

# **DEPARTMENT OF BOTANY**

[DST-FIST & UGC-SAP SPONSORED DEPARTMENT]

**M.Sc. Botany**  
**Five year Integrated Programme**  
**Syllabus with effect from 2014 – 2015**

**ANNAMALAI**  **UNIVERSITY**

**ANNAMALAI NAGAR – 608 002**

**ANNAMALAI UNIVERSITY**  
**DEPARTMENT OF BOTANY**  
**M.Sc. BOTANY**  
**FIVE YEAR INTEGRATED PROGRAMME**

**REGULATIONS**

**Common to all Departments of Studies in the Faculty of Science**

Mathematics, Statistics, Physics, Chemistry, Botany, Zoology, Earth Sciences, Bio Chemistry and Biotechnology.

**Master's Programme**

A Master's Programme consists of a number of courses, in M.Sc. A Master's Programme consists of a set of compulsory courses and Language Papers.

**Credits**

The term credit is used to describe the quantum of syllabus for various programme in terms and hours of study. It indicates differential weightage given according to the contents and duration of the courses in the Curriculum design.

The minimum credit requirement for the award of the Degree of Five Years Master's Programme shall be 225.

**Courses**

Each course may consist of Lectures/ Tutorials/ Laboratory work/ Seminar etc.

Normally, in each of the courses, credits will be assigned on the basis of the Lectures/ Tutorials/ Laboratory work and other form of learning in a 18 week schedule.

**Eligibility for Admission**

Candidates for admission to the first year of the Five Year Integrated M.Sc. Degree Courses shall be required to have passed the final examination of the plus 2 (Higher Secondary Course) and Equivalent thereto aggregate under academic stream / Vocational Stream with the following subjects as in Appendix-A, conducted by the Board of Secondary Education, Tamilnadu Government or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

**Grading System**

The term Grading system indicates a 10 point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

## **Course Duration**

The duration for completion of a Five-Year Integrated M.Sc. Programme in any course is Ten Semesters.

## **Student Counsellors**

To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study.

## **Attendance**

Every teaching faculty handling a course shall be responsible for the maintenance of Attendance Register for candidates who have registered for the course.

The instructor of the course must intimate the Head of the Department at least Seven Calendar Days before the last instruction day in the semester about the particulars of all students who have secured an attendance of less than 80%.

A candidate who has attendance less than 80% shall not be permitted to sit for the End –Semester Examination in the course in which the shortage exists.

However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of a condensation fee and such exemptions should not under any circumstances be granted for attendance below 70%.

## **Examination**

There will be two sessional assessments and one End-Semester Examination during each semester.

Sessional Test – I will be held during Sixth Week for the syllabi covered till then.

Sessional Test – I will be a combination of a variety tools such as class test, assignment and paper presentation that would be suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However the tests are compulsory. Test – I may be for one hour duration. The pattern of question paper will be decided to the respective Faculty. Sessional Test-I will carry 20% of marks of the entire course.

Sessional Test – II will be conducted with a variety of assessment tools. It will also have an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However the tests are compulsory. Test – II may be for two hours' duration. The pattern of question paper will be decided to the respective Faculty. Sessional Test-II will carry 20% of marks of the entire course.

There will be one End Semester Examination of 3 hours duration in each course.

The end semester Examination will cover all the syllabus of the course for 60% of marks.

## Evaluation

Evaluation will be done on a continuous basis. Evaluation may be by Objective Type Questions, Quiz, Short Answers, Essays or a combination of these, but at the End Semester it has to be a Written Examination.

The performance of students in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The sum of the total performance in each semester will be rated by GPA while the continuous performance from the 2<sup>nd</sup> Semester onwards will be marked by OGPA.

## Marks and Grading

A student cannot repeat the assessment of Sessional Test - I and Sessional Test- II. However, if for any compulsive reason, the student could not attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

A minimum of 50% marks in each course is prescribed for a pass. A student has to secure 50% minimum in the End Semester Examination.

If a candidate who has not secured a minimum of 50% of marks in a course shall be deemed to have failed in that course.

The student can repeat the End Semester Examination when it is offered next in the subsequent Odd/Even Semesters till the regulations are in force. However, a candidate cannot move to the next odd/even semester if he/she has more than six papers as arrears at any point of time.

A candidate who has secured a minimum of 50% marks in all the courses prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's Programme.

## Grading

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme.

Marks	Grade Point	Letter Grade	Class
90+	10	S	Exemplary
85-89	9.0	D++	Distinction
80-84	8.5	D+	Distinction
75-79	8.0	D	Distinction
70-74	7.5	A++	First Class
65-69	7.0	A+	First Class
60-64	6.5	A	First Class
55-59	6.0	B	Second Class
50-54	5.5	C	Second Class
49 or Less		F	Fail

The successful candidates in the Core Subjects are classified as follows:

I Class-60% marks and above in Overall Percentage of Marks (OPM).

II Class-50-59% Marks in Overall Percentage of Marks.

Candidates who obtain 75% and above but below 90% of Overall Percentage of Marks (OPM) shall be deemed to have passed the examination in FIRST CLASS (Distinction) provided he/she passes all the papers prescribed for the programme at the **First appearance**.

For the Internal Assessment Evaluation, the break up marks shall be as follows for **theory**:

Test (Two)	---	15 Marks
Assignment	---	5 Marks
Seminar	---	5 Marks
<b>Total</b>		<b>25 Marks</b>

For the Internal Assessment Evaluation, the break up marks shall be as follows for **practical**:

Test (Two)- 10+10	---	20 Marks
Record	---	10 Marks
Herbarium / Slide	---	10 Marks
<b>Total</b>		<b>40 Marks</b>

The M.Sc., students of Botany shall undertake a Botanical Tour during IX semester under the guidance of the staff members for field training and plant collection.

### Course-Wise Letter Grades

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than F. A letter grade F in any course implies a failure in that course. A course successfully completed cannot be repeated for the purpose of improving the Grade point.

The F grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the odd/even semester in which the candidate has appeared for clearance of the arrears.

### Transitory Regulations

Wherever there had been change of syllabi, examinations based on the existing syllabus will be conducted for three consecutive times after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendations of the Head of the Department concerned.

### APPENDIX – A

M.Sc . BOTANY	:	A pass in H.Sc. (10+2 level) Regular OR Vocational with Botany/ Biology or Vocational course with Agriculture/ Plant Protection as one of the papers.
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**M.Sc. BOTANY**  
**FIVE YEAR INTEGRATED PROGRAMME**  
**SCHEME OF EXAMINATION AND SYLLABUS**

**Total Credits: 225**

**FIRST SEMESTER**

CODE	COURSE	L	P	C	Int. Asse. Marks	End Sem. Exam Marks	Total Marks
		Hrs					
ITAC11	Part- I: Language – Tamil/Hindi/ French	3	0	3	25	75	100
IENC12	Part-II: Language –English	3	0	3	25	75	100
ICEC13	Civics, Environmental Awareness & Health Science	3	0	3	25	75	100
IBOT14	Morphology of Angiosperms	5	0	5	25	75	100
IBOA15	Allied - I : Zoology Paper – 1	4	0	4	25	75	100
	Total	18	0	18			

**SECOND SEMESTER**

ITAC21	Part- I: Language – Tamil/Hindi/ French	3	0	3	25	75	100
IENC22	Part-II: Language –English	3	0	3	25	75	100
ICAC23	Computer Applications	3	0	3	25	75	100
IBOT24	Phycology	5	0	5	25	75	100
IBOA25	Allied - I: Zoology Paper - 2	4	0	4	25	75	100
IBOP26	Allied – I – Zoology Practical	0	6	2	40	60	100
IBOP27	Practical – I covering IBOT14 and IBOT24	0	9	3	40	60	100
	Total	18	15	23			

**THIRD SEMESTER**

ITAC31	Part- I: Language – Tamil/Hindi/ French	3	0	3	25	75	100
IENC32	Part-II: Language –English	3	0	3	25	75	100
IBOT33	Bryology and Pteridology	5	0	5	25	75	100
IBOT34	Mycology and Lichenology	5	0	5	25	75	100
IBOA35	Allied – II : Chemistry Paper - 1	4	0	4	25	75	100
IBOP36	Practical – II covering IBOT33 & IBOT34	0	9	3	40	60	100
	Total	20	9	23			

#### FOURTH SEMESTER

CODE	COURSE	L	P	C	Int. Asse. Marks	End Sem. Exam Marks	Total Marks
		Hrs					
ITAC41	Part- I: Language – Tamil/Hindi/ French	3	0	3	25	75	100
IENC42	Part-II: Language –English	3	0	3	25	75	100
IBOT43	Gymnosperms and Paleobotany	5	0	5	25	75	100
IBOT44	Anatomy and Embryology of Angiosperms	5	0	5	25	75	100
IBOA45	Allied – II : Chemistry Paper – 2	4	0	4	25	75	100
IBOA46	Allied – II - Chemistry Practical	0	6	2	40	60	100
IBOP47	Practical – III covering IBOT43 and IBOT44 Pre-lab Discussion Practicals	0	1	3	40	60	100
		0	5				
	Total	20	12	25			

#### FIFTH SEMESTER

IBOT51	Cell Biology	5	0	5	25	75	100
IBOT52	Genetics , Plant Breeding and Evolution	5	0	5	25	75	100
IBOT53	Taxonomy of Angiosperms and Economic Botany	5	0	5	25	75	100
IBOT54	Microbiology	5	0	5	25	75	100
IBOP55	Practical –IV covering IBOT51, IBOT52, IBOT53 and IBOT54	0	9	3	40	60	100
	Total	20	9	23			

#### SIXTH SEMESTER

IBOT61	Plant Physiology and Biochemistry	5	0	5	25	75	100
IBOT62	Environmental Biology	5	0	5	25	75	100
IBOT63	Plant Biotechnology	5	0	5	25	75	100
IBOT64	Molecular Biology and Genetic Engineering	5	0	5	25	75	100
IBOP65	Practical – V covering IBOT61 ,62,63 and 64	0	9	3	40	60	100
	Total	20	9	23			

### SEVENTH SEMESTER

CODE	COURSE	L	P	C	Int. Asse. Marks	End Sem. Exam Marks	Total Marks
		Hrs					
IBOT71	Plant Diversity – I	5	0	5	25	75	100
IBOT72	Mycology, Microbiology and Plant Pathology	5	0	5	25	75	100
IBOT73	Biological Techniques	4	0	4	25	75	100
IBOP74	Core Practical- VII covering IBOT71, 72 & 73	0	9	3	40	60	100
	Total	14	9	17			

### EIGHTH SEMESTER

IBOT81	Plant Diversity - II	5	0	5	25	75	100
IBOT82	Plant Anatomy, Embryology and Morphogenesis	5	0	5	25	75	100
IBOT83	Genetics and Plant Breeding	5	0	5	25	75	100
IBOP84	Core Practical - VIII covering IBOT81, 82 & 83	0	9	3	40	60	100
	Soft Skill Development	4	0	4	25	75	100
	Optional I	4	0	4	25	75	100
	Total	23	9	26			

### NINTH SEMESTER

IBOT91	Taxonomy of Angiosperms and Economic Botany	5	0	5	25	75	100
IBOT92	Cell Biology and Molecular Biology	5	0	5	25	75	100
IBOT93	Bio-technology, Genetic Engineering and Tissue Culture	5	0	5	25	75	100
IBOT94	Research Methodology, Bio-informatics and Nanotechnology	4	0	4	25	75	100
IBOP95	Core Practical- IX covering IBOT91, 92, 93 & 94	0	9	3	40	60	100
	Optional II	4	0	4	25	75	100
	Total	23	9	26			



**TENTH SEMESTER**

CODE	COURSE	L	P	C	Int. Asse Marks	End Sem. Exam Marks	Total Marks
		Hrs					
IBOT101	Plant Physiology	5	0	5	25	75	100
IBOT102	Environmental Biology	5	0	5	25	75	100
IBOP103	Core Practical- X covering IBOT101 & 102	0	9	3	40	60	100
IBOT 104 A (or) 104 B	Optional –III Applied Botany (or) Enzyme Technology	4	0	4	25	75	100
IBOT 105A (or) 105B	Optional – IV Horticulture and Landscaping (or) Bio Prospecting of Medicinal and Aromatic Plants	4	0	4	25	75	100
	Total	18	9	21			

**I – SEMESTER**  
**IBOT14- MORPHOLOGY OF ANGIOSPERMS**

**Objectives:**

1. To acquire the knowledge about external features of angiosperms.
2. To study the different parts of plants.
3. To understand the modifications of different plant parts.
4. To analyze the significance of reproductive structures of plants.
5. To appreciate the fruits and seeds dispersal.

**Unit – I**

Parts of Plant: Root – Characteristics of the root; Tap root and its modifications; Branched root modification – Pneumatophores; Adventitious root and its modification; Epiphytes, Velamen and Assimilatory roots.

The Stem – Characteristics of the Stem; Nodes, Internodes and Buds. Modifications of Stem – Aerial and Subaerial modifications – Thorn, Phylloclade, Cladode and Bulbil.

**Unit – II**

Leaf: Phyllotaxy; Parts and Types of Leaves; Stipules and their kinds; Margin, Surface and Shape of leaves; Venation; simple and compound leaves; Modification of leaves and Heterophylly.

**Unit – III**

Inflorescence: Racemose and its types: Cymose and its types; Special types of Inflorescences.

Flower: Perianth; Position of floral leaves on the Thalamus. Bract and its kinds; Symmetry of the flower – Actinomorphy and Zygomorphy: Polypetalous and Gamopetalous flowers: Aestivation; Cohesion and Adhesion of stamens.

Gynoecium - Apocarpous and Syncarpous: Pistillode: Placentation: Structure and types of Ovule.

**Unit – IV**

Methods of pollination and process of fertilization, Double fertilization and Triple fusion - Development of Embryo: Dicot and Monocot embryos;

Seed - Albuminous and Exalbuminous seeds.

Germination – Epigeal and Hypogeal – viviparous. Development of seedling.

**Unit – V**

Fruit: Development of Fruit – Dehiscence of fruits;  
Classification - simple – Dry dehiscent and Dry indehiscent; Splitting of Schizocarpic fruits; Simple, fleshy and its types; Aggregate and Multiple fruits.  
Dispersal of seeds and fruits.

## **Practicals**

1. Parts of a plant
2. Types of Root and their modifications
3. Types of Stem and their modifications
4. Types of Leaves and their modifications
5. Inflorescence and their types
6. Floral parts of monocots
7. Floral parts of dicots
8. Methods of Pollination and process of fertilization
9. Classification of fruits and their characteristic features
10. Seed structure in monocot and dicot plants
11. Mechanisms of Fruit and Seed dispersal
12. Seed Germination Methods

## **Books:-**

1. Dutta.A.C.2007. A Class Book of Botany-Seventeenth New Revised Edition, Oxford IBH Press, New Delhi
2. James D. Mauseth.2013. Botany Methods- An Introduction to Plant Biology. Panima Book Agency, Bangalore.
3. Pandey, B.P. 1999. College Botany. S.Chand & Co., New Delhi
4. Subramanian,N.S. 1996. Modern Plant Taxonomy, Vikas Publishing House, New Delhi.
5. Vashistha, B.R. 1999. Botany. S.Chand & Co., New Delhi.
6. Lowson J.M and Birbal Sahni. 1960. Text Book of Botany, University tutorial Press Ltd, London.
7. Arther J. Eames. Morphology of Angiosperms. 1961. Tata MCGraw Hill Publishing, London , U.K.

## **II – SEMESTER** **IBOT24 – PHYCOLOGY**

### **Objectives:**

1. To study the classification of Algae
2. To know the algal flora in land, fresh water and marine environment
3. To study the range of thallus structure, reproduction and life history of algae.
4. To know the economic importance of algae.
5. To distinguish the fresh water algae from the marine form

### **Unit-I:**

Classification of algae by F.E.Fritsch. Distribution of algae: soil, fresh water and marine environment. Fossil algae. Algal pigments,(Chlorophyll, carotenoids and phycobilin).

### **Unit-II:**

General characters, life history and economic importance of Chlorophyceae. (*Chlorella*; *Ulva*, *Ulothrix* and *Caulerpa*).

### **Unit-III:**

General characters, life history and economic importance of Xanthophyceae, (*Vaucheria*) and Bacillariophyceae(Centric and Pennate diatoms),

#### **Unit-IV:**

General characters, life history and economic importance of Phaeophyceae (*Padina* and *Sargassum*) and Rhodophyceae (*Polysiphonia* and *Gracilaria*).

#### **Unit-V:**

General characters, life history and economic importance of Cyanophyceae. (*Oscillatoria*, *Nostoc*, *Scytonema* and *Stigonema*).

#### **Practicals :-**

Structure, reproduction and diagnostic features of fresh water and marine algal forms from the list of specimens mentioned in the theory.

#### **Books:**

1. Bilgrami, K.S and L.C.Sha, 2004. A Text book of Algae, CBS publications
2. Sambamurthy, A.V.S.S.2005. A Text book of Algae. I.K. International Pvt.Ltd, New Delhi.
3. Sharma, O.P. 2006. Text book of Algae, Tata McGraw Hill publishing Company Ltd., New Delhi.
4. Sundararajan, S. 2005. Practical manual of algae, Anmol publications Pvt.Ltd.
5. Vashishta, B.R, A.K. Sinha and V.P.Singh, 2008. Botany for degree students – Algae. S.Chand & Co. New Delhi

### **III – SEMESTER**

#### **IBOT 33- BRYOLOGY AND PTERIDOLOGY**

#### **Objectives:**

1. To know about the origin and Evolution of the Primitive land plants
2. To understand the life cycle of Thalloid Liverworts, Leafy liverworts, Hornworts and Mosses.
3. To know about the general characters and classification of life cycle of Pteridophytes
4. To understand the development of sporangium and sex organs
5. To study the life cycle of living forms

#### **Bryology:**

##### **Unit – I :**

Introduction to Bryophytes – General characters - Classification of Bryophytes (Watson's). Origin and Evolution of Bryophytes – Asexual and Sexual Reproduction in Bryophytes Life cycle: Alternation of Generation.

##### **Unit – II :**

Structure, reproduction of Gametophytes and Sporophytes of *Riccia*, *Porella*, *Marchantia*, *Anthoceros* and *Polytrichum*.

#### **Pteridology**

##### **Unit – III :**

General characters and classification of Pteridophytes (Reimer's, 1954) classification) - Life cycles – homosporous and heterosporous and evolution of seed habit – alternation of Generations- Apogamy and Apospory.

##### **Unit – IV:**

Range of structure, reproduction of sporophytes and gametophytes in the following living forms: *Lycopodium*, *Selaginella*, *Equisetum*, *Osmunda* and *Marsilea*.

## Unit – V:

Sporangium development – Eusporangiate and Leptosporangiate. Sex organs – Development and structure of Antheridium and Archegonium. – Embryo development and spore germination.

### Practicals:

#### Bryology

1. *Riccia, Porella, Marchantia, Anthoceros and Polytrichum*

#### Pteridology

2. Living forms: *Lycopodium, Selaginella, Equisetum, Osmunda and Marsilea.*

### Books:

1. Gilbert Smith.1976. Cryptogamic Botany-Volume I, Tata McGraw Hill Book company Ltd, New Delhi.
2. Pandey.S.N., S.P.Misra and P.S. Trivedi. 2002. A Text book of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
3. Parihar, N.S. 2005. An Introduction to Embryophyta – Bryophyta, Central Book Depot, Allahabad.
4. Rashid.A. 2007. An Introduction to Bryophyta – Vikas Publications, New Delhi.
5. Rashid.A. 2007. An Introduction to Pteridophyta – Vikas publications, New Delhi.
6. Sambamurthy,A.V.S.S. 2005. A Text Book of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. Vedams Book International Publications, New Delhi.
7. Smith,A.2013. Bryophyte Ecology. Springer.
8. Sporne, K.R.1975. The Morphology of Pteridophytes. Hutchinson University Library, London.
9. Vashishta. B.R., A.K. Sinha and Adarsh Kumar. 2012. Botany for Degree students. Pteridophytes. S. Chand and Company Ltd., New Delhi.
10. Watson. E.V. 2003. Structure and Life of Bryophytes – B.I Publications, New Delhi.

### IBOT34 - MYCOLOGY AND LICHENOLOGY

### Objectives:

1. To acquire knowledge on the classification , occurrence, structure and reproduction of fungi
2. To acquire knowledge about the economic importance of fungi and lichens
3. To understand the role of fungi in medicines and industry.
4. To study the mode of nutrition in fungi
5. To study the classification and structure of Lichens

### Mycology

#### Unit-I:

Introduction, Position among Living organisms (Whittakers (1990) 5-Kingdom concept) General characters, Classification with reference to Alexopoulos and Mims – range structure, reproduction, life history, Evolution and economic importance of fungi.

Myxomycetes - *Stemonites*

Chytridiomycetes – *Synchytrium*

#### Unit-II :

General characters- classification, life history in Oomycetes : *Albugo, Pythium*  
Plasmodiophoromycetes : *Plasmodiophora*  
Zygomycetes : *Mucor.*

#### Unit-III:

General characters- classification, life history - Ascomycetes : *Yeast, Penicillium, Peziza*  
Basidiomycetes: *Puccinia, Polyporus*.  
Deuteromycetes: *Cercospora*.

**Unit-IV:**

Mode of nutrition in Fungi. Endophytic fungi and their uses. Mycorrhiza - types, Physiology and functions, Fungi as Biocontrol agents.

**Lichenology:**

**Unit-V:** Classification, structure, nutrition, reproduction and economic importance of Lichens:- *Parmelia, Usnea, Cladonia*.- Lichen as pollution indicator.

**Practicals:-**

*Stemonitis, Synchytrium, Albugo, Pythium, Plasmodiophora, Mucor, Yeast, Penicillium, Peziza, Puccinia, Polyporus, Cercospora, Parmelia, Usnea, Cladonia*.

**Books:**

1. Alexopoulos.C.J., C.W. Mims and M. Blackwell. 2007. Introductory Mycology. IV Edition. Wiley India (P) Ltd., Daryaganj, New Delhi.
2. Carlile, M.J.2001. The Fungi (2<sup>nd</sup> ed) Academic Press.
3. Dube, H.C. 1983. A Textbook of Fungi, Bacteria and Viruses, Vikas Publishing Houses Pvt Ltd.
4. Dutta., A.C. 1984. College Botany. Oxford Press.
5. Geeta Sumbali . 2005. The Fungi. Narosa Publishing House, New Delhi.
6. John Webster. 1999. Introduction to Fungi. Cambridge University Press. Cambridge.
7. Sharma O.P. 1989. A Textbook of Fungi. Tata McGraw hill publishing Co., New Delhi.
8. Sharma,P.D.2009. The Fungi. Rastogi Publications, Meerut.
9. Vashista, B.R and A.K. Sinha. 2008. Botany for Degree Students – Fungi. S.Chand & Company, New Delhi.

**IV – SEMESTER**

**IBOT 43 - GYMNOSPERMS AND PALAEOBOTANY**

**Objectives**

1. To acquire knowledge on the morphology and classification
2. To study the structure and reproductive features of Gymnosperms.
3. To study the economic importance of Gymnosperms.
4. To study the Geological time scale
5. To know the techniques of fossil study.

**Gymnosperms:**

**Unit I:**

General characters, Classification of Gymnosperm by K.R. Sporne (1965) and economic importance, Life cycle, alternation of generations of gymnosperms. *Cycas* : *External Morphology and Internal structure of corolloid root, stem and leaf*.  
Reproduction: Male and Female reproductive structures, fertilization and embryo development.

**Unit II:**

*Pinus* : *External Morphology and Internal structure of root, stem and leaf*.  
Reproduction: Male and Female reproductive structures, fertilization and embryo development.

### **Unit III:**

*Gnetum* : External Morphology and Internal structure of stem and leaf. Reproduction: Male and Female reproductive structure, fertilization and embryo development.

### **Palaeobotany:**

#### **Unit IV:**

Palaeobotany – General account, Geological time scale – determination of geological age of Fossil (carbon dating), Methods of Fossilization, knowledge, conservation and exploration of fossil fuels.

#### **Unit V:**

Types of Fossils, Process of preservation – impression, compression, casts, molds and petrifications, Techniques of fossil study, study of pollen – Acetolysis.

### **Practicals :-**

Gymnosperms: Identification and characteristic features of *Cycas*, *Pinus*, and *Gnetum*

Palaeobotany: Impression, compression, casts, molds and petrifications.

#### **Books:**

1. Bhatnagar S.P and Alok Moitra. 1997. Gymnosperms. New Age Internat.(P) Ltd, New Delhi.
2. Biswas.C and B.M.Johri 1999. The Gymnosperms, Narosa Publishing House, Chennai.
3. Govil,C.M. 2010. Gymnosperms extinct and extant. Krishna Prakasam Media Pvt Ltd., New Delhi.
4. Johri,R.M. 2012. A Text book of Gymnosperms. Dominant Publishers and Distributors Pvt Ltd., New Delhi.
5. Kumar, A.2012. Text book of Gymnosperms. Random exports Publishers and distributors, New Delhi.
6. Steward,W.N. and Rathwell,G.W.1993. Palaeobotany and evolution of plants. Cambridge University Press, London.
7. Shukla,A and Mishra,S.P.1982. Essentials of Palaeobotany. Vikas publishing House pvt Ltd., New Delhi.
8. Vashista.P.C, A.K.Sinha and Anilkumar 2000. Gymnosperms, S.Chand & Company Ltd, New Delhi.
9. Sporne, K.R. 1965. The Morphology of Gymnosperms, Hutchin, University LTd. London.
10. Agashe, S.N. 1995. Palaeobotany, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

## **IBOT 44 - ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS**

### **Objectives:**

1. To understand the structure of cell wall and the nature of meristems, types of tissues and internal structures of Angiosperms and their functions.
2. To acquire knowledge about the internal structure of root and Stem
3. To know the methods of Pollination
4. To study microsporogenesis and megasporogenesis, embryo and Endosperm.
5. To understand the development of embryo in dicot and monocot

## **ANATOMY**

### **Unit – I:**

Tissue Types and their distribution: Parenchyma, Collenchyma, Sclerenchyma Xylem and phloem - Tissue system – Meristematic and permanent - simple and complex tissues. Vascular bundles- types - open and closed- – Concentric, collateral, bicollateral and radial. Endarch, Exarch and mesarch Xylem.

#### **Unit – II:**

Root system – Vascularization of primary root in monocotyledons and dicotyledons. Shoot system - Vascularization of primary shoot in monocotyledons and dicotyledons. Secondary growth in thickness – Anomalous secondary thickening – cortical bundles – medullary bundles.

#### **Unit – III:**

General structure of wood; characteristics of growth rings. Leaf anatomy: Internal structure of a monocotyledons and dicotyledons leaf – stomata and its types.

### **EMBRYOLOGY OF ANGIOSPERMS:**

#### **Unit -IV:**

Structure of anther and pistil – types of pollination – Microsporogenesis: Morphology, Cytology, development and formation of male gametes – role of vegetative and generative nuclei – pollen wall ornamentation.

#### **Unit - V:**

Megasporogenesis: Types and Organization of the embryo sac – role of synergids and antipodal haustoria, nutrition of embryo sac – Double Fertilization –Triple fusion , Embryo development in dicot and monocots.

#### **Practicals:**

##### **Anatomy:**

Examination of Root and Shoot Apices; Maceration,  
Study of simple tissues and complex tissues.  
Study of cross section in Monocot and Dicot root.  
Study of Monocot and Dicot stem  
Study of Monocot and Dicot leaf.  
Types of stomata and stomatal index.  
Anomalous secondary thickening in *Bougainvillea*, *Boerhaavia* and *Nyctanthes* stem.

##### **Embryology**

Dissection of Pollinium from *Calotropis*  
Dissection of embryo from *Tridax* and *Cleome*  
Development of Microsporangium, Pollengrains and their variations,  
Different types of Ovary, Ovules and placentation,  
Female gametophyte – Monosporic, Bisporic and Tetrasporic Embryo sacs  
Endosperms and their haustorial apparatus,  
Dissection of Anther and angiosperm embryos.

#### **Books**



1. Arthur J. Eames and Lawrence. H., Mac Daniels. 2005. An Introduction to Plant Anatomy. Tata McGraw Hill Publishing Co.Ltd, New Delhi.
2. Bhojwani, S.S and Bhatnagar, S.P. 1981. Embryology of Angiosperms. Vikas Publication Pvt Ltd, New Delhi.
3. Esau,K. 2007. Anatomy of seed plants. John Wiley & Sons, New Delhi.
4. Fahh,A. 1990. Plant Anatomy. Pergamon press, Oxford, UK.
5. Katherine Esau. 2002. Plant Anatomy. John Wiley & Sons, New Delhi.
6. Maheswari,P. 1993. An Introduction to Embryology of Angiosperms. Tata McGraw Hill, New Delhi.
7. Pandey, S.N and A.Chadha.2005. Plant Anatomy and Embryology. Vikas publishing House Pvt Ltd., New Delhi.
8. Shivanna, K.R. 2003. Pollen Biology and Biotechnology. Oxford & IBH Publishing company (P) Ltd, New Delhi
9. Singh.V., P.C. Pande and D.K.Jain. 2003. Embryology of Angiosperms. Rastogi Publications. Meerut.

## V – SEMESTER

### IBOT51 : CELL BIOLOGY

#### Objectives

- To understand the basic concept of cells and organelles
- To acquire knowledge about the cell cycle
- To study the organelles of Plant cell
- To study the chromosome structures
- To understand the special types of chromosomes and aberrations

#### Unit-I :

Cell – Historical accounts. Structure of cells: Prokaryotic cell – Bacterial cell and Blue green algae. Eucaryotic cell – Ultra structure of plant cell. Plasma membrane – Dynamic structure, models of plasma membrane and functions. Ergastic substances and vacuoles.

#### Unit-II :

Mitochondria – Ultra structure, mitochondrial membrane, mitochondrial complexes and functions. Plastids – Types, Ultra structure of chloroplast – membrane and functions. Ribosomes – Types, Ultra structure and functions. Structure and functions of Endoplasmic reticulum, Golgi apparatus and Lysosomes. Nucleus – Ultra structure, nuclear membrane and functions. Nucleolus – Fine structure and functions.

#### Unit-III :

Cell – G<sub>1</sub>, S, G<sub>2</sub> and M phases. Types of cell division – Amitosis, Mitosis and Meiosis – karyokinesis and cytokinesis – significance of mitosis and meiosis.,

#### Unit-IV

Chromosomes – structure – types of chromosomes, Karyotype – Idiogram. Special types of chromosomes – Polytene and Lampbrush chromosomes. Fundamentals and significance of Cytotaxonomy

#### Unit-V:

Structural changes of chromosomes – deficiency – duplication – translocation and inversion.  
Numerical changes of chromosomes – aneuploids and euploids. Polyploids – auto and allo polyploids

### **Practicals**

#### **Cell Biology**

- 1) Learning and perfecting squash and smear techniques.
- 2) Study of cell division: Mitosis – *Allium cepa*, *Rhoeo*.
- 3) Meiosis – *Allium cepa*, *Helianthus*.
- 4) Preparation of Idiogram.
- 5) Study of special types of chromosomes

#### **Reference Books**

- 1) Darlington, C. 1987. Recent advances in Cytology. J A Churchill London.
- 2) David E.Sadava.2010. Cell Biology. Panima book distributors, New Delhi.
- 3) Rastogi, S.C. 2004. Cell Biology. New Age International Publication, New Delhi.
- 4) Sharma,A.K. and Sharma,A.1980. Chromosome Techniques-Theroy and Practice. Oliver and Boyd, London.
- 5) Singh and Tomar.2004.Cell Biology. Rastogi publishers, Meerut.
- 6) Swanson,C.P.1972. Cytology and Cytogenetics. Macmillan New York.
- 7) Verma,P.S. and V.K. Agarwal.2012. Cell Biology, Genetics and Molecular Biology. S.Chand Company. New Delhi.

## **IBOT52 - GENETICS , PLANT BREEDING AND EVOLUTION**

### **Objectives:**

1. To understand the Mendelian laws
2. To study the sex determination and sex linked inheritance
3. To understand the Chromosome maps
4. To acquire knowledge on plant breeding technique and their applications
5. To understand the basic principles of evolution

### **GENETICS:**

#### **Unit – I:**

Mendelian genetics – Introduction, Mendel’s laws. Monohybrid cross, Dihybrid cross, Test cross, Back cross. Non-Mendelian Genetics- Introduction, Incomplete dominance and Interaction of genes Multiple alleles, Quantitative inheritance, linkage and crossing over, significance of crossing over, sex determination – sex determination by hormones, Sex determination by chromosomes and sex linked inheritance.

#### **Unit -II:**

Extra chromosomal inheritance. Construction of chromosome map in *Drosophila*. Three point cross. Mutations – Spontaneous and Induced mutations, Molecular basis of gene mutations, Point and Frame shift mutations.

### **PLANT BREEDING:**

#### **Unit -III:**

Objectives of Plant breeding, Breeding methods: Methods of Plant breeding in self and cross pollinated crops. Breeding for special purposes- Breeding for diseases & pest resistance – breeding for quality- breeding for hybrid varieties.

#### **Unit - IV:**

Hybridization techniques, Pure line Selection, Mass Selection, Intervarietal; Interspecific and Intergeneric hybridization. Hybrid Vigour and Mutation breeding.

## **EVOLUTION:**

### **Unit - V:**

Origin of life - Operin's concept of chemical evolution. Evolutionary theories of Lamark, Darwin, De Vries, Modern synthetic theory of Evolution.

**Practicals:** Monohybrid cross and test cross, Dihybrid cross and test cross, Incomplete dominance, Gene interaction, Quantitative inheritance, Sex – Linked Inheritance, Chromosome map. Emasculation – Cross pollination.

### **Books**

1. Chaudhari, H.K. 1984. Elementary Principles of Plant Breeding. Oxford IBH, New Delhi.
2. Gupta, P.K. 2003. Cytogenetics. Rastogi Publications, New Delhi.
3. Jain, H.K and M.C.Kharkwal. 2004. Plant Breeding. Narosa publishing House
4. Sambamurthy, A.V.S.S. 2005. Genetics. Narosa Publishing House, New Delhi
5. Singh, B.D. 2001. Fundamentals of Genetics, Kalyani Publications, New Delhi.
6. Singh, B.D. 2001. Plant Breeding, Principles and Methods. Kalyani Publications, New Delhi
7. Singh, B.D. 2001. Fundamentals of Genetics, Kalyani Publications, New Delhi.
8. Vijendra Das, L.D. 2005. Genetics and Plant Breeding. New Age International (P) Ltd., New Delhi.

## **IBOT53 - TAXONOMY OF ANGIOSPERMS and ECONOMIC BOTANY**

### **Objectives:**

- 1) To understand the principle of classification of angiosperms
- 2) To acquire knowledge about the characteristic features of angiosperm families
- 3) To acquire knowledge about the importance of plants in human welfare
- 4) To study the concept of Cytotaxonomy
- 5) To understand the hierarchy in Systematic Botany

### **TAXONOMY OF ANGIOSPERMS:**

#### **Unit – I**

Principles of Taxonomy - Identification, Description, Nomenclature and, Taxonomy and its importance, outline classification of Artificial system- Linnaeus, Natural system - Bentham and Hooker, Phylogenetic system- Engler and Prantl.

#### **Unit – II**

Taxonomy Biosystematics and Phylogeny, Taxonomic hierarchy (Major and minor categories), ICBN- principles of ICBN- naming of Taxa- genus and species, citation of authors, herbarium technique, cytotaxonomy - chromosome number and structure, Botanical Survey of India - Headquarters and Regional Offices – current activities of BSI.

#### **Unit – III**

A detailed study of the following families and their relationship and phylogeny

Nymphaeaceae

Capparidaceae

Portulacaceae

Malvaceae

Rutaceae

Lythraceae

Asteraceae

#### **Unit IV**

Solanaceae  
Asclepiadaceae  
Convolvulaceae  
Bignoniaceae  
Amaranthaceae  
Commelinaceae  
Zingiberaceae  
Cannaceae  
Poaceae

## **ECONOMIC BOTANY:**

### **Unit V**

Importance of Economic Botany. Brief account of Binomial, sources and uses - Fruit and vegetables – Mango, Papaya, Guava and Banana – Brinjal- Raphanus and cabbage- Cereals, millets and nuts(rice, Wheat, Ragi, Red gram, Black gram, and Casew) - Fibres and Fibre yielding plants – Textile fibres – Surface fibres (cotton) – soft or bast fibres (Jute) – Hard fibres (coir) - Spices and Condiments -roots (*Ferula asafoetida*) underground stem (*Allium cepa*), Bark (*Cinnamomum zeylanicum*)

Drugs from roots, underground stems, Bark stems, leaves, flowers, fruits, seeds and entire plants (two from each category).

#### **Practicals:-**

Detailed study of the families mentioned in the theory with representative species from the local area.

Familiarity of the binomial nomenclature of the available species from the local flora using Gamble flora.

Identification of family, genus, species and morphology of the useful parts of plants mentioned in the theory.

#### **Books**

1. Dutta, S.C. 2003. Systematic Botany, New age International (P) Ltd Publication, New Delhi
2. Gurucharan Singh, 2004. Plant Systematics, Oxford & IBH Publishing company (P) Ltd, New Delhi
3. Kochhar.2009. Economic Botany in the tropics. Macmillan publishers
4. Naik, V.N., 2002. Taxonomy of Angiosperms. Tata McGraw Hill, New Delhi.
5. Pooja.2010. Economic Botany. Discovery Publishing House, New Delhi
6. Sambamurthy, A.V.S.S. 2005. Taxonomy of Angiosperms. I.K. International Pvt.Ltd
7. Sivarajan, V.V. 1999. Principles of Taxonomy. Oxford and IBH Publications, New Delhi.
8. Singh, Pandey and Jain.2009. Diversity of Systematics of seed plants. Rastogi publications, Meerut.
9. Singh,S.K and Seema Srivastava. 2009. Economic Botany. Campus Book International, New Delhi.

## **IBOT54 - MICROBIOLOGY**

### **Objectives:**

1. To study the basic concepts of Microbiology
2. To study the sterilization methods
3. To study the classification, structure and reproductive features of bacteria and viruses.
4. To understand the microbial interaction
5. To understand the process of fermentation

### **Unit – I:**

Wittaker's five Kingdom concept. Introduction to microbiology, Scope of microbiology, Characterization of microorganisms, microscopic observation. Methods in microbiology: Basic principles of microscopy, micrometry, staining techniques.

**Unit – II:**

Sterilization methods, culture media, pure culture methods, methods for population estimation, growth determination.

**Unit – III:**

Fine structure of Prokaryotic and Eukaryotic microorganisms. Archea; Bacteria- Structure properties, classification and reproduction. Viruses- Structure properties and classification and reproduction. Bacteriophage, Characteristic features of host- Virus interaction , general account of mycoplasma, spiroplasma and Phytoplasma,

**Unit – IV:**

Plant - Microbe interactions in Soil- Biological Nitrogen Fixation – Phosphate solubilization and Biocontrol – Vermi composting; Biogas- generation . Factors affecting microbial community in soil.

**Unit – V:**

Fermentation and Fermentors - microbial production of antibiotics, organic acids – Ecological groups of Microorganism – Microbial contamination – Biological welfare.

**Practicals:**

1. Staining of microorganisms – Simple staining – Gram staining – Spore and acid – fast staining
2. Isolation of microorganisms – Anaerobic, Aerobic and soil microbes
3. Hanging drop method
4. Identification of plant diseases included in theory syllabus.

**Books:**

1. Ananthanarayanan, R and CKJ. Paniker, 2004. Text book of Microbiology. Orient Longman Pvt. Ltd.
2. Dubey R.C. and D.K. Maheshwari, 2005. A Text book of Microbiology. S.Chand and Company Ltd, New Delhi.
3. Dubey, R.C. and D.K. Maheswari, 2010. A Text book of Microbiology, S. Chand & Company, New Delhi.
4. Khuntia,B.K.2013. Basic Microbiology: An Illustrated Laboratory Manual. Astral International (P) Ltd.
5. Michael J. Pelzar, J.R.E.C. Channoel and R. Krieg, 2005. Microbiology, McGraw Hill., New Delhi.
6. Stuart Hogg.2013. Essential Microbiology. Panima Book Distributors, Meerut.

**VI – SEMESTER**

**IBOT61 - PLANT PHYSIOLOGY and BIOCHEMISTRY**

**Objectives:**

1. To acquire the knowledge about the functioning of plants
2. To understand the biophysical and biochemical processes
3. To understand the concept of growth regulators on growth and development of plants
4. To develop the skill on various aspects of reproduction physiology
5. To appreciate the biomolecules and their functions

## **PLANT PHYSIOLOGY:**

### **Unit-I:**

Importance of water to plant life – physical properties of water: diffusion, osmosis, absorption, transport of water and transpiration – physiology of stomata.

Absorption and translocation of minerals. Mineral nutrients – Micro and macro nutrients and their role,

### **Unit-II:**

Photosynthesis: Structure of Chloroplast, Mechanism of light absorption, photo-phosphorylation: Photosynthetic electron transport (cyclic non-cyclic) Carbon metabolism : C<sub>3</sub>, C<sub>4</sub> and CAM pathways and their distinguishing features.

### **Unit-III:**

Respiration: Aerobic and anaerobic - Glycolysis, Krebs' cycle and electron transport system, Factors affecting respiration, photo-respiration and its significance.

### **Unit IV:**

Nitrogen metabolism, Biological Nitrogen fixation and Nitrogen Cycle. Plant growth and development: Growth regulators: Auxins, gibberellins, cytokinins and Ethylene and their influence on plant growth.

Photoperiodism, Vernalization and senescence.

## **BIOCHEMISTRY:**

### **Unit - V:**

Structure, classification and properties of carbohydrates, lipids, proteins and Nucleic acids. Enzymes – properties, nomenclature and classification. Co-enzymes and co-factors. Mechanism of enzyme action.

### **Practicals:**

Determination of osmotic potential by plasmolytic method.

Effect of monochromatic light on apparent photosynthesis

Separation of chloroplast pigments using paper chromatographic technique

Estimation of chlorophyll content using Arnon's method

Rice coleoptile straight growth test for Indole acetic acid.

Estimation of Protein content

Estimation of Reducing Sugar Content

Estimation of Starch Content

Estimation of Lipid content

Estimation of  $\alpha$ - amylase and  $\beta$ - amylase

### **Books:**

1. Heldt, H.W. 2005. Plant Biochemistry. Academic press, London.
2. Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons Inc., New York
3. Jain, J.L. 2001. Fundamentals of Biochemistry. S.Chand & Company Ltd., New Delhi
4. Lincoln Taiz and Eduardo Zeiger, 2003. Plant Physiology, Sinauer Associates, Inc. Publishing, Sunderland Massachusetts.
5. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.
6. Srivastava, H.S. and N.Shankar. 2013. Plant Physiology and Biochemistry. Rastogi publications.
7. Salisbury and Ross. 2004. Plant Physiology. Wordsworth Publishing co., Belimont, USA.
8. Verma, S.K. 2006. A Text book of Plant Physiology, S.K.Chand & Co., New Delhi.

## IBOT62 – ENVIRONMENTAL BIOLOGY

### Objectives:

1. To understand the basic concepts of Ecology
2. To understand the ecosystem and energy cycle
3. To acquire knowledge about the types of pollution and control measures
4. To understand Biodiversity and its conservation
5. To acquire knowledge about the natural resources

### Unit – I

Ecology – Introduction – Scope and Importance. Ecological Factors: Climatic, Edaphic, and Biotic factors. The Environment – Atmosphere, Lithosphere, Hydrosphere and Biosphere.

Structure and functions of ecosystems – Producer, Consumer and Decomposer. Energy flow – Food chain, Food Web, Trophic Level and Ecological Pyramids. Types of ecosystems. Terrestrial (Forest, desert and Grassland) and aquatic (Freshwater, Marine) Biogeochemical cycle: Hydrological, Gaseous and Sedimentary cycle.

### Unit – II

Natural resources – Forest, water, Mineral, food, energy and land – conservation of natural resources.

Methods of studying vegetation- qualitative and quantitative characters. Quadrats:- types – Ecological succession: Types, processes, causes, Theories of succession. Hydrosere and Xerosere. Ecological Indicators.

### Unit – III

Pollution – causes, effects and control of: Air, Water, Soil, Thermal, Noise and Radioactive pollution. Climate change: Global warming, Acid rain, Ozone layer depletion. Disaster management- Floods, earth quake, Cyclone and land slide.

### Unit –IV

Introduction – Definition – Genetic, species and ecosystem diversity – Values of biodiversity – biodiversity at global, national and local level. India as mega diversity nation – causes for loss of biodiversity – conservation of biodiversity (*In situ* and *Ex situ*) – Hot spots of biodiversity – Endangered and Endemic species of India

### Unit –V

Principles of Phytogeography –Vegetational types of India – Endemism – Age and Area hypothesis – Altitudinal and latitudinal distribution of vegetation-Continuous and Discontinuous distribution of vegetation - Application of Remote sensing to Ecological studies.

### Practicals:

1. Identification of plants in Botanical Garden
2. Determination of Abundance of a particular species in a given area.
3. Determination of frequency of a particular species in a given area.
4. Determination of Density of a particular species in a given area.
5. Determination of the Biomass of a particular area.
6. Determination of the biotic components of pond ecosystem.
7. Determination of the biotic components of Grassland ecosystem.
8. Ecological adaptations of plants:  
Hydrophytes: *Hydrilla*, *Eicchornia*, *Nymphaea*  
Xerophytes: *Nerium*, *Casuarina*, *Opuntia*
9. Special mode of Nutrition (adaptation)
  - (i) Symbiosis : root nodules of blackgram

- (ii) Mycorrhiza: root of *Pinus*
- (iii) Epiphyte: *Vanda*
- (iv) Insectivorous : *Nepenthes*
- (v) Parasitic Plant : *Cuscuta*

10. Determination of soil properties (pH, EC, moisture content, temperature, soil texture)

**Books:**

1. Ambasht. R.S. 1998. A Text book of Plant Ecology. Students & Friends Publications, Varnasi.
2. Asthana D.K and Meena Asthana. 2006. A Text book of Environmental Studies. S. Chand & Company, New Delhi.
3. Dash.M.C. 2007. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi.
4. Dubey,A.K.2012. A Text book of Ecology. Dominant publishers pvt ltd.,
5. Edward.J. Kormandy.2000. Concepts of Ecology. Prentice Hall of India, New Delhi.
6. Eugene Odum and Murray Bavvick. 2005. Fundamentals of Ecology, Cengage Learning.
7. Joshi PC and Namita Joshi. 2004. Biodiversity and Conservation. APH Publishing Corporation, New Delhi.
8. Kumaraswamy.K.A., Alagappa Moses and M. Vasanthi. 2008. Environmental studies. Bharathiyar University, Trichy
9. Odum, E.P.1978. Basic Principles of Ecology. Thomson, Brooks/cole, Australia.
10. Odum, E.P. Gary W. Barrelet.2004. Fundamentals of Ecology-15<sup>th</sup> edition. Thomson Asia pvt., Ltd.
11. Rajagopalan. R. 2011. Environmental Studies –2<sup>nd</sup> Edition. Oxford Press, New Delhi.
12. Sharma.P.D. 2011. Ecology and Environment. 11<sup>th</sup> edition, Rastogi Publishers, Meerut.
13. Shukla R.S and R.S. Chandel. 1998. Plant Ecology. S.Chand &Co. Pvt.Ltd, New Delhi.
14. Subramanian .V. 2005. A Textbook in Environmental Science. Narosa Publishihng House, New Delhi.

**IBOT63 - PLANT BIOTECHNOLOGY**

**Objectives:**

1. To understand the concepts of culture and purification
2. To study the importance of Metabolites
3. To study the basic concept of fermentation
4. To understand the applications of Biotechnology

**Unit – I:**

Biotechnology – History, isolation and cultivation of economically important microbes (*Scenedesmus*, *Aspergillus*) Culture and purification of single cell protein (*Spirulina*), Mushroom cultivation. Algal biomass production and maintenance.

**Unit – II:**

Production of primary and secondary metabolites by microbes - Ethanol by yeast, Citric acid by *Aspergillus niger*, *Pencilium*. Biofertilizers- *Agrobacterium tumifaciens* – Edible vaccines – Transgenic plants (Bt-cotton, Bt- tomato and golden rice).

**Unit – III:**

Fermentation technology – Microbial growth – Batch culture – Continuous culture – Fermentor design and operations- Bioreactors – types – Industrial microbial enzymes production and applications – Intellectual property rights – Patenting for higher plants and microbes.

**Unit – IV:**

History of plant tissue culture Laboratory organization – Basic principles of plant tissue culture – Callus culture, Totipotency of cells, differentiation, dedifferentiation and



redifferentiation (physical and chemical methods) - callus induction – Plant cell culture methods, Subculture maintenance, Culture media-MS and B5, Phytohormones.

**Unit – V:**

Morphogenesis in Tissue Culture – Role of Hormones, Organ culture, shoot tip culture, apical meristem culture, ovary culture, ovule culture, endosperm culture, embryo culture – Callus - metabolic patterns in callus culture – Harvesting and measurements.

**Practicals:**

1. Sterilisation of Explants
2. Preparation of Media
3. Isolation of Protoplast (Enzymatic method)
4. Protoplast fusion by using PEG
5. Callus, Embryo and Shoot tip culture
6. Artificial seeds and method of protection (synthetic seed)
7. ELISA – methods to observe pathogen (virus) free plants
8. The process of fermentation using *E-coli* strains
9. Explaining the process of making Transgenic crops (Bt cotton, Bt Brinjal, Golden rice and Milk products)

**Books**

1. Dubey,R.C.2007. A text book of Biotechnology.S.Chand publishers, Meerut.
2. Hammond et al. 2004. Plant Biotechnology. Springer Pvt. Ltd., New Delhi.
3. Ignachimuthu, S.1997. Biotechnology: An Introduction-2<sup>nd</sup> Edition, Panima Book Distributors.Narosa Publishing House, New Delhi.
4. Lindsey. 2007. Plant Tissue Culture. Springer (India) Pvt. Ltd., New Delhi
5. Prave.2013.Fundamentals of Biotechnology. Panima Book Distributors.
6. Ratledge.2003. Basic Biotechnology. Cambridge University press., New Delhi
7. Sathiyararyana. U. 2008. Biotechnology. Allied Pvt. Ltd. Calcutta.
8. William. J.Thieman, Michael A.Palladino. 2012. Introduction to Biotechnology. Benjamin Cummings publishers.

**IBOT64 – MOLECULAR BIOLOGY AND GENETIC ENGINEERING**

**Objectives:**

1. To introduce the basic concepts in the Structure of Gene and its regulating components
2. To understand the mechanism of Transcription in Prokaryotes and Eukaryotes
3. To understand the principles of mechanism of protein synthesis
4. To acquire the basic knowledge and concepts in Genetic Engineering
5. To understand the basic screening methods for Gene cloning

**MOLECULAR BIOLOGY:**

**Unit – I:**

DNA as the genetic material, Nucleic acids- structure, properties and function. DNA forms- RNA, tRNA, rRNA, and mRNA. Organization of Genomes- Viral, Bacterial, Organelles, Prokaryotic and Eukaryotic genomes.

**Unit – II:**

Definition of gene – Introns- exons Recons, Regulatory gene sequences, promoters, enhancers. DNA replication in prokaryotes and eukaryotes, DNA damage and repair and mutations.

**Unit – III:**

Transcription in prokaryotes and eukaryotes, RNA polymerase, regulation of transcription. Genetic code, Protein synthesis, Post-translational modifications of protein.

## **GENETIC ENGINEERING:**

### **Unit – IV:**

Genetic Engineering – Methods of gene transfer, types, salient features of Vectors  
Mechanism of cloning in plasmid vectors – Phage vectors – Bacteriophage and Cosmids.

Control of Gene expressions – The Operon concept – Lac and Trp operon. Hormonal control of Gene Expression.

### **Unit – V:**

Gene identification and DNA Libraries – Genomic Library Construction – cloning. Vectors for Gene Libraries – Cosmid Library. Screening methods based on Gene Expression – oligonucleotide probes – Colony and plaque Hybridization – Screening methods in genomic library.

### **Practicals**

1. Importance of clean handling, sterility, cleanliness, reagent preparation
2. DNA isolation – a) Bacterial DNA b) Eukaryotic DNA
3. Absorption spectra of Proteins, Nucleic acids
4. Analysis of DNA by Agarose gel electrophoresis
5. Restriction enzyme digestion
6. SDS-Page separation of proteins
7. Polymerase Chain Reaction
8. Protoplast isolation and somatic cell hybridization

### **Books**

1. Bernard R. Glick and Jack J. Pasternak. 2002. Molecular Biotechnology. Principles and application of recombinant DNA. Panima publishing corporation, New Delhi.
2. Benjamin Lewin . 2008. Genes IX. Jones & Barlett Publishers, London.
3. Brown, T.A. 2005. Modern Genetics, BIOS Scientific Publishers, London
4. Freifelder. 1990. Molecular Biology, Narosa Publications, New Delhi.
5. James D.Watson, Michael Gilman, Jan Litkowski, and Mark Zoller. 1998. Recombinant DNA (Sec. Ed.), Scientific American books, New York.
6. Lodish,H, A.Berk, A.Kaiser, M. Krieger, P.Scott, A.Bretscher, H. Ploegh and P.Matsudaira. Cell and Molecular Biology. 2008. W.H. Freeman and Company, New York.
7. Marina Cohen.2009. Genetic Engineering. Carbtree publishing Co., Canada.
8. Rocky Singh.2008. Genetic Engineering. Jnanda Prakashan publishers.
9. Verma,P.S & V.K.Agarwal. 2009. Genetic Engineering. S.Chand publications, New Delhi.
10. Watson D.Baker,A, P.Bell, Alexander Gann, Micheal Levine and Richard Losick. 2004. Molecular biology of Gene. Pearson Education, Singapore.
11. Weaver. 2005. Molecular Biology. IV Edition. McGraw Hill Higher Education, New Delhi.

## **VII – SEMESTER**

### **IBOT – 71 - PLANT DIVERSITY – I**

#### **Objectives:**

1. To acquire knowledge of the algal flora in land, fresh water and marine environment.
2. To understand the structure, reproduction and life cycle of algae.
3. To appreciate the uses of algae as food, fodder and pharmaceuticals.
4. To study the character of thalloid and leafy liverworts and mosses.
5. To acquire knowledge about structure and reproduction of Lichens.

## **PHYCOLOGY:**

### **Unit – I**

Classification, range of structure, reproduction; evolutionary trends; fossil history, economic importance, ecology and phylogeny in Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae and. Cyanophyceae,

## Unit – II

Origin and evolution of sex in algae - Distribution of algae in soil, fresh water and marine environment- Role of Algae in soil fertility - fossil algae. Culture and cultivation of algae - Algal pigments and their uses –Ecological and Economic importance of algae.

### **BRYOLOGY :**

#### **Unit III**

Introduction and Classification of Bryophytes, Life cycle and Alternation of Generation-two theories, Origin and Evolution of Bryophytes, Fossil Bryophytes and Interrelationship of Bryophytes.

#### **Unit IV**

Gametophyte and sporophyte of thalloid liverworts, Gametophyte and sporophyte of leafy liverworts, Asexual and sexual reproduction in Bryophytes, Gametophyte and sporophyte of Mosses

### **LICHENOLOGY**

#### **Unit – V**

General account of structure and life cycle of Lichens-broad outline classification. Structure, reproduction and lifecycle of the following types: a) *Parmelia*; b) *Usnea*. Ecological role and economic importance of lichens.

#### **Practicals:**

#### **Phycology**

*Chlamydomonas, Volvox, Chlorella, Hydrodictyon, Ulothrix, Ulva, Draparnaldia, Oedogonium, Caulerpa, Acetabularia, Halimeda, Codium, Valonia, Chara, Nitella. Desmids, Ectocarpus, Colpomenia, Padina, Stoechospermum, Sargassum, Turbinaria., Batrochospermum, Polysiphonia, Gracilaria, Microcystis, Nostoc, Stigonema, Anabaena, Lyngbya, Scytonema and Spirulina.*

#### **Bryology:**

*Riccia, Targionia, Reboulia. Dumortiera, Pallavicinia, Riccardia, Porella, Sphagnum and Bryum.*

#### **Lichenology:**

Collection and identification of lichen specimens and make labelled sketches of specimens. Study the external and internal structures of the types mentioned.

#### **Books:**

1. Andrew J.wood. 2010. New Frontiers in Bryology: Physiology, Molecular Biology and Functional Genomics.Springer Netherland.
2. Fritsch,F.E.1972. Structure and Reproduction of Algae I & II, Cambridge University Press.
3. Gilbert Smith.1976. Cryptogamic Botany. Tata McGraw Hill Book company Ltd, New Delhi.
4. Pandey.S.N., S.P.Misra and P.S. Trivedi. 2002. A Text book of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
5. Parihar, N.S.1991. An Introduction to Embryophyta – Bryophytes, Central Book Depot. Allahabad.
6. Rashid.A. 2007. An Introduction to Bryophyta – Vikas Publications, New Delhi.
7. Sambamurthy A.V. S.S. 2005. A Text book of Algae. I.K. International Pvt.Ltd, New Delhi.
8. Sharma O.P, 2007 ; Text book of Algae; Tata Mcgraw – Hill Publications Pvt – New Delhi
9. Sundara Rajan, S. 2005, Practical Manual of Algae ; Anmol Publications Pvt New Delhi
10. Trivedi, P.C.2013. Algal Biotechnology. Pointer Publishers, Jaipur.
11. Vashishta. B.R., A.K. Sinha and Adarsh Kumar. 2005. Botany for Degree students- Bryophyta. S. Chand and Company Ltd., New Delhi.
12. Vashishta. B.R., A.K. Sinha and Adarsh Kumar. 2008. Botany for Degree students - Algae. S. Chand and Company Ltd., New Delhi.

### **IBOT – 72 MYCOLOGY, MICROBIOLOGY AND PLANT PATHOLOGY**

**Objectives:**

1. To study the classification, structure and reproductive features of fungi, bacteria and viruses.
2. To develop skill in isolation and purification of microbes.
3. To understand the morphology and genetics of microbes and their uses.
4. To have knowledge of the causative organism, etiology, symptoms and control of various diseases.
5. To understand the host-parasite interactions and the role of enzymes and toxins in pathogenesis.

**MYCOLOGY****Unit – I**

Introduction to Fungi, Position of Fungi among living organisms – criteria and evidences - Recent trends in the classification of Fungi with special reference to Alexopoulos and Mims.

Structure, Nutrition of fungi

Myxomycotina : *Fuligo, Physarum*.

Eumycotina : *Olpidium*.

Mastigomycotina : *Phytophthora, Perenospora*

Plasmodiophoromycetes : *Plasmodiophora*.

Zygomycotina : *Pilobolus*.

**Unit – II**

Classification and diversity of Fungi Ascomycotina : *Aspergillus, Xylaria, Claviceps, Peziza, Morchella*.

Basidiomycotina : *Lycoperdon, Ustilago, Polyporus*.

Deuteromycotina : *Alternaria, Fusarium*

Spore dispersal and factors affecting spore germination, reproduction, life history, phylogeny and affinities of the major groups of Fungi.

Heterothallism, Parasexual cycle, Degeneration of sexuality.

Economic importance, Fungi as bio-control agents.

Ecology of Fungi - Soil Fungi – Sugar Fungi – Cellulose and lignin degrading Fungi. Role of fungi in Industry, Medicine and as food.

**MICROBIOLOGY****Unit – III**

Ultra structure of Bacteria, Nutrition and growth curve of Bacteria- measurements of growth, Methods of culturing bacteria – sterilization – kinds of media and preparation techniques – Isolation: serial dilution technique - pure culture – maintenance and preservation- inoculation of bacteria- Bacterial staining methods – Stains and dyes – gram, flagella and other types of staining. Morphology of viruses – classification of viruses – Virus-Vector relationships – replication of virus. Satellite virus. Bacteriophages - Viroids and Prions – isolation and purification of viruses. Uses of virus in Biotechnology.

**Unit – IV**

Role of microbes in cycling of nitrogen, carbon and phosphorus. Microbial control- methods of physical control (Heat, Cold, desiccation, radiation and sound waves). Microbial leaching of minerals. Sterilization by filtration, chemical agents – disinfectants, antiseptics and antibiotics. Role of Microbes in waste water treatment, General design and application of biofermentor. Microbes in food spoilage and food poisoning. Food preservation - Micro organisms as food – Probiotics. Microbes used as Bio fertilizers – *Rhizobium, Azospirillum, Acetobacter, Azolla* and blue-green algae.

**PLANT PATHOLOGY****Unit – V**

History of Plant Pathology – causes of Plant diseases – Diagnosis of Plant diseases - Koch's Postulates – Symptoms and signs. Classification of Plant Diseases – Host parasite interaction – Disease resistance defence - Histological and biochemical aspects - Metabolic changes during disease development – Role of enzymes and toxins during pathogenesis.

Etiology, Symptoms, Causative agents and Control of the following diseases: Tobacco Mosaic, Bunchy top of Banana, Leaf spot in Cotton, Blight of Paddy, Citrus canker, Soft rot in vegetables, Little leaf of Brinjal; Blast of Paddy, Red rot of Sugar cane, Tikka disease of ground nut and Damping off of seedlings. Plant disease management - Principles and methods of disease control – Chemical, Biological and Agronomical Practices – Modeling and disease forecasting- Legislation and quarantine practices in India.

**Practicals :**

**Mycology**

Structure, reproduction and diagnostic features of *Phytophthora*, *Peronospora*, *Pilobolus*, *Saccharomyces*, *Aspergillus*, *Xylaria*, *Claviceps*, *Peziza*, *Morchella*, *Lycoperdon*, *Ustilago*, *Polyporus*, *Alternaria*, *Fusarium*

**Microbiology**

Staining of microorganisms: Simple staining. Gram staining – spore and acid fast staining, preparation of culture media – Synthetic and Non-synthetic. Isolation of microorganisms. Aerobic and anaerobic forms and soil microbes, purification technique of microorganisms. Serial dilution technique. Hanging Drop method.

**Plant Pathology:**

Verification of Koch's postulates. Identification of plant diseases included in theory syllabus.

**Books:**

1. Abigall A. Salyers, Dixie D. Whitt. 2013. Microbiology- Diversity, Disease and the Environment. Panima Distributors, Meerut.
2. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 2007. Introductory Mycology. IV Edition. Wiley India (P) Ltd., Daryaganj, New Delhi.
3. Brain D. Robertson and Brendan W. Wren. 2012. Systems Microbiology: Current topic and Applications. ISBN. 978-1-908230.
4. Charles lane, Paul Beales, Kevin Hughes. 2012. Fungal Plant Pathogens. CABI publishing.
5. Dasgupta, M.K. 2004. Principles of Plant Pathology. Allied publishers Ltd. New Delhi.
6. Dubey, R.C. and D.K. Maheswari, 2010. A Textbook of Microbiology, S. Chand & Company, New Delhi.
7. Gupta, G.P. 2004. Plant Pathology. Discovery Publishing House. New Delhi.
8. Raina M. Maier ; Lan L. Pepper ; Charles .P. Gerba 2009; Environmental Microbiology; Elsevier Academic press
9. Rangaswami, G, A. Mahadeven. 2006. Diseases of crop plants in India. Prentice Hall Pvt. Ltd. New Delhi.
10. Robert Burns; 2010; Plant Pathology - Techniques and Protocols; Springer – Humana press
11. Sambamurthy A.V. S.S. 2006. A Textbook of Plant Pathology. I.K. International Pvt. Ltd., New Delhi.
12. Sharma, O.P. 2005. The Text book of Fungi. Tata McGraw Hill publishing company ltd, New Delhi.
13. Sharma, P.D. 2009. The Fungi. Rastogi publications, Meerut.
14. Singh. R.S. 2009. Plant Diseases. Oxford & IBH publishing Co. Pvt Ltd. New Delhi
15. Talaro K.P and Talaro, A. 2006. Foundation in Microbiology (6<sup>th</sup> Ed)- McGraw-Hill College, Dimensi.
16. Vashista, B.R and A.K. Sinha. 2008. Botany for Degree Students – Fungi. S.Chand & Company, New Delhi.

**IBOT73- BIOLOGICAL TECHNIQUES**

**Objectives:**

1. To study the principles of various biological techniques and their application
2. To understand the basic application and working principles of Biological techniques

**Unit – I**

Principles, image formation and applications of Light, Confocal, Polarizing, Transmission and Scanning electron microscopes - Material preparation for Electron microscopy. Microscopic measurements: Micrometers – Ocular, Stage, Haemocytometer and Camera Lucida - Fixatives, dehydrating agents, stains and their uses.

#### **Unit- II**

Microtomes: Rocking, Rotary, Sledge and Ultra microtomes and their uses - Material preparation techniques for microtome sectioning. Killing, fixing and staining of plant tissues: Histochemical techniques – staining of Proteins, Carbohydrates, Lipids and enzymes.

#### **Unit III**

Principles and applications of pH meter and Conductivity meter. Centrifugation – Density gradient and ultra centrifugation.

#### **Unit-IV**

Calorimeter-Principles and Applications – Spectrophotometry –UV-visible –Infrared- Atomic absorption Spectrophotometer – Chromatography – Paper, TLC, Column and Affinity. Radio Isotopes-Types of Radio activity- Gieger-Muller counter- scintillation counters – Autoradiography.

#### **Unit – V**

Electrophoresis – General principles - PAGE -SDS -- Agarose gel.

Blotting techniques- Southern, Northern and Western.

ELISA, RIA, Polymerase Chain Reaction, RAPD, RFLP, SSR, DNA finger printing and FISH techniques

#### **Practicals :**

##### **Biological techniques**

1. Principles, identification and components of Light , Polarizing , TEM , SEM, ELISA and PCR
2. Fixing , Embedding and Sectioning with microtome
3. Single and Double stained slide preparation with hand and microtome sections
4. Measurement of soil pH
5. Measurement of electrical conductivity
6. Electrophoretic separation of proteins by SDS-PAGE
7. Separation of DNA with Agarose gel
8. RAPD

##### **Books:**

1. Albert Schneider.2012. Microscopy and Microtechnique. Rare book club.com, United States, New York.
2. Albrecht Zimmermann. 2013. Botanical Microtechnique. Nabu press, New York
3. Baker and John Randal.1958. Principles of biological Micro technique: A study of Fixation and dyeing. London Methuen & Co. ltd, New York.
4. Berlyn, P.G, 1986. Botanical Microtechnique and Cytochemistry, Springer-Verlag, Berlin, Germany.
5. Jayaraman, J. 1992. Techniques in Biology. HigginBothams Pvt Ltd, Chennai.
6. Jeremy K.M.Sanderson and Jeremy B.Sanderson.1994. Biological Microtechnique. Garland Science, London, UK.
7. John E.Sass. 2007. Elements of Botanical Microtechnique. Bente press, London, UK.
8. Krishnamurthy, K.V, 1988. Methods in Plant Histochemistry. Viswanathan printers and publishers, Chennai.
9. Marimuthu,R. 2010. Microscopy and Microtechnique, MJP publishers, Chennai
10. Michael J.Bykstra.1992. Biological Electron Microscopy. Springer-Verlag, New York.
11. Robinson, P.C, 1992. Qualitative Polarized light microscopy. Oxford University Press, U.K.
12. Srivastava, M.S. 2008. Bio- analytical Techniques, Narosa Publishing House, New Delhi.

13. Steven E. Ruzin. 1999. Plant Microtechnique and Microscopy. Oxford University Press, London, UK.
14. Surzycki. 2013. Basic techniques in Molecular Biology. Panima Book Distributors, Bangalore.

**VIII – SEMESTER**  
**IBOT 81- PLANT DIVERSITY - II**

**Objectives**

1. To acquire knowledge on living and Fossils forms of Pteridophytes and Gymnosperms.
2. To understand the reproductive feature of Pteridophytes and Gymnosperms.
3. To apply the knowledge on fossil and fossilization.

**PTERIDOLOGY:**

**Unit – I**

Classification of Pteridophytes (Reimer's) - Origin of Vascular plants - Different theories – Telome concept - Life cycle of Pteridophytes. Range of structure, reproduction and evolution of Sporophytes in Pteridophytes of Fossil forms: *Rhynia*, *Horneophyton*, *Asteroxylon*, *Lepidodendron*, *Sphenophyllum* and *Calamites*. Living forms: *Ophioglossum*, *Angiopteris*, *Osmunda*, *Dicranopteris*, *Alsophila*, *Adiantum*, *Pteris*, *Salvinia* and *Azolla*. Types of Sporangium development – Eusporangiate type Leptosporangiate type- polarity Type - Embryo development and Spore germination.

Gametophytes in Pteridophytes, – sex organs. Apogamy and Apospory

**Unit – II**

Stelar evolution and soral evolution in Pteridophytes and Phylogeny. Heterospory and seed habit, ecology and ecological indicators and economic importance of Pteridophytes.

**GYMNOSPERMS**

**Unit – III**

Classification of Gymnosperms (Sporne, 1965). A general account of distribution, morphology, anatomy, reproduction, phylogeny and relationship of the following orders with special reference to the genera mentioned against each order.

**Cycadopsida**

1. Pteridospermales

Lyginopteridaceae : *Lyginopteris*, *Heterangium*, *Lagenostoma*, *Physostoma*.

Medullosaceae : *Medullosa*, *Trignocarpus*

Glossopteridaceae : *Glossopteris*

Caytoniaceae : *Caytonia*.

2. Bennettitales

Cycadeoidaceae : *Cycadeoidea*.

3. Pentoxylales

Pentoxylaceae : *Pentoxylon*

4. Cycadales

Cycadaceae : *Zamia*

**UNIT – IV**

**Coniferopsida**

1. Cordaitales.

Cordaitaceae : *Cordaites*.

2. Coniferales.

Cupressaceae : *Cupressus*

Podocarpaceae : *Podocarpus*.

Araucariaceae : *Araucaria*

3. Taxales

Taxaceae : *Taxus*.

4. Ginkgoales  
Ginkgoaceae : *Ginkgo*

**Gnetopsida**

Ephedraceae : *Ephedra*

Evolution of Gymnosperms. General account of Cycadofilicales. Economic importance of Gymnosperms.

**PALAEOBOTANY**

**UNIT – V**

Contributions of Birbal Sahani to Palaeobotany – Study of fossils in understanding evolution – Fossilization and fossil types. Economic importance of fossils – fossil fuels and Industrial raw materials.

Geological Time scale- Radio Carbon dating, Fossils and fossilization. Kinds of fossils: Impressions, Compressions, casts, molds, petrifications and coal balls. Importance of the study of Palaeobotany

**Practicals :**

**Pteridology:**

Fossil forms: *Rhynia*, *Horneophyton*, *Asteroxylon*, *Lepidodendron*, *Lepidocarpon*, *Sphenophyllum* and *Calamites*.

Living forms: *Ophioglossum*, *Angiopteris*, *Osmunda*, *Dicranopteris*, *Alsophila*, *Adiantum*, *Pteris*, *Marsilea*, *Salvinia* and *Azolla*.

**Gymnosperms:**

Identification and characteristic features of *Lyginopteris*, *Heterangium*, *Lagenostoma*, *Physostoma*, *Trignocarpus*, *Zamia*, *Cupressus*, *Podocarpus*, *Araucaria*, *Ginkgo*, and *Ephedra*.

**Paleobotany**

Compression, Impression and Petrified Fossils

**Books**

1. Arnold C.R.1974. Introduction to Palaeobotany. TMH publishing Co.Ltd., Bombay.
2. Bhatnagar, S.P. and Alok Moitra, 2003. Gymnosperms, New age International Pub., New Delhi.
3. Biswas,C., B.M.Johri, 1999. The Gymnosperms, Narosa Publishing House, Chennai.
4. Johri,R.M. 2012. A Textbook of Gymnosperms. Dominant publishers and Distributors pvt., ltd, New Delhi.
5. Johri, Lata and Tyagi.2012. A Textbook of Gymnosperms. Dominant publishers and Distributors pvt.,ltd, New Delhi.
6. Kumar,A. 2012. Textbook of Gymnosperms. Random experts publishers and distributors, New Delhi.
7. Parihar,N.S. 2005.An Introduction to Embryophyta – Pteridophytes – Central Book Depot, Allahabad.
8. Pandey, B.P. 2006. College Botany-Volume –II. S.Chand & Company ltd, New Delhi.
9. Rashid.A. 2007. An Introduction to Pteridophyta – Vikas Publications, New Delhi.
10. Mukta Bhargava. 2003. The latest portfolio of theory and practice in Gymnosperms, Dominant Publishers and Distributers, New Delhi.
11. Sambamurthy A.V. S.S. 2005. A Textbook of Pteridophytes, Bryophytes, Gymnosperms and Paleobotany ; I.K. International Pvt.Ltd., New Delhi.
12. Singh S. K.; 2008 Gymnosperms and Palaeobotany; Campus books Publications – New Delhi
13. Shukla.A and Mishra S.P. 1975. Essentials of Palaeobotany. Vikas Publishing House, Pvt. Ltd. New Delhi.



14. Shirpad N. Agashe. 1995. Palaeobotany. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.  
15. Vashishta. P.C., A.K. Sinha and Anil Kumar. 2008. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.

## **IBOT 82 PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS**

### **Objectives:**

1. To acquire the knowledge internal structure of plants.
2. To understand the fertilization and development of Embryo.
3. To apply knowledge on cell enlargement and differentiation.

### **PLANT ANATOMY**

#### **Unit – I**

Simple and Complex permanent Tissues – Cell wall: Ultra structure and Chemical nature – Plasmodesmata - Meristems: Apical, Lateral and Intercalary meristem – Theories of Apical organization: Apical theory, Histogen theory and Tunica carpus theory – Shoot apex and Root apex - Xylem and Phloem: – Primary and Secondary structures – Phylogenetic trends and specialization of xylem and phloem – Vascular cambium: Origin, Structure and Seasonal activity - Transfer cells – Lenticels

#### **Unit – II**

Leaf Anatomy – Types of stomata and Stomatal index. Anatomy of floral parts, Anatomy of Fruit wall and Seed Coat.

Nodal anatomy – Types and phylogenetic trends in nodes – Periderm formation: rays and Fibers - Lignin, Cellulose, Pectin, Waxes - wound healing and grafting – Secondary growth in thickness – Anomalous secondary thickening in dicots and monocots.

Wood anatomy: Physical, chemical and mechanical properties of wood – Defects in wood – compression and Tension wood.

### **EMBRYOLOGY**

#### **Unit - III**

Pollen – pistil interactions and fertilization : barriers of fertilization, control of fertilization and current concept of fertilization – self incompatibility – methods to overcome self incompatibility - Experimental Embryology including pollen storage and test tube fertilization. Endosperm : classification and types, haustoria - functioning of storage metabolites  
Embryo – development of dicot and monocot embryo – nutrition of embryo

#### **Unit - IV**

Polyembryony : classification and types

Apomixis : diplospory , apospory, parthenogenesis and parthenocarpy : practical applications of apomixis and polyembryony.

Embryology and Taxonomy – embryological features of taxonomical importance.

Shoot, root and leaf development and phyllotaxy; Transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

### **MORPHOGENESIS**

#### **Unit - V**

Morphogenesis : Basic concepts and its importance. Morphogenetic factors – extra cellular matrix and cell membrane- their role in morphogenesis

Cell differentiation and its mechanism – nucleo-cytoplasmic interactions

Internal morphology : classical concept of flower, conduplicate carpel theory, floral vascularization – inferior ovary and carpel polymorphism

**Practicals:**

**Plant Anatomy:**

Examination of Root and Shoot apices ; Maceration , clearing and peeling techniques; cambial variant in *Bougainvillea*, *Boerhaavia*, *Nyctanthes*, *Bignonia*, *Aristolochia*, *Strychnos* and *Dracaena*. Nodal Anatomy – Different types of nodes. Different types of stomata - Calculation of stomatal index and frequency.

Fruit wall and Floral vascular Distribution.

**Embryology**

Different stages of anther, embryo sac, endosperm and embryo development

Pollen germination and viability test

Dissection of embryo – *Tridax*, *Crotalaria* and *Cleome*

Endosperm and endosperm haustoria – Cucurbitaceae members

**Morphogenesis**

Wounding of young stem and study of the wound healing response

Effect of removal of leaf primordial and axillary buds

Study of T.S. of Receptacle, Sepal, Petal, Stamen of Carpel traces and Inferior ovary.

**Books:**

1. Cutler, D.F., Botha, T and Stevenson, D.W. 2013. Plant Anatomy – an applied approach. Panima Educational Book Agency, New Delhi.
2. Edmond W. Sinnott.1960. Plant Morphogenesis. McGraw Hill Book Company, Inc- USA
3. Fahn, 1989. Plant Anatomy. Pergaman Press. London.
4. Katherine Esau. 2006. Anatomy of seed plants. John Willey & sons publications, New Jersey.
5. Maheshwari, P. 1963. An Introduction to Embryology of Angiosperms. Tata Mc Grow Hill. New York.
6. Pandey B.P., 1995. Embryology of Angiosperms. S.Chand & Company Ltd., Ram nagar, New Delhi
7. Pandey, S.N and A.Chadha.2005. Plant Anatomy and Embryology. Vikas Publishing House Pvt Ltd., New Delhi.
8. Sharma H.P; 2009; Plant Embryology; Narosha Publishers, New Delhi
9. Shivanna.K.R. 2003. Pollen Biology and Biotechnology. Oxford IBH, New Delhi
10. Singh.V., P.C. Pandey and D.K.Jain. 2003. Embryology of Angiosperms. Rastogi Publications. Meerut.
11. Singh.V, Pande.P.C and S.D.K.Jain. 1998. Anatomy of Seed Plants. Rastogi Publications, Meerut.
12. Steward, F.C. 1971. Plant growth and development, Academic Press, New York.
13. Taylor, M.S. 2008. Plant Anatomy. Rastogi publications, Meerut.

**IBOT 83- GENETICS AND PLANT BREEDING**

**Objectives:**

1. To acquire the knowledge in Heredity and variation.
2. To understand the fundamental and molecular basis of gene action.
3. To develop skill on different methods and techniques of breeding.

**GENETICS**

**Unit – I**

Mendelian Inheritance – Introduction, basic concepts and outputs. Non-Mendelian Inheritance- Types of Interaction of Genes.

Sex determination in plants and sex linked inheritance, Chromosome mapping –Reverse genetics and epigenetics and their biological importance.

### **Unit – II**

Extra-nuclear inheritance: cytoplasmic inheritance – chloroplast and Mitochondrial genome in higher plants.

Microbial Genetics: Methods of Gene transfers – Transformation, Conjugation, Transduction - Mapping genes by interrupted mating – Transposable elements, Jumping genes- Population genetics.

### **Unit – III**

Classification of Mutation - Gene Mutation: spontaneous and induced mutation – physical and chemical mutagens. Molecular basis of gene mutation, point and frame shift and suppressor mutation. Gene regulatory mechanisms. Genetic disorders in Human being, Gene therapy.

## **PLANT BREEDING**

### **Unit - IV**

Introduction- Floral biology: significance – floral biology of crop plants in relation to their breeding systems.

Importance of male sterility and haploid plants in Plant breeding- Heterosis.

Breeding methods: Methods of Plant breeding in self and cross pollinated crops.

Centre of origin of cultivated plants – Role of plant domestication, Introduction and acclimatization in plant breeding.

National and International organizations for crop improvement

### **Unit – V**

Selection techniques: Types of selection – pure line selection – mass selection – recurrent selection and clonal selection

Selection in segregating populations – Pedigree method, bulk method and back cross method

Plant Hybridization – Types and process of Hybridization

Modern methods of Plant breeding- Mutation breeding, Polyploidy breeding and Distant hybridization.

Role of Biotechnology in Plant breeding

### **Practicals:**

#### **Genetics**

Genetics problems in Mendelian inheritance, gene interaction, quantitative inheritance , multiple alleles, sex linkage and genetic maps

Survey of genetic inheritance in a population.

#### **Plant Breeding**

Methods of vegetative propagation – Layering, Budding and Grafting

Techniques in selfing and hybridization

### **Books:**

1. Basu.S.B. and M.Hossain.2004. Principles of Genetics. Books and Allied (P). Ltd, Kolkatta.
2. Gardner, Simmons, Snustad; 2006; Principles of Genetics; Wiley student edition.
3. Gurbachan and S. Miglani, 2000. Basic Genetics, Narosa Publishing House, New Delhi.
4. Hartle, D.L. and E.W. Jones, 2005. Genetics - Analysis of Genes and Genomes. 6<sup>th</sup> Ed., Jones and Bartlett publishers, London.
5. Inbasekar.2013. Cell Biology and Genetics. Panima Book Distributors, Bangalore.
6. John Ringo, 2004. Fundamental Genetics. Cambridge University press, UK
7. Lynch, M. 2013.Genetics and Analysis of Quantitative Traits. Panima Book Distributors, Bangalore.
8. Maloy.2013. Microbial Genetics-2<sup>nd</sup> Edition, Panima Book Distributors, Bangalore
9. Sarin.C.2002. Genetics. Tata McGraw-Hill Publishing Co.Ltd, New Delhi.

10. Sharma, A.K. and Sharma, A. 1980. Chromosome Techniques Theory and Practice. Oliver and Boyd, London.
11. Singh, B.D. 2005. Genetics. Kalyani Publishers. New Delhi.
12. Chaudhari, H.K. 1984. Elementary Principles of Plant Breeding Oxford IBH. New Delhi
13. Hays, K.K. Immer, F.R. and Smith, D.C. 1985. Methods in Plant Breeding. Tata Mc Graw Hill. New York.
14. Jack Brown & Peter Callgarl. 2013. An Introduction to Plant Breeding. Panima Book Distributors, Meerut.
15. Mohan, K.V. 2010. Essentials of Plant Breeding. PHI Learning Private Limited, New Delhi.
16. Neal, C. Stopskopf. 1999. Plant Breeding Theory & Practices. Scientific Publishers, Jodhpur.
17. Sanjay Kumar Singh. 2005. Plant Breeding. Campus book international, New Delhi.
18. Singh, B.D. 2001. Plant Breeding, Principles and Methods. Kalyani Publications, New Delhi.

## **IX - SEMESTER**

### **IBOT 91 - TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY**

#### **Objectives:**

1. To acquire knowledge in naming of plants.
2. To understand the method of classification
3. To apply the knowledge in biosystematics
4. To develop skill to enumerate the family characters.
5. To appreciate the economic potential of plants.

#### **TAXONOMY OF ANGIOSPERMS:**

##### **Unit – I**

Essentials of Taxonomy, Historical account on classification of angiosperms- A detailed account of the systems of classification of Linnaeus, Bentham and Hooker, Engler and Prantl and a general account on the system of classification of Takhtajan . Chemotaxonomy and Numerical taxonomy.

Nomenclature and taxonomical techniques. Plant Nomenclature – Brief History on the origin and development of nomenclature; Detailed study of the major provisions of the International Code of Botanical nomenclature (ICBN) – Effective and valid publications , Role of priority and its limitation, typification, Different kinds of types, Author citation and rejection and retention of names, conserved names.

##### **Unit- II:**

APG System and its significant Different kinds of identification keys, Construction of dichotomous keys- Indented and bracketed keys. Various kinds of Taxonomic literature: Floras, Revisions, Manuals – Monographs, Periodicals. Computational Taxonomy, Information systems- data banking and use of computers in Taxonomy, computer constructed keys. Uses of molecular tools in Taxonomy, RFLP, RAPD and AFLP. Methods of Plant exploration ; Management of Herbaria; Major Herbaria in India and the World; Role of Herbaria in Taxonomy. Botanical Survey of India. Conservation of Biological Diversity (*In situ* and *Ex situ*)

##### **Unit – III**

A detailed study of the following families and their interrelationship and phylogeny

Annonaceae	Combretaceae
Portulacaceae	Myrtaceae
Sterculiaceae	Lythraceae
Zygophyllaceae	Passifloraceae
Rhamnaceae	Cucurbitaceae
Sapindaceae	Apiaceae
Fabaceae	

#### **Unit – IV**

A detailed study of the following families and their interrelationship and phylogeny

Rubiaceae	Nyctaginaceae
Apocyanaceae	Verbenaceae
Gentianaceae	Euphorbiaceae
Boraginaceae	Casuarinaceae
Scrophulariaceae	Liliaceae
Acanthaceae	Poaceae
Lamiaceae	

### **ECONOMIC BOTANY**

#### **Unit – V**

A brief account of Botany, cultivation and utilization of Cereals, pulses, nuts vegetables and fruits

Spices and condiments

Fats and oils-essential oils

Commercial crops- Wheat, Cotton and Sugarcane, fibres, timbers

Tannins, resins, alkaloids

Drug yielding plants

Plants as a source of renewable energy – Ethnobotany and its importance.

#### **Practicals:**

##### **Taxonomy of Angiosperm**

Detailed study of the families mentioned in the theory with two representative species from the local area.

Familiarity of the binomial nomenclature of the available species from the local flora using Gamble's flora.

Solving the taxonomical problems

##### **Economic Botany**

Identification of family, genus, species and morphology of the useful parts of plants mentioned in the theory.

#### **Books**

1. Dutta, S.C. 2003 Systematic Botany, New age International (P) Ltd, Publication, New Delhi.
2. Gamble, J.S. 1956. Flora of the Presidency of Madras . Vol. I,II & III. Bishen Singh Mahendra Pal Singh, Dehradur, India.
3. Greuter,W.,1988. International Code of Botanical nomenclature. Today and Tomorrow's Printers and Publishers, New Delhi.
4. Gurucharan Singh, 2004. Plant Systematics, Oxford & IBH Publishing company (P) Ltd, New Delhi
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6. Jones,S.D and A.E. Luchsinger, 1987. Plant Systematics. Tata McGraw-Hill, New York
7. Lawrence, G.H.M. 1964, Taxonomy of Vascular Plants, Oxford & IBH Publishing company (P) Ltd, New Delhi.

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9. Pandey.B.P. 2009. Taxonomy of Angiosperms. S.Chand & Co. Ltd. New Delhi.
10. Quicke, D.L.J, 1993. Principles and techniques of contemporary Taxonomy, Chapman and Hall, London.
11. Sambamurty, A.V.S.S, 2005. Taxonomy of Angiosperms, I.K. International Pvt. Ltd.,
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17. Stace, C.A, 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
18. Subramaniam, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House, New Delhi.
19. Wickens. 2013. Economic Botany: Principles and Practices. Panima Book Distributors, Bangalore.
20. Simpson, 2010. Plant Systematics, Academic Press.

## **IBOT -92 - CELL BIOLOGY AND MOLECULAR BIOLOGY**

### **Objectives:**

1. To acquire the knowledge of fundamental unit of living being.
2. To understand the different types of cells and cell organelles.
3. To apply the knowledge in structure and function of gene at molecular level.
4. To develop skill on different methods of Molecular Biology.

## **CELL BIOLOGY**

### **Unit – I**

Structural organization and functions of intracellular organelles: Cell Wall, Nucleus, Mitochondria, Golgi body, Lysosome, Endoplasmic reticulum, Ribosome, Peroxisome, Plasmid, Vacuole, Chloroplast, structure & function of Cytoskeleton and its role in motility. Cell Membrane, Structure and Membrane Transport.

Cell signaling: Signaling through G-Protein coupled receptors - signal transduction pathways - Second messengers - regulation of signaling pathways. Hormone receptors - signal transduction and gene expression.

### **Unit – II**

Cell division: Types of cell divisions, Events of cell division, Differences between Mitosis and Meiosis - Molecular basis of cell cycle.

Synapsis, Synaptonemal complex, Mechanism of crossing over and formation of Chiasma.

Chromosomes: Types, Fine structure of eukaryotic chromosome – Kinetochore, chromomeres, satellite, Euchromatin and Heterochromatin- special types of chromosomes - Chromosome banding and chromosome painting.

Chromosomal variation and aberration, Karyotype analysis

## **MOLECULAR BIOLOGY**

### **Unit – III**

Chemical nature of DNA– A,B and Z forms of DNA – Superhelical structure of DNA – Structure of Prokaryotic gene-Structure of simple, compound and complex genes – Regulatory structures – Promoter, Enhancer, Attenuator and Terminator - Structure of eukaryotic gene - Introns and Exons- Satellite DNA

DNA Replication – Methods of DNA Replication- Enzymology of DNA replication- Mechanism of DNA replication- RNA primers- - origin of replication - Replication fork - Okazaki fragments- Continuous and Discontinuous synthesis of DNA - DNA repair mechanism: Excision repair -Mismatch repair.

#### **Unit - IV**

Transcription – Definition– Initiation, elongation and termination in prokaryotes and eukaryotes –Promoters – Pribnow box– TATA binding proteins – Complimentary palindroms - Prokaryotic and Eukaryotic- RNA polymerases- Regulatory proteins – Zinc fingers - Post transcription modifications in prokaryotes and eukaryotes—Capping- Polyadenylation – RNA splicing – Types of RNA - Amino acyl t-RNA synthetase- Peptidyl transferase.

#### **Unit – V**

Genetic code –Types of codons – codons usage – universal codon – Wobble hypothesis polycistronic m-RNA – overlapping genes – Components of protein synthesis – sigma factor – *Rho* factor – structure of ribosome – polysomes – ribosome entry sites – selenocysteine insertion sequence - Protein synthesis in Prokaryotes – Initiation, Elongation - Termination.

Alternative Splicing: RNA Splicing – Spliceosome machinery – Splicing pathways – Alternative Splicing regulated by activators and Repressors – Sn RNPs- Exon Shuffling – RNA Editing – mRNA Transport.

Coupled transcription - Translation - Translation and post-translational modifications in Eukaryotes-Protein folding.

#### **Practicals:**

##### **Cell Biology**

1. Squash and smear techniques
2. Study of cell division – Mitosis (*Allium cepa*, *Rhoeo*, *Urgenia*, *Scilla*)
3. Study of Meiosis - (*Allium cepa*, *Helianthus*, *Tredescantia* flower buds)
4. Study of chromosomal aberrations and polyploidy
5. Karyotype analysis – Idiogram preparation
6. Study of special types of chromosomes

##### **Molecular Biology**

1. Isolation of high molecular weight genomic DNA from rice
2. Isolation of DNA from tender coconut
3. Separation of plant genomic DNA by electrophoresis
4. Qualification of Plant Genomic DNA by Spectrophotometric method
5. Quality checking of DNA by Electrophoresis
6. RAPD Techniques
7. Isolation of plasmid DNA
8. Southern blotting (Demonstration)
9. Western blot - detection of proteins (Demonstration)

#### **Books:**

1. Allison.A. 2007. Fundamental Molecular Biology. Blackwell Publishing, UK.
2. Benjamin, Levin. 2004. Genes VIII. Pearson Education International, USA.
3. De Robertis and De Robertis, 2004. Cell and Molecular Biology. Lippincott. Williams and Wilkins. USA.
4. Freifelder, 1990. Molecular Biology, Narosa Publishing House, New Delhi.
5. Geoferey M. Cooper . 2013. The Cell : A Molecular Approach. Panima Book Distributors, Bangalore.
6. George,M. Malacinsji, 2007.Essentials of Molecular Biology, IV Edition, Jours and Bartlett Publishers, Massachusetts.
7. Gerald Karp. 2010. Cell biology. John wiley & Sons. Inc
8. Harvey Lodish, Arnold Berk, Chris A.Kaiser. 2013. Molecular Cell Biology-7<sup>th</sup> Edition, Panima Distributors, Meerut.

9. Mary A. Schuler Raymond and E.Zrelinski, 2005. Methods in Plant Molecular Biology, Academic Press. An imprint of Elsevier
10. Peter Porella, 1998. Introduction to Molecular Biology, Mc Graw – Hill, New York.
11. Pragya Khanna; 2008; Cell and Molecular Biology ; I.K. International Publications- New Delhi.
12. Ramawat,K.G. and Shaily Goyal, 2010. Moleuclar Biology and Biotechnology, S.Chand Company Ltd Publication, New Delhi.
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20. William D. Stansfield. Jaine S. Colone Raul J. Chand, 2004. Molecular and Cell Biology, Tata Mc Graw-Hill Publishing Company, New Delhi.

### **IBOT93- BIOTECHNOLOGY , GENETIC ENGINEERING AND TISSUE CULTURE**

#### **Objectives:**

1. To understand and acquire the knowledge of Bio-technological innovative methods and products
2. To acquire basic knowledge on Plant Genomics
3. To understand the basic knowledge on patent rights
4. To acquire knowledge about the various aspects of tissue culture and their importance.

#### **BIOTECHNOLOGY:**

##### **Unit – I**

Introduction - Scope and importance of Biotechnology. Microbial fermentation- Types and design of fermentors - Production of biogas, alcohol, hydrogen. Algal biotechnology: Single cell protein - Production of food and flavour. Fungal biotechnology: Production of food and flavours – Mushroom cultivation. Enzyme Biotechnology – Methods of Enzyme production – Application of enzymes. Plants as bioreactors: Edible vaccines - Production of antibiotics. Plant nutraceuticals: Introduction, scope and applications. Molecular farming.

##### **Unit – II**

Industrial applications of enzymes and secondary metabolites: *In vitro* techniques of synthesis – various enzymes and secondary metabolites. Production of amylase, pectinase, cellulase , proteinase and their uses . Immobilized enzymes - Methods of immobilization and applications. Biotechnology and novel production in crops- transgened traits: Delayed ripening - Modification of starch, oil, vitamins, minerals and seed storage proteins.

#### **GENETIC ENGINEERING:**

##### **Unit – III**

Basic principles: Restriction endonucleases– Methods of gene transfer - Particle Gun Method – Electroporation- Microinjection – Liposome - Calcium Phosphate Co-precipitator - Cloning vectors – plasmids - phages - cosmids -viral vectors.



DNA Sequencing Methods: Maxam and Gilbert – Sanger method and Pyrosequencing method – Short gun sequencing – High throughput sequencing by sequencers.

c-DNA libraries - Genomics for evolutionary studies, Choice of host organisms for cloning-bacteria, yeast plants- Preparation of molecular genetic maps in cereals, legumes, cotton and forest trees.

#### **Unit – IV**

Genetic engineering of *nif* genes in non leguminous plants – marker gene enzymes, vector, organization, transformation and integration. Transgenic plants – methods, selective marker genes and detection of gene transformation. Fungicide and herbicide resistance markers – Biocontrol methods of pest and diseases. Control of transgene expression in plants: Selectable markers for plants. Role of Biotechnology in agriculture

#### **TISSUE CULTURE:**

#### **Unit – V**

Principles of tissue Culture- Callus, organ-shoot culture - Synthetic seeds, production of synthetic seeds, artificial seeds - Protoplast isolation fusion and somatic hybridization technique, Haploids and their significance, Anther and Pollen culture.

Somatic embryogenesis and hybridization - Somaclonal variation: mechanism, causes and Applications of somaclonal variations – Cryopreservation - production of secondary metabolites through cell culture. Micropropagation of banana and eucalyptus - Hairy root culture for secondary metabolites - Tissue culture as a tool for Biotechnology.

#### **Practicals:**

1. Isolation of single cell protein
2. Immobilization of yeast cells
3. Analysis of digest from cellulose
4. PCR – Technique with known primers
5. Bio control of plant insects using *Bacillus thuringiensis*
6. Bio control of plant insects using PHV.
7. Preparation of explants
8. Establishment and maintenance of Carrot callus
9. Initiation and establishment of cell suspension culture of carrot
10. Embryogenesis in cultured cells of carrot
11. Microspore culture- preparation of artificial seeds

#### **Books:**

1. Bernard R. Glick and Jack J. Pasternak, 2001. Molecular Biotechnology – 2<sup>nd</sup> edition, ASM press, Washington DC.
2. Brown.2013. An Introduction to Biotechnology. Panima Book Distributors, New Delhi.
3. Chawla, H.S, 2000. Introduction to Biotechnology. Oxford & IBH Publishing Co Pvt. Ltd, New Delhi
4. Dubey R.C.; 2009 A Textbook of Biotechnology; Chand & Company LTD. New Delhi.
5. Gupta, P.K. 2011. Elements of Biotechnology-2<sup>nd</sup> Edition. Rastogi Publisher, Meerut.
6. Ignachimuthu, S.1997. Biotechnology: An Introduction-2<sup>nd</sup> Edition, Narosa Publishing House, New Delhi.
7. Renneberg,R.2013. Biotechnology for Beginners. Panima Book Distributors.
8. Kumar, H.D. 2004. A Textbook on Biotechnology – 2<sup>nd</sup> edition, Affiliated East West press Pvt., Ltd., London.
9. Gupta, P.K. 2003. Biotechnology and Genomics, Rastogi Publisher, Meerut.
10. Ralph Rapley and Stuart Harbon. 2004. Molecular Analysis and Genome Discovery. John Wiley & Sons Ltd., England.
11. Ramawat,K.G. 2003. Plant Biotechnology. S.Chand & Co., New Delhi
12. Ramawat, K.G and JM. Merillon. 2003. Biotechnology: Secondary Metabolites. Oxford & IBH Publishing Co.Pvt.Ltd, New Delhi.

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14. Smith Rastogi and Neelam Pathak.2009. Genetic Engineering. Oxford Univ.press.
15. Walker J.M and R. Repley. 2006. Molecular Biology and Biotechnology. IV Edition. Panima Publishing Company, New York.
16. William. J.Thieman, Michael A.Palladino. 2012. Introduction to Biotechnology. Benjamin Cummings publishers.

# **IBOT94- RESEARCH METHODOLOGY, BIO-INFORMATICS AND NANOTECHNOLOGY**

## **Objectives:**

1. To acquire basic knowledge on Research methodology and computer application
2. To acquire basic knowledge on Bio-informatics and Nanotechnology
3. To understand the basic applications and operating procedure of computer
4. To develop skill in Internet usage.

## **RESEARCH METHODOLOGY**

### **Unit – I**

Scientific writing – Characteristics, Logical format for writing thesis and papers  
Essential features of abstracts - components of thesis writing-  
Introduction –Review of literature – Primary, secondary references  
Materials and methods- Effective illustration- Tables and figures- Discussions, Reference styles – Harvard and Van couver system

### **Unit – II**

Computer in Biological science, scope and prospects  
Operation system – Definition- Classification-Input and output devices  
Introduction to windows operating system- MS windows – MS-Word-folders, files, MS Excel – MS Power point - creating slides – templates – animation and transitions - Data storage – Data analysis —- On line publications: Electronic journals - Email e-access data base concepts and implication  
Biostatistics packages- Data base preparation- Graphic applications in Biology

## **Bioinformatics**

### **Unit – III**

Introduction and scope of bioinformatics  
Internet-World Wide Web-Search engines – their functions. Boolean searching – file formats  
Biological Databases – Nucleic acid , protein sequence and structure data bases- data retrieval - web based tools for sequence searches – sequence similarity searches – FASTA and BLAST, Clustral and Phylip –Motif analysis and presentation.

## **NANOTECHNOLOGY**

### **Unit – IV**

Introduction, Basic principles, tools and techniques, nanobioelectronic devices and Polymer nano containers, Microbial production of inorganic nano particles, Role of Computers in Nanotechnology. DNA based nanostructures- Topographic and electrostatic properties of DNA and proteins – Hybrid conjugates of gold nano particles – DNA Oligomers metal nano particles and nucleic acid and protein based recognition groups- nano particles as carrier for genetic materials – Applications of nanotechnology in medicine.

## Unit – V

IPR Patents - Patent procedures - Infringement problems – Patenting information systems and services in India - Trade secrets - Copy rights and Trade marks - Patenting biological materials - Higher plants, transgenic organisms, isolated genes and DNA sequences- biotechnological innovations.

IPR for Plant breeding: Plant variety protection - Plant breeder's rights - Farmer's rights - WTO – GATT, conventions and treaty on patent and trade, TRIPS.

Bioethics – Biosafety regulations, IBSC, Good Laboratory practices.

### Practicals:

1. Acquiring of basic skills in Internet browsing
2. Familiarization of web browsers and search engines
3. Familiarisation of important biological and bioinformatics web sites
4. Write an algorithm to find sequence similarity search using BLAST
5. Write an algorithm to determine protein structure using protein databases.

### Books:

1. Andreas D. Baxevanis and B.F. Francis overlette, 2002. Bio-informatics, John Wiley & Sons.
2. Challa, S.S.R. Kumar, Josef Hormes, Carola Leuschner. 2005. Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. Willey – VCH.
3. Connor and Peter Woodford, 1979. Writing scientific paper in English. Pitman Publ. Co, U.K.
4. Deenadayalu, R. 1987. Computer Science Vol I. Tata MacGraw Hill. Pub, Co, U.K.
5. Des Higgins, Willie Taylor, 2004. Bio-informatics, Oxford University Press.
6. Ignacimuthu, S.J. 2005. Basic Bio-informatics, V.K. Mehra, Narosa Publishing House, New Delhi.
7. Irfan Alikhan, Atiya Khanum, 2003. Essentials of Bio informatics, Ukaaz publications.
8. Kothari, C.R, 1991. Research Methodology—Methods and Techniques. Wiley Eastern Ltd, New Delhi.
9. Niemeyer, C.M and C.A. Mirkin. Wiley, 2004. Nanobiotechnology – Concepts, Applications and Perspectives. VCH.
10. Pradeep, T.2007. Nano: The essentials. McGraw- Hill education.
11. Singh, R. 2006. Research Methodology in Plant Science. M.J.P. Publications, New Delhi.
12. Sree Ramalu, V.S, 1988. Thesis writing. Oxford & IBH publications, New Delhi.

## X- SEMESTER

### IBOT101 PLANT PHYSIOLOGY

#### Objectives:

1. To acquire the knowledge about the functioning of plants
2. To understand the biophysical and biochemical processes
3. To apply the growth regulators on growth and development of plants
4. To develop the skill on various aspects of reproduction physiology
5. To appreciate the plant adapted to various environmental conditions

#### Unit – I

Physical and chemical properties of water – water in soil – water absorption by roots – Apoplast and Symplast - water transport through the xylem – SPAC concept – Transpiration and evapotranspiration- stomatal structure and function – mechanism of stomatal opening and closing – mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders – absorption of solutes – translocation of solutes – pathways and mechanisms.

#### Unit – II

Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra- photoreceptors- Ultra structure and biochemical compartmentation of Chloroplast; Photosynthetic Electron Transport and Photophosphorylation( cyclic and non-cyclic): Photosystems and reaction centres - Light

Harvesting complexes - Photo System II and Oxidation of Water; Carbon metabolism: C<sub>3</sub>, C<sub>4</sub> and CAM pathways and their distinguishing features - photorespiration and its significance – phloem loading and unloading - translocation of photosynthates – source- sink relationship – partitioning of assimilates and harvest index.

### **Unit – III**

An overview of plant respiration – Glycolysis – TCA cycle– Electron Transport and ATP synthesis – chemiosmotic Theory - Pentose Phosphate Pathway– Respiration and its significance in crop improvement. Cyanide resistant respiration; Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation: Nitrate and Ammonium assimilation, Secondary metabolites in plants: Nature, distribution and function of alkaloids, flavonoids, and nitrogenous compounds.

### **Unit – IV**

Definition of growth – growth factors – growth correlation – growth dynamics and growth analysis; Growth substances (Auxin, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, polyamines, jasmonic acid, salicylic acid): Chemical nature, biosynthesis, physiological effect and mechanism of action in agricultural and horticultural crops; Photoperiodism – classification of plants and mechanism of flowering in photoperiodic sensitive plants – theories related to flowering – phytochrome and their action on flowering – vernalization: mechanism and its practical application; Plant senescence and their biochemical mechanism; fruit ripening and its molecular basis and manipulation.

### **Unit – V**

Responses of Plants to Biotic (Pathogen and insects) and Abiotic stress( Water deficit and flooding, Temperature - high and low, chilling and freezing, Salinity and alkalinity): Mechanism of tolerance to various stresses – significance of water use efficiency, importance of osmoregulation, stress responsive proteins - Role of antioxidative mechanism in stress tolerance.

#### **Practicals:**

1. Determination of osmotic potential by plasmolytic method.
2. Determination of water potential using gravimetric method.
3. Determination of water potential using dye method (Chardakov's method).
4. Effect of Monochromatic light on apparent photosynthesis.
5. Effect of CO<sub>2</sub> concentration on apparent photosynthesis.
6. Effect of temperature on protoplasmic membrane.
7. Separation of chloroplast pigments using paper chromatographic technique.
8. Estimation of chlorophyll content using Arnon's method.
9. Determination of rate of photosynthesis using O<sub>2</sub> electrode.
10. Experiment to study the rate of Hill activity of isolated chloroplast by dye-reduction.
11. Rice coleoptile straight growth test for Indole Acetic Acid.
12. Effect of Auxin on root initiation
13. Experiments to show the herbicidal action of Auxin (2-4D).
14. Effect of synthetic Cytokinin on the destruction of chlorophyll.
15. Estimation of Proline content
16. Estimation of Glycinebetaine content
17. Determination of Relative Water Content

## **Books**

1. Bidwell, R.G.S. 1974. Plant Physiology, Macmillan Publisher, Boston.
2. Devlin, R.M. 1996. Plant Physiology, PWS publisher, Boston.
3. Heldt, H.W. 2005. Plant Biochemistry. Academic press, London.
4. Jain, V.K. 2008. Fundamentals of Plant Physiology, S.Chand & Company Ltd., New Delhi
5. Leopold, A.C, 1994. Plant growth and Development, McGraw Hill, New York.
6. Lincoln Taiz and Eduardo Zeiger, 2005. Plant Physiology. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2<sup>nd</sup> Edition). Springer-verlag, New York, USA.
8. Noggle, R.G and Fritz, G.J. 2010. Introductory Plant Physiology, PHI Learning Pvt Ltd, New Delhi.
9. Park, S. Nobel. 2005. Physicochemical and Environmental Plant Physiology. Elsevier Academic press, New York.
10. Panda, S.K, 2005. Advances in Stress Physiology of Plants. Scientific Publishers India, Jodhpur.
11. Robert L. Benech and Arnold Rodolfo A. Sanchez. 2013. Handbook of Seed Physiology. Panima Book Distributors.
12. Salisbury, F.B and Cleon Ross, 2007. Plant Physiology, Wadsworth Publishing Company, Belmont.
13. Shinha, R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.
14. William G. Hopkins, 1999. Introduction to Plant Physiology, John Wiley and sons, INC, New York.

## **IBOT - 102 ENVIRONMENTAL BIOLOGY**

### **Objectives :**

1. To acquire knowledge on environment.
2. To understand the different type of ecosystem.
3. To apply the knowledge in control of pollution.
4. To understand Biodiversity and its conservation
5. To study about the various aspects of Conservation Biology.

### **Unit – I**

Autecology and Synecology. Ecological life cycle – species interaction – types – Population Ecology – Density, Mortality, Natality. Survival and r and k selection- Density, Abundance, Frequency and IVI, Polygraph charting – Raunkiaer's Life forms. Population Dynamics. Remote sensing - study of vegetation with remote sensing.

### **Unit - II**

Environmental Pollution: causes, effects and control of air, water, soil, noise, marine, thermal and radioactive pollution. Biomagnification: Eutrophication, Solid Waste management. Urban Waste Management. Bioremediation - saline land reclamation Causes, effects and control of Green house effect, Ozone layer depletion and Acid rain - Energy crisis- its dimensions and management. Disaster Management: Earthquake, Volcanoes, Landslides and Tsunami.. Environment and human health.

### **Unit - III**

Biodiversity: Concepts, types measures and distribution of diversity, Major Biomes of the World – Biogeographical zones of India- Vegetational types. Economic values of Biodiversity, Loss of biodiversity. Endemism, Hotspots, Red Data Book, Threatened plants and animals of India,–

## **Unit - IV**

Conservation of Biodiversity and Wild Life ( Ex situ and In situ methods) – Forests: Afforestation –Social Forestry, Agro forestry, Extension forestry and Urban forestry. Sustainable development: Public Awareness - Environmental Protection Act. (Air, Water, Wildlife and Forest) Rio-summit Agenda: Chipko movement, Carbon credit. Importance of Environmental Impact Assessment (EIA) studies.

## **Unit - V**

Principles of Conservation: Conservation of Natural Resources. National and International conservation agencies ( UNEP, MAB, WWF, CITES, RAMSAR and Biodiversity convention), Conservation strategy in India (Project Tiger; Biodiversity Heritage sites, Biosphere Reserves), Environment Act - The Air act – the water act - The wild Life protection act – Forest Conservation Act, Biodiversity act of 2002.

### **Practicals:-**

#### **Methods of studying vegetation**

1. Quadrat method : List quadrat, count-quadrat, minimum size of the quadrat for a given vegetation.
2. Transect method : Line transect, belt transect and bisect method. Relative frequency, relative density and relative dominance. Important value index and polygraph charting.

#### **Pollution studies**

Effect of industrial effluents on seed germination, - Estimation of the dust pollution on plants. - Ecological Instruments- Ecological adaptation of plants.

#### **Water analysis**

Estimation of EC,pH turbidity and TDS.

Estimation of Sulphate and Nitrate

Analysis of Na, K, Ca and Cl in pond water

#### **Soil analysis**

Estimation of EC,pH

Soil moisture content

Soil N,P,K turbidity and TDS

#### **Books**

1. Agarwal, K.C, 2001. Fundamentals of Environmental Biology, S.Chand, New Delhi.
2. Chapman,J.L.2009. Ecology principles and applications. Cambridge University press.
3. Daniel B.Botkin and Edward A.Keller.2014. Environmental Science: Earth as a living planet, 9<sup>th</sup> edition, Wiley.
4. Dash, M.C, 2004. Fundamentals of Ecology, Tata McGraw, Hill, New Delhi.
5. Dubey,A.K.2012. A Text book of Ecology. Dominant publishers pvt ltd.,
6. Duffous, J.H, 1980. Environmental Toxicology. Edward Arnold Publication, London.
7. Edward J. Kormondy, 2003. Concepts of Ecology – 4<sup>th</sup> edition, Prentice Hall of India Pvt.,
8. Eugene Odum and Murray Bavvick. 2005. Fundamentals of Ecology, Cengage Learning.
9. Gabriel Melchais. 2004; Biodiversity and conservation ; Oxford & IBH Publishing company Pvt. Ltd.
10. Hamlyn G. Jones and Robin A.Vaughan, 2010. Remote sensing of vegetation Principles, Techniques and Applications. First Ed., <http://www.oup.com>
11. Iqbal Hussain, P.K.Goel, Rubkumar.2010. Textbook of Plant Ecology.ABD publishers.
12. Joshi, P.C. Namita Joshi, 2004. Biodiversity and Conservation, APH publishing company, New Delhi
13. Krishnamurthy, K.V. 2004. An advanced text book of Biodiversity. Oxford & IBH, New Delhi.

14. Michael Begon, Colin R. Townsend and John L. Harper. 2013. Ecology, 4<sup>th</sup> edition. Panima Distributors.
15. Odum, E.P. 1978. Basic Principles of Ecology. Thomson, Brooks/Cole, Australia.
16. Odum, E.P. Gary W. Barlett. 2004. Fundamentals of Ecology- 15<sup>th</sup> edition. Thomson Asia Pvt., Ltd.
17. Prithipalsingh, 2007; An Introduction to Biodiversity; Anes book India – Chennai
18. Sharma, P.D, 1993. Environmental Biology and Toxicology. Rastogi Publications, Meerut.
19. Sharma. P.D. 2011. Ecology and Environment. 11<sup>th</sup> edition, Rastogi Publishers, Meerut.
20. Subramaniam N.S, A.V.S. Sambamurthy; 2008. Ecology. Narosha Publications, New Delhi.

### **IBOT 104 A- OPTIONAL- III- APPLIED BOTANY**

#### **Objectives:**

1. To understand the Post harvest technology of fruits
2. To study about the principles of seed storage
3. To acquire knowledge on seed certification.

#### **Unit – I:**

Classification of fruits – Temperate and subtropical production – varieties, climate and soil requirements – propagation, planting density and cropping system- training and pruning – uses of growth regulators and nutrients to improve production. Weed management – pests, disease and their control – harvesting, post harvesting handling and storage – Marketing and export of the following.

Citrus, Banana, Guava, Mango, Grapes, Papaya, pineapple and Tamarind.

#### **Unit – II:**

Rose, Jasmine, Crossandra, Marigold, Dahlia and Anthurium, Micropropagation of orchids- Shadenet and green house cultivation.

#### **Unit – III:**

Principles and methods of seed storage. Effect of storage environment on seed longevity. Growth of seeds – seed maturation, Germination – Factors affecting germination – metabolism during germination – seed dormancy – types of dormancy.

#### **Unit – IV:**

Seed production in self and cross pollinated crops. Classes of seed: Nucleus, breeder, foundation and certified seeds - Seed harvesting, seed processing, seed treatments, seed testing and seed sampling. Viability and vigour - Seed borne pathogens - Seed certification, standard inspection, legislation and seed law-enforcement.

#### **Unit – V:**

Introduction: production of fruits- quality losses of fruits, Determination of harvest maturity and handling methods - Factors affecting fruits during storage, package design, packaging types.

#### **Practicals:**

1. Analysis of seed purity
2. Determination of seed moisture
3. Germination Test
4. Tetrazolium test for seed viability
5. Determination of seed vigour
6. Study of starch degradation during ripening of fruits
7. Effect of storage moisture on seed viability
8. Effect of storage temperature on seed viability

#### **References:**

1. Hartme, H.T. and Kester, D.E. 1986. Plant propagation principles and practices. Prentice Hall of India Ltd., New Delhi
2. Janick, J.W.H. 1988. Horticultural Science. Freeman and Co., San Francisco.
3. Kumar, N. 1993. Introduction to Horticulture. Rajalakshmi publication, Nagercoil.



4. Agarwal,R.L. 2008. Seed Technology. Oxford and IBH publishing. New Delhi.
5. Agarwal, P.K and M.Dadlani. 1992. Techniques in seed science and technology.
6. Khan.A.A.Ed.1977. Physiology and Biochemistry of seed dormancy and germination.

### IBOT 104 B- OPTIONAL -III - ENZYME TECHNOLOGY

#### Objectives:

1. To acquire the knowledge of nomenclature, classification, properties of enzymes and mechanism of action.
2. To understand the methods of isolation and purification of enzymes
3. To understand the various methods of immobilization and its application
4. To know about the enzymes of industrial and clinical significance.
5. To study about the enzymes in salinity tolerance and in Food Industry

#### Unit – I

**Enzymes:** Biological catalysts – Nomenclature and classification; properties of enzymes – Isoenzymes, enzyme co-factors and activators, factors affecting enzyme activity; Mechanism of enzyme action (Kinetics of enzymatic catalysis); enzyme inhibition; Co-enzymes.

#### Unit – II

**Isolation and Purification of enzymes:** Biological sources for enzymes production; Location of enzymes; Extraction of enzymes; Purification by differential solubility, Chromatographic methods, Electrophoresis and Ultracentrifugation; Bio safety in Industrial isolation and purification of enzymes.

#### Unit – III

**Immobilised Enzymes:** Advantages of using immobilised enzymes; Methods of Immobilization: Adsorption, Entrapping, ionic bonding, cross linking and encapsulation. Effect of enzyme immobilization on enzyme stability, Applications of immobilized Enzymes.

#### Unit – IV

**Industrial Enzymology:** Enzymes of Industrial and clinical significance, sources of Industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, peptic enzymes, lipases.

#### Unit – V

**Enzymes biotechnology:** Enzymes in salinity tolerance, New strategies for target identification, validation and use of enzymes in high-throughput screening; use of genomics for enzyme-based drug discovery; assigning precise function to genes; redesigning binding and catalytic specificities of enzymes;

#### Practicals

1. Estimation of protein by Lowry *et al.*
2. SDS – PAGE of Proteins
3. Estimation of  $\alpha$  - amylase and  $\beta$  amylase
4. Determination of optimum pH and temperature for any two enzymes
5. Isolation and purification of any two enzymes
6. Estimation of proline oxidase
7. Estimation of Super Oxide Dismutase

#### References and Text books

1. J.L.Jain, Sunjay Jain and Nitin Jain, 2008. Fundamentals of Biochemistry. Published by S.Chand and Company Ltd. New Delhi
2. Mathews, Van Holde and Ahern, 2005. Bio chemistry. Published by Pearson Education (Singapore) Pvt. Ltd.
3. William H. Elliott and Daphne C. Elliot, 2005. Biochemistry and Molecular biology. Oxford University Press Inc., New York.
4. Prakash S.Lohar, 2005. Biotechnology. MJP publishers, Chennai.
5. Sriram Sridhar, 2005. Enzyme Biotechnology. A.S. Saini for Dominant publishers and Distributors, Delhi.

6. R.C.Dubey, 2008. A Textbook of Biotechnology. S. Chand and company Ltd. New Delhi.
7. Uhlig, H. 1998. Industrial Enzymes and their applications. John Wiley.

### **IBOT 105 A- OPTIONAL -IV- HORTICULTURE AND LANDSCAPING**

#### **Objectives**

1. To acquire knowledge on structure and construction of garden
2. To understand the diseases and control measures in Horticultural crops
3. To acquire knowledge on cultivation of fruit and flowering crops

#### **Unit – I**

Importance of Horticulture, divisions of Horticulture - classification of Horticultural plants. Garden and Garden design. Knowledge of plants – Soil Types – Transplanting- Potting- Soil less culture. Lawn – Rock garden – Rosary – water garden – terrace garden – Kitchen garden – Landscaping-Fences for utility and beauty – Archers and pergolas – Green house and glasshouse – summer house.

#### **Unit- II**

Seed – Seed dormancy – Seed germination – Seed Production in Vegetables - Propagation techniques – Sexual propagation –Vegetative cuttings – Layering – Grafting – Budding – Stock – Scion relationships – Micro Propagation- Marketing.

#### **Unit – III**

Use of plant growth regulators in horticulture  
Manures and Manuring – Training and Pruning – Irrigation techniques  
Fungal and bacterial disease management in tropical and subtropical fruit crops  
Some important diseases of Horticultural Plants and plant protection.

#### **Unit – IV**

Fruit culture : Mango – Guava – Banana – Papaya, Jack fruit, Limes and Lemons.  
Culture of Economically important flowers: Jasmine – Chrysanthemum - Rose – Cut flowers.

#### **Unit – V**

Flower arrangements and decorations- Harvesting – Marketing – Scientific Post harvest Storage of fruits and vegetables – Preservation and transport of fruits and vegetables – their economic impacts.

#### **Books:-**

1. Adams C.R and Early M.P. 2005. Principles of Horticulture. Elsevier India Pvt Ltd, New Delhi.
2. Bhattacharjee,S.K. 2010. Advanced commercial Floriculture. Aavishkar publishers, Jaipur.
3. Bose .T.K. Som. M.G. and Katrir. J. 1993. Vegetable Crops, Naya Prakash, Calcutta.
4. Bose T.K. 1990. Fruits of India. Tropical and subtropical, Naya Prakash, Calcutta.
5. Chadha,K.L.2003. Handbook of Horticulture. Indian Council of Agricultural Research, New Delhi.
6. Hartman. H.T. and Kester D.E . 1986. Plant propagation principles and practices Prentices Hall of India Ltd., New Delhi.
7. Janick. J.W.H. 1988. Horticulture Science. Freeman and Co., Sanfrancisco.
8. Nambisan .K.M.P. 1992. Design Elements of Landscape Gardening- Oxford and IBH Publications, New Delhi
9. Shanmugavelu K.G. 1989. Production Technology of vegetable Crops. Oxford India. Publication, New Delhi.

## **IBOT 105 B- OPTIONAL -IV- BIO PROSPECTING OF MEDICINAL AND AROMATIC PLANTS**

### **Objectives:**

1. To acquire knowledge on medicinal and aromatic plants
2. To understand antioxidant metabolism
3. To study about post harvest technology in medicinal plants

### **Unit – I:**

Medicinal and Aromatic Plants – Importance and Scope – Classification of medicinal plants – based on morphology of useful parts, habit, taxonomical, pharmacological, chemical and Ayurvedic formulations – Cultivation of medicinal and aromatic plants – History of herbal medicine- Contribution of the Egyptians, Chinese, Greeks, Arabs and Indians -Different systems of herbal medicine: Ayurveda, Siddha and Unani.

### **Unit – II:**

Quality control for medicinal and aromatic plant materials: Microscopic and Macroscopic examination – Visual examination and odour – Histochemical detection of cell walls and contents. Drug Evaluation: Methods of drug evaluation: Organoleptic, Microscopic, Physical, Chemical and Biological evaluation. Chemical nature of drugs: Crude drugs – Preparation and preservation - Chemical nature and Methods of tests for Carbohydrates, Glycosides, Tannins, Volatile oils, Lipids, Resinous substances and Proteins.

### **Unit – III:**

General properties of Alcohols, Aldehyde, Glutaraldehyde, Halogens, Phenols, Gases, Surface active agents and Metallic salts; Secondary Metabolites - Classification, General characters, Chemical nature, Extraction and Estimation methods for Alkaloids, Flavanoids, Terpenoids and Phenolic compounds -Separation, Identification and Characterization of the potential bioactive compounds using UV, FTIR, <sup>1</sup>H NMR, <sup>13</sup>C NMR, 2D NMR, GC-MS and XRD. Bioactive molecules – Antibacterial, Antifungal, Antiplasmodial, Larvicidal and Antiviral drugs – mode of its action.

### **Unit – IV:**

Antioxidant metabolism: Plant defense mechanism – Antioxidants – Reactive oxygen species – Enzymatic and non enzymatic antioxidants –Role of antioxidants –Estimation of antioxidants – Ascorbic acid and alpha Tocopherol. Antioxidant enzymes – Peroxidase, SOD and Catalase. Free radicals, types of free radicals, Production of free radicals and Lipid peroxidation.

### **Unit – V:**

Post-harvest technology in medicinal plants: scope and importance. Processing and utilization – Storage of crude drugs, Adulteration with reference to plant drugs, types of adulterants and methods of adulteration, Identification of adulterants. - Importance of herbal marketing -Future prospects and constraints of the herbal drug industry - Regulatory status of herbal medicine in India.

### **References:**

1. Farooqi, A.A. and B.S.Sreeramu, 2004. Cultivation of medicinal and aromatic crops. Revised edition, Universities Press (India) Private Limited, Hyderabad.
2. WHO, 2002. Quality control methods for medicinal plant materials, World Health Organization, Geneva, A.I.T.B.S., Publishers and Distributors, New Delhi.
3. Harbone, J.B. 1998. Phytochemical Methods; A guide to modern techniques of plant analysis. 3<sup>rd</sup>Edn., Springer (India) Private Limited, New Delhi.
4. Mc.Kane, L. and J. Kandel. 1996. Microbiology: Essential and Applications. 2<sup>nd</sup>Edn., McGraw – Hill, Inc, New Delhi.
5. Ananthanarayan, R. and C.K.J. Paniker. 1996. Text book of Microbiology. 5<sup>th</sup>Edn., Orient Longman Ltd., Chennai.
6. Halliwall, B. and J.M.Gutteridge. 1985. Free radicals in Biology and medicine. Oxford university press.

7. Roxanne Rutledge, C. 2008. Mosquitoes (Diptera: Culicidae). Encyclopedia of Entomology, Springer Science<sup>+</sup> Business Media B. V. Berlin.
8. Tyagi, B.K. 2003. Medical Entomology: A Hand book of Medicinally important Insects and other Arthropods. Scientific Publishers (India), Jodhpur.
9. Animal cell culture- A practical approach, 4<sup>th</sup> Edition by Wiley Publications.

### **Optional papers for Inter Departmental Students**

#### **IBOT 81 A/ IBOT 91 A - PLANT TISSUE CULTURE**

##### **Objectives:**

- 1.To acquire knowledge in recent developments in Plant Tissue Culture
- 2.To understand the concepts in plant propagation.
- 3.To study about production of Secondary metabolites

##### **UNIT – I Introduction**

Plant cell – Totipotency – Culture of plant cells, tissue and organs. Organization of Plant tissue culture laboratory – Aseptic techniques. Culture media – Nutritional components.

##### **UNIT – II Preparations**

Preparation of explants – Callus initiation types and maintenance –Hardening. Root culture – Cell suspension cultures- Meristem culture- Organogenesis .Maintance of culture vilification.

##### **UNIT – III Micro-propagation**

Micro-propagation – Shoot apex culture – Somatic embryogenesis – Isolation, purification and culture of protoplasts. Protoplast fusion and somatic hybridization, Artificial seed.

##### **UNIT – IV Haploids and variations in tissue culture**

Anther and pollen culture – Somaclonal variation – Screening and Production of tolerant plants for various stresses.

##### **UNIT – V Application of Tissue Culture**

Production of secondary metabolites and single cell proteins by cell culture – Artificial seed, Rapid propagation Case studies on Tissue Culture in conservation of endangered plants – Banana – Rose and orchids. Tissue culture as a tool for Bio- technology.

##### **Books:**

1. Baker. F.N.G.1992. Rapid propagation of fast growing woody species CAB Inter national. London.
2. Bhojwani,S.S. and M.K.. Razdan.2013. Plant Tissue Culture , theory and Practices. Panima book Distributors.
3. Dodds. J.H and L.N. Roberrtis.1985. Experiments in Plant tissue culture, Cambridge University Press – New York.
4. Reinert.J and M.M .Yeoman.1983. Plant Cell and Tissue Culture – Laboratory manual. Narosa Publishing House. New Delhi
5. Narayanaswamy.S.2005. Plant Cell and Tissue Culture. Tata Mc.Graw Hill, New Delhi

## **IBOT 81 A/ IBOT 91 A - GARDENING AND HORTICULTURE**

### **Objectives**

1. To acquire knowledge on garden, structure and development
2. To understand the plant disease control
3. To acquire knowledge on fruit and flowering crops

### **Unit – I - Garden Design**

Garden and Garden design. Knowledge of plants – Soil Types – Transplanting- Potting- Soil less culture.

Lawn – Rock garden – Rosary – water garden – terrace garden – Kitchen garden – Landscaping-Fences for utility and beauty – Archers and pergolas – Green house and glasshouse – summer house.

### **Unit- II – Propagation**

Propagation techniques – Sexual propagation – Seed – Seed dormancy – Seed germination – Vegetative cuttings – Layering – Grafting – Budding – Stock – Scion relationships – Micro Propagation.

### **Unit – III - Nutrition and Diseases**

Manures and Manuring – Training and Pruning – Irrigation techniques.

Use of plant growth regulators in horticulture – Some important diseases of Horticultural Plants and plant protection.

### **Unit – IV – Pomology and Floriculture**

Fruit culture : Mango – Guava – Banana - Papaya.

Culture of Economically important flowers : Jasmine – Rose – Cut flowers.

### **Unit – V - Post Harvest Technology – Storage and Transport**

Flower arrangements and decorations- Harvesting – Marketing – Scientific Post harvest Storage of fruits and vegetables – Preservation of fruits and vegetables – their economic impacts.

### **Books:-**

1. Bhattacharjee,S.K. 2010. Advanced commercial Floriculture. Aavishkar publishers, Jaipur.
2. Bose .T.K. Som. M.G. and Katrir. J. 1993. Vegetable Crops, Naya Prakash, Calcutta.
3. Bose T.K. 1990. Fruits of India. Tropical and subtropical, Naya Prakash, Calcutta.
4. Hartman. H.T. and Kester D.E . 1986. Plant propagation principles and practices Prentices Hall of India Ltd., New Delhi.
5. Janick. J.W.H. 1988. Horticulture Science. Freeman and Co., Sanfrancisco.
6. Nambisan .K.M.P. 1992. Design Elements of Landscape Gardening- Oxford and IBH Publications, New Delhi
7. Shanmugavelu K.G. 1989. Production Technology of vegetable Crops. Oxford India. Publication, New Delhi.

## IBOT 81 A/ IBOT 91 A -PLANT SCIENCE – I

### Objectives:

1. To acquire basic knowledge in Plant Science
2. To impart knowledge in classical and modern concepts of Plant Science.
3. To update their knowledge and understand the concepts in Plant Science.

### Unit – I Systematic Botany

Principles of Taxonomy – Taxonomic structure –Classifications of Plant Kingdom – Bio-systematics – Plant Geography – Floristics (Regions in India].

### Unit – II Plant Diversity

Patterns of variation in morphology and Life History in plants. Broad outlines of classification and evolutionary trends among Algae, Fungi, Bryophytes and Pteridophytes – Principles of Palaeobotany – Economic importance of Algae, Fungi and Lichens.

### Unit – III Anatomy

Comparative Anatomy and Developmental Morphology of Gymnosperms and Angiosperms – Meristems and Tissue Differentiation and Morphogenesis.

### Unit – IV Embryology

Structural and Functional aspects of pollen and pistil - Androgenesis and Gynogenesis - Pollination Biology – Fertilization – Embryo and Seed development Male sterility – Self and interspecific incompatibility.

### Unit – V Plant Breeding

Principles of Plant breeding – Conventional methods of breeding, self, cross pollinated and vegetatively propagated crops - Non-conventional methods of breeding – Polyploidy – Genetic variability – Plant diseases and defensive mechanism.

### Books

1. Singh,V., Pande, P.C. and D.K. Jain. 2005. Embryology of Angiosperms. Rastogi Publications, Meerut.
2. Sharma O.P. 2007. A Textbook of Algae. Tata Mc Graw Hill Publishing Co.Ltd. New Delhi.
3. Sarabhai,B.P. 2005. A Textbook of Algae. Anmol publications, New Delhi.
4. Sambamurthy, A.V.S.S., 2005. Taxonomy of Angiosperm, I.K. International Pvt.Ltd., New Delhi
5. Chahal S.S. Gosal. 2003. Plant Breeding. Narosa Publishers, New Delhi.
6. David Allen Sleper and John Milton Poehlman.2006. Breeding Field Crops – 5<sup>th</sup> Edition. Blackwell publishing.
7. Malik,C.P.2009. Crop Breeding and Biotechnology. Aavishkar publishers and Distributors, Jaipur.
8. Sivarajan,V.V.1999. Introduction to the principles of Plant Taxonomy. Oxford & IBH Publishers, New Delhi.
9. Tayal,M.S. 2001. Plant Anatomy. Rastogi Publications, Meerut.
10. Sundararajan,S. 2005. Practical manual of Plant Anatomy and Embryology. Anmol publications, New Delhi.
11. Jack Brown and Peter Callgarl.2013. An Introduction to Plant Breeding. Panima Book Distributors.

## IBOT 81 A/ IBOT 91 A - PLANT SCIENCE – II

### Objectives:

1. To acquire knowledge in recent developments in plant science
2. To impart the functional concepts of plant science
3. To study about tissue culture techniques

### Unit – I Plants and Human welfare

Plants and civilization, centers of origin and Gene diversity of crop plants – utilization, cultivation of plants for food, drug, fibre and industrial values, unexploited plants of potential economic value – plants as a source of renewable energy – Genetic resources and their conservation.

### Unit – II Plant Physiology

Water relations – Photosynthesis – C<sub>3</sub>, C<sub>4</sub> & CAM Cycles - Photorespiration – Stomatal Physiology – source and sink relationship - Mineral nutrition – Nitrogen, Phosphorus and Sulphur metabolism.

### Unit – III Plant Growth and Development

Dormancy, Physiology and Biochemistry of seed dormancy and seed germination – Plant Hormones - Hormonal regulation of growth and development – photoregulation, growth responses, physiology of flowering – senescence.

### Unit – IV Plant Tissue culture

Sterilisation techniques – media preparations – plant cell, Totipotency- Cell and tissue culture in plants –cell line – cell clones. Callus cultures – soma clonal variations – clonal propagation.

### Unit – V Micropropagation

Micropropagation – somatic embryogenesis – Haploidy. Protoplast isolation, fusion and somatic hybridization – Cybrids– Artificial seeds– Gene transfer methods in plants.

### Books:

1. Dodds J.H and L.W. Roberts. 1995. Experiments in Plant tissue culture. (2nd Ed) Cambridge Uni. Press. London.
2. Lincoln Taiz and Eduardo Zeiger 2002. Plant Physiology. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
3. Narayanaswamy. S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Reinert, J. and Bajaj, Y.P.S., 1989. Applied and fundamental aspects of Plant cell tissue and organ culture. Narosa Publishing House, New Delhi.
5. Wetter, L.R. and F. Constabel ed., 1982. Plant tissue culture methods. National research council of Canada. Ontario, CANADA.
6. William G. Hopkins, 1999. Introduction to Plant Physiology. John Wiley and Sons. INC, New York.
7. Yeoman, 1987. Plant cell culture technology Narosa Publishing House, New Delhi.
8. Deberg, P.C and R. Zimmerman. 2013. Micropropagation, Technology and Application. Panima Book distributor, Meerut.
9. Bhojwani, S.S. and M.K.. Razdan. 2013. Plant Tissue Culture, theory and Practices. Panima book Distributors, Meerut.
10. Wickens. 2013. Economic Botany- principles and Practices. Panima book Distributors, Meerut.

## **IBOT 11A - ALLIED BOTANY I: PLANT DIVERSITY, ANATOMY AND EMBRYOLOGY**

### **Objectives:**

1. To study the structure and reproductive features of bacteria and viruses
2. To understand the structure, reproduction and life cycles of Algae, Bryophytes, Pteridophytes and Gymnosperms
3. To understand the anatomical structures of tissues, Dicot stem, Leaf and Root.
4. To study microsporogenesis, megasporogenesis and the structure of endosperms

### **Unit – I**

General account of bacteria – ultrastructure, nutrition and nutritional types, reproduction- Asexual and parasexual. Economic importance

Viruses: Structure- ultrastructure of TMV, Bacteriophage, reproduction of viruses.

### **Unit – II**

Structure, Reproduction and Life history of *Nostoc*, *Oedogonium*, *Ectocarpus* and *Polysiphonia*, *Albugo*, *Pencillium* and *Agaricus*.

### **Unit – III**

Structure, Reproduction and Life history of *Funaria*, *Lycopodium* and *Cycas*.

### **Unit – IV**

Anatomy – simple and Complex tissues, Internal structure of Dicot root, stem and leaf - Monocot stem and leaf. Normal secondary thickenings of dicot stem.

### **Unit – V**

Embryology – Microsporogenesis – Male gametophyte, Megasporogenesis (*Polygonum* Type) – types of ovule, double fertilization, Types of endosperms.

### **Practicals:**

1. To make suitable micropreparations, describe and identify the specimens of Algae, Fungi, Bacteria, Viruses, Bryophytes, Pteridophytes and Gymnosperms prescribed in theory syllabus.
2. Study of Anatomical features of leaf, stem and root of dicots and monocots
3. Study of different types of anther, LS of ovule.

### **Books:-**

1. Bhojwani, S.S and Bhatnagar, S.P. 1981. Embryology of Angiosperms. Vikas Publications PVT Ltd., New Delhi.
2. Pandey, S.N. 2009. Plant Anatomy. S.Chand & Company, New Delhi
3. Sambamoorthy, A.V.S.S. 2005. A Textbook of Algae. I.K. International Pvt Ltd., New Delhi.
4. Sharma, O.P. 2007. Textbook of Algae. Tata McGraw Hill Publications Pvt Ltd, New Delhi.
5. Vashista, B.R. 2009. Textbook of Fungi. S.Chand & Company, New Delhi
6. Vashista, B.R., A.K. Sinha and Adarsh Kumar. 2005. Botany for Degree students- Bryophyta. S.Chand & Company, New Delhi
7. Vashista, B.R. 2008. Textbook of Pteridophyta. S.Chand & Company, New Delhi



## **IBOT 21 A- ALLIED BOTANY II: TAXONOMY, PHYSIOLOGY, ECOLOGY AND BIOTECHNOLOGY**

### **Objectives:**

1. To understand the principles, classification and salient features of Angiosperm families.
2. To understand the physiological principles of plants
3. To understand the role of Hormones in plant growth and development
4. To understand the basic concepts of Ecology

### **Unit – I**

Outline the classification of natural system- Bentham and Hooker, A detailed study of following families and their economic importance: *Annonaceae*, *Zygophyllaceae*, *Caesalpinia* and *Cucurbitaceae*

### **Unit – II**

A detailed study of following families and their economic importance: *Rubiaceae*, *Apocynaceae*, *Lamiaceae*, *Nyctaginaceae*, *Cannaceae* and *Poaceae*

### **Unit – III**

Physiology: Absorption of water, absorption of minerals, photosynthesis- photo system I and Photo system II, C<sub>3</sub> C<sub>4</sub> and CAM pathways. Respiration- Glycolysis, TCA cycle and electron transport system, Pentose phosphate pathway. Growth Hormones- Physiological effects of growth substance – Auxins, Gibberellins and Cytokinins.

### **Unit – IV**

Ecosystem: Biotic and Abiotic components – Food chain – food web – Energy Flow. Plant Ecology: Factors affecting vegetation- abiotic and biotic. Morphological and anatomical adaptations in hydrophytes and *Xerophytes*.

### **Unit – V**

Plant Biotechnology: enzymes (restriction enzymes, DNA Ligase). Cloning vectors (Plasmid, Cosmid, Tiplasmid). Production of rDNA. Production of Transgenic plants. Tissue culture techniques (Aseptic conditions, MS media and Callus induction)

### **Practicals:**

1. Detailed study of families mentioned in the theory with one representative specimen from the local Flora
2. Simple experiments and experimental set up in Plant Physiology section of the syllabus.
3. Study of anatomical structure of Hydrophytes and Xerophytes

### **Books:-**

1. Devlin, R.M.1996. Plant Physiology. PWS Publishers, Boston.
2. Dubey, R.C.2009. A Textbook of Biotechnology. S.Chand & Company, New Delhi
3. Dutta, S.C.2003. Systematic Botany. New Age International pvt Ltd., New Delhi
4. Jain, V.K. 2008. Fundamentals of Plant Physiology. S.Chand & Company, New Delhi.
5. Pandey, B.P. 2009.Taxonomy of Angiosperms. S.Chand & Company, New Delhi
6. Sambamoorthy, A.V.S.S.2005. Molecular Biology. Narosa Publishers, New Delhi.
7. Shukla R.S and R.S. Chandel. 1998. Plant Ecology. S.Chand &Co. Pvt.Ltd, New Delhi.