ocean energy – Tidal energy – Wave energy – Thermal energy – Geothermal energy – Hydrogen fuel – Biomass gasification – Biofuels – Improved cookstove for villagers – Energy and Environment pollution.

**UNIT III:** Sun and its energy – Photothermal conversion – Flat plate collectors – Concentrating collectors – Solar photovoltaic conversion – Solar energy utilization in India – Solar gadgets available – Future prospects for solar energy.

**UNIT IV:** Wind energy – Basic components of a Wind Energy Generating System (Wind mill) – Transmission and control – Supporting structure – Wind power details – Advantages and disadvantages of Wind energy system – Win power development in India – Management of Win farms – Future prospects of Wind energy.

**UNIT V:** Biomass – Anaerobic fermentation – Bioenergy – Substrate available for biogas production – Factors affecting biogas production – Various models of biogas plants – Biogas from various waste materials including night-soil – Recent advances in biogas generation and its application in rural sectors – Vegetable oils and alcohols as energy sources.

### Practicals

1. To learn about biodiesel and biogas producers and utilization.
2. To demonstrate Anaerobic fermentation.

### Books for Study

1. Shyam M., Pandey K.C., and A.K. Dubey, 2005, Renewable energy Technologies for rural sector, Published by Central Institute of Agricultural Engineering, Nabi bagh, Berasia Road, Bhopal.

2. Shyam M., 2003, Biennial Report on Renewable Energy Sources, Published by Co-ordinating cell on RES, CIAE, Bhopal, Madhya Pradesh.

### **Books for Reference**

1. Barker H.A., 1956, Bacterial fermentation, John Wiley and sons, Inc. New York.
2. Browning B.L., 1967, Methods on wood chemistry Vol. II, P. 395 – 396. Interscience Publishers, New York.
3. Sykee G. and Skinner F.A., Microbial aspects of pollution. Eds., Academic Press London and New York.
4. Hobson P.N., Bousfield S. and Summers, R., 1981, Methane production from Agricultural and Domestic Wastes, Applied Science Publishers Ltd. Ripple Road, Barking complex; England.
5. Khendelwal K.C., 1990, Proceedings of the International conference held at Pune on Biogas Technology, Implementation strategies (Ed. Borda).
6. King J.L., 1974, Weeds of the world, Biology and control, Wiley Eastern private Ltd., New Delhi – India.
7. Kumaresan and Bhagavathi. S., 1989, Biogas – Retrospect and prospect, Published by Sri Parasakthi College Press, Courtallam.
8. Majid F.Z., 1986, Aquatic weeds utility and Development, Agro Botanical Publishers India.
9. Making Aquatic weeds useful – Some perspectives for developing countries, 1976, Report of an Ad Hoc Panel of the Advisory committee on Technology Innovation Board on Science and Technology for International Academy of Science, Washington, D.C.
10. Mossy F.E., 1974, Anaerobic Biological treatment. Inst. Water. Poll. Control. Symposium on treatment of wastes from food and Drink industry, New Castle, Ubon – Tyne. UK.
11. Sathianathan M.A., 1975, Biogas Achievements and challenges, Sagar printers and publishers, Udaichand Mar, New Delhi.
12. Tadulingam C. and Vankatanarayana G., 1985, A hand-book of some South Indian weeds, Periodical Expert Book Agency New Delhi – India.

## Evaluation

Continuous assessment of the academic performance of the students is essential to bring out the best in them and make them more competent. It has to be done by the respective teachers who are actually in contact with the students. It will greatly help the teaching and learning process.

Hence the following methods of internal evaluation are suggested here which may be done in addition to the external examinations conducted by the respective universities.

### 1. Quiz:

It is desirable and feasible to conduct this programme in the form of written Quiz by giving multiple choice questions; a model of which is given below;

Example: Choose the correct answer by marking  $\checkmark$

1. The organism which has nitrogen fixing capacity is-
  - a) Mushroom
  - b) Nostoc
  - c) Nostoc
  - d) Funaria
  
2. Onion plant belongs to the family
  - a) Amarantaceae
  - b) Euphorbiaceae
  - c) Zingiberaceae
  - d) Rutaceae

### 2. Assignments

Simple assignments may be given to students to undertake simple biological surveyes or experiments or a field study and may be submitted for internal assessment. This will kindle the spirit of research and invention among the students and will expose them the realities outside their class rooms and libraries.

Examples: **Submit a report for four pages on any one of the following topics**

1. Weeds of my college campus.
2. Ten common medicinal plants of my locality.
3. Mushroom cultivation.
4. Few commonly used medicinal plants.
5. A survey on the customer response to edible mushrooms.
6. Observations on a coir industry.
7. Floriculture.
8. Common Ferns along the Kodaikanal/Ooty roadways.

**Materials Required**

1. Books and periodicals – a list is given at the end of the syllabus of each paper.
2. Encapsulated materials.
3. Museum specimens.
4. Herbarium sheets.

**Media to be used**

1. O.H.P.
2. Educational C.D' S.
3. Powerpoint presentations.