

Semester-wise Syllabus for Undergraduate Programme

Botany

To be introduced from July 2012



DEPARTMENT OF BOTANY
NAGALAND UNIVERSITY
LUMAMI

INTRODUCTION

The Syllabus is designed to suit the semester pattern and credit system adopted by the University. The remodeling of the syllabus have been made with an inter-disciplinary approach and is therefore worked out trying to maintain an evolutionary link throughout the subject beginning with the origin and evolution of biodiversity through ecology and conservation. Attempts have been made to restructure the syllabus to meet the emerging concepts of twenty first century. It has been designed as to incorporate the new advances and trends in the disciplines within the limitations of the UG syllabus. Thus the latest concepts in Cell Biology, Biotechnology and Molecular Biology have been incorporated.

The syllabus has been also been developed envisaging the teacher, learner and the application of the synergetic interaction between the two. It aims to progressively enhance the students' knowledge over the subject and inculcate in them a sense of spirit, wonder and appreciation to the dynamics of nature. The syllabus has been drafted clearly and concisely so that the students have the knowledge to acknowledge and owe responsibility to the environment, ecology and biodiversity of plants.

Ethnobotany and traditional knowledge has been drafted to enrich the students with the treasures of our state and society. The study of Medicinal Botany and Economic botany enriches the Systematic Botany which can be of potential botanical, pharmacological and economic usage. This study will be useful in identifying medicinal taxa; since the students are aware of systematic botany (Morphology and Taxonomy of Flowering Plants).

The curriculum for B.Sc. programme in Botany which is of six semester duration contains in 6 Pass papers with 3 credit points each and 5 Honours papers with 2 credit points each. Each of the theory paper for both Pass and Honours course will have a corresponding practical with 1 credit point each. In the sixth semester, students can opt for a CBCS paper (Choice Based Credit System) from the options offered by the College which carries 3 credit point and a corresponding project work with 1 credit point of the CBCS.

While retaining the basic concepts of the subject, the practical components are designed in correspondence with the theory courses to impart the skills and techniques required in these areas. Seminars, tutorials, quiz, assignments, field survey, project, study tour and other such activities will supplement the programme of instruction relating to a unit. The

syllabus will give a solid foundation for the post-graduate courses like Molecular Biology, Microbiology, Medical Genetics, Horticulture and Plant Biotechnology besides Botany itself.

REFERENCES:

1. Present Nagaland University syllabus as template
2. Banaras Hindu University syllabus, U.P.
3. Bharathidasan University syllabus, Tiruchirappalli
4. Calcutta University syllabus, West Bengal
5. Calicut University syllabus, Kerela
6. Delhi University syllabus, Delhi
7. Guwahati University syllabus, Assam
8. Jamia Millia Islamia University syllabus.
9. Kannur University syllabus, Kerela
10. Madras University syllabus, Tamil Nadu
11. North Eastern Hill University syllabus, Meghalaya

**NAGALAND UNIVERSITY
CURRICULUM FOR B.Sc PROGRAMME IN BOTANY**

Semester		Course Number	Course Name	Credits	Total Credits
I	Pass	BOT-101 BOT-102	Biodiversity I Practical	4 1	8
	Honours	BOT-103 BOT-104	Microbiology and Plant Pathology Practical	2 1	
II	Pass	BOT-201 BOT-202	Biodiversity II and Plant Pathology Practical	4 1	8
	Honours	BOT-203 BOT-204	Embryology and Palynology Practical	2 1	
III	Pass	BOT-301 BOT-302	Morphology, Anatomy and Angiosperm Taxonomy Practical	4 1	8
	Honours	BOT-303 BOT-304	Ethnobotany, Economic Botany and Biometric Practical	2 1	
IV	Pass	BOT-401 BOT-402	Plant Physiology and Ecology Practical	4 1	8
	Honours	BOT-403 BOT-404	Environmental Biology and Phytogeography Practical	2 1	
V	Pass	BOT-501 BOT-502	Biochemistry and plant breeding Practical	4 1	8
	Honours	BOT-503 BOT-504	Molecular Biology and Biotechnology Practical	2 1	
VI	Pass	BOT-601 BOT-602	Cell Biology and Genetics Practical	4 1	10
	Honours	BOT-603	<u>Choice Based Credit System</u> a) Angiosperm Taxonomy b) Methodology and Perspective of Science c) Plant Biotechnology d) Forestry e) Mushroom Cultivation f) Horticulture	3	
		BOT-604	Project Work	2	

Highlights of the Curriculum

- *Choice Based Credit Paper will be offered depending on the availability of specialized teachers in respective colleges.
- * The Practical Examination will be conducted internally which will be of 50 marks. It will be a Continuous evaluation.
- * All theory papers are of 100 marks (70% external and 30% internal).
- * Each Theory Paper will have five units.
- * Project work will be assigned to students by the faculties of the department depending upon the availability of facilities and infrastructure of the department. Evaluation will be assessed jointly by internal and external examiners. In the absence of external examiner, the examination committee of the college may appoint a faculty member as an examiner.
- *Credits: - Theory: 1 Credit = 15 hrs
Practical: 1 Credit = 30 hrs

SEMESTER I

Course No: **BOT-101** **BIODIVERSITY I (Bacteria, Algae, Fungi and Viruses)**

UNIT 1: Origin and Evolution of Biodiversity

General account on Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation.

Three Domains of life—Archaea, Bacteria and Eukaryota;

Evolutionary relationship among the three domains.

11 HOURS

UNIT II: Bacteriology

Ultra structure of bacterial cell

Comparison of Archaeobacteria and Eubacteria

Gram positive and Gram negative Bacteria

Bergey's Classification of Bacteria

Shapes of bacteria

Reproduction- vegetative, asexual, sexual (conjugation, transformation and transduction)

Bacterial genome and plasmid

Economic importance of Bacteria

12 HOURS

UNIT III: Phycology

Cyanobacteria: Cell structure, thallus organization,

Structure and life history of *Nostoc* and *Anabaena*.

Outlines of Fritsch's classification of algae

Types of alternation of generation

Range of vegetative and reproductions in Chlorophyceae, Xanthophyceae, Phaeophyceae and Rhodophyceae

Important features of life cycle of *Oedogonium*, *Vaucheria*, *Ectocarpus*, and *Polysiphonia*

Economic importance of Algae

13 HOURS

UNIT IV: Mycology

General characters and classification of Fungi

Range of vegetative structure and reproduction in fungi

Important features of life cycle of *Pythium*, *Erysiphe*, *Aspergillus*, *Puccinia*, *Agaricus*, and *Alternaria*.

General account of Lichens

Mycorrhizae,

13 HOURS

UNIT V: Virology

Discovery of Virus

Replication, lytic (T4 phage) and Lysogenic cycle (Lambda phage);

Types-DNA virus (coliphage T32), RNA virus (TMV), Retro virus (HIV);

Viriods and Prions

11 HOURS

Suggested Readings:

- 1) Alexopoulos C.J and MIMS C.V 1988. *Introductory Mycology*, John Wiley and Sons.
- 2) Bold, H.C. and Wayne, M.J. 1996 *Introduction to Algae (2nd Edition)*. Prentice Hall, Inc. Englewood Cliffs, New Jersey.
- 3) Campbell, N.A. and Reece, J. B. (2008) *Biology 8th edition*, Pearson Benjamin Cummings, San Francisco.
- 4) Dubey R C and D K Maheswary : *A Text Book of Microbiology* : S Chand and Co New Delhi,
- 5) Lee, R.E. 2008. *Phycology, Fourth Edition*, Cambridge University Press, USA.
- 6) Pandey and Trivedi - *A text book of Fungi, Bacteria and Virus* Vikas Publishing House, New Delhi.
- 7) Pelczar, M.J. (2001) *Microbiology, 5th edition*, Tata Mc Graw-Hill Co, New Delhi.
- 8) Prescott, L. Harley, J. and Klein, D. (2005) *Microbiology, 6th edition*, Tata Mc Graw-Hill Co. New Delhi.
- 9) Raven, P.H *et al* (2006) *Biology 7th edition* Tata McGrawHill Publications, New Delhi
- 10) Sambamurthy, AVSS. 2006. *A Textbook of Algae*. I. K. International Pvt. Ltd., New Delhi.
- 11) Thakur Anil K, Bassi Susheel K, *Diversity of microbes and Cryptogams*. S. Chand and Company, New Delhi
- 12) Van den Hoek, C.; Mann, D.J. and Jahns, H.M. 1995. *Algae: An introduction to Phycology*. Cambridge Univ. Press.
- 13) Webster, J. and Weber, R. 2007 *Introduction to Fungi. 3rd edition*, Cambridge University Press, Cambridge.

PRACTICALS

Course No: **BOT-102** **BIODIVERSITY I (Bacteria, Algae, Fungi and Viruses)**

Section A

30 HOURS

1. Introduction on handling and maintenance of laboratory equipments
2. Types of bacteria from temporary/permanent slides.
3. Gram staining of bacteria from root nodules and curd.
4. Models of viruses and virus infected plants.

Section B

1. Introduction on techniques of slide preparation, stain preparation and staining.
2. Study of vegetative and reproductive structure of
 - i. *Chlamydomas*
 - ii. *Oedogonium*
 - iii. *Chara*
 - iv. *Ectocapus*
 - v. *Puccinia*
 - vi. *Pythium* ,
 - vii. *Erysiphe*,
 - viii. *Pezizia/Agaricus*
3. Study of types of lichens
4. Study of Mycorrhizae

Course No: **BOT-103**

MICROBIOLOGY AND PLANT PATHOLOGY

UNIT 1: Introduction to Microbiology

History and Development of Microbiology; the microscope, spontaneous generation, biogenesis, fermentation, germ theory of diseases

Culture technique;

Microbial Nutrition

Growth Curve

Measurement of growth

Scope of microbiology

6 HOURS

UNIT II: Soil and water Microbiology

Soil microbiology: Role of microbes in decomposition of organic matter,

Nitrogen cycle (Symbiotic and non-symbiotic biological nitrogen fixation)

Role of microbes in Agriculture (biofertilizer and biopesticide).

Water microbiology;

Sewage treatment and Purification of water

6 HOURS

UNIT III: Application of Microbiology

Industrial application of microbes

Antibiotics (History, types, Mode of action and Production),

Microbiology of fermented food (Dairy products, alcoholic beverages), Probiotics.

Basic concept of food spoilage and food preservation.

6 HOURS

UNIT IV: Plant Pathology

History of Plant pathology

Classification of plant diseases (Koch's Postulate)

Host Parasite interaction and defense mechanisms (Histological, Physiological, Biochemical)

Mechanism of infection; transmission and dissemination of disease

Control of plant diseases (Physical, Chemical and Biological)

6 HOURS

UNIT V: Plant diseases

Disease symptoms; disease cycle and control measures of

- i. Late and Early Blight of Potato.
- ii. Blast disease of Rice,
- iii. Citrus canker,
- iv. Bacterial leaf spots
- v. Tea Rust, and
- vi. Wheat Rust.

6 HOURS

Suggested Readings:

- 1) Agrios, G.N. 1997 *Plant Pathology*, 4th edition, Academic Press, U.K.
- 2) Dubay R.C. and D.K. Maheswari 2000. *A Textbook of Microbiology*, Chand and Co, New Delhi.
- 3) Frazier W.C. 1998. *Food Microbiology*, Prentice Hall of India, Pvt. Ltd.
- 4) Kumar H.D. and S. Kumar. 1998. *Modern Concepts of Microbiology* Tata McGraw Hill, Delhi.
- 5) Mckane, L. and K. Judy. 1996. *Microbiology: Essentials and Applications*. McGraw Hill, New York.
- 6) Mehotra RS 1995 *Plant Pathology 12th Edition* Tata Mc Graw-Hill Co, New Delhi
- 7) Mishra RR 1996 *Soil Microbiology* CBS Publication.
- 8) Pelczar, M.J. (2001) *Microbiology*, 5th edition, Tata Mc Graw-Hill Co, New Delhi.
- 9) Presscott, L. Harley, J. and Klein, D. (2005) *Microbiology*, 6th edition, Tata Mc Graw-Hill Co. New Delhi.
- 10) Rangaswami, R and C.K.J. Paniker. 1998. *Textbook of Microbiology*, Orient Longman.
- 11) Sharma P.D., 2004. *Microbiology and Plant Pathology* Rastogi Publication.
- 12) Singh, R.S. 1998 *Plant Diseases*. 7th edition, Oxford and IBH, New Delhi
- 13) Wheeler B.E J 1992, An Introduction to Plant Diseases, Oxford and IBH.
Rengasamy G. Diseases of Crop Plants of India, Prentice Hall.

PRACTICALS

Course No: **BOT-104**
SECTION A

MICROBIOLOGY AND PLANT PATHOLOGY
30 HOURS

1. Techniques on cleaning and Sterilization of equipments.
2. Preparation of media (Potato-dextrose- Agar and Rose Bengal Agar Media)
3. Preparation of Slant and pour plates
4. Inoculation of microbes from soil and water by serial dilution.
5. Determination of microbial population by haemocytometer.
6. Study of Gram positive and Gram negative bacteria.

Section B

1. Preparation of stains and staining technique.
2. Technique on microscopy
3. Technique on permanent slide preparation.
4. Study of diseased specimens prescribed in the theory paper by temporary and permanent slide preparation.
5. Collection, identification and submission of atleast 5 diseased specimen.

SEMESTER II

Course No: **BOT-201** **BIODIVERSITY II (Archegoniatae) AND PALAEOBOTANY**

UNIT 1: BRYOLOGY

General characteristic of Bryophytes
Classification of Bryophytes (Proskauer, 1957)
Distribution, Structure (Morphological and anatomical), reproduction, life cycle and affinities of following: *Marchantia* (Hepaticopsida), *Anthoceros* (Anthocerotopsida), *Funaria* (Bryopsida)
Economic importance of Bryophytes

12 HOURS

UNIT II: PTERIDOLOGY

General account of Pteridophytes
Origin, Telome theory
General Classification
Evolution of stele,
Heterospory and Seeds habit
Life cycle of *Psilotum*, *Selaginella*, *Equisetum* and *Marsilea*.

12 HOURS

UNIT III: GYMNOSPERM

General account,
Classification of Gymnosperms (Sporne's, 1965)
Morphology and Anatomy of *Cycas*, *Pinus* and *Gnetum*.
Economic importance of Gymnosperms

12 HOURS

UNIT IV: REPRODUCTION IN GYMNOSPERM

Reproduction of *Cycas*, *Pinus* and *Gnetum*.
Affinities of Gymnosperms with Pteridophytes and Angiosperms

12 HOURS

UNIT V: PALAEOBOTANY

Geological time scale
Fossil types and their formation,
General account of dominant fossil flora of different ages,
Palaeobotany in relation to exploration of fossil fuels

12 HOURS

Suggested Readings:

BRYOPHYTES

- 1) Campbell H.D, 1940, *The Evolution of land plants (Embryophyta)*, Univ. Press, Stanford.
- 2) Chopra R.N. and P.K. Kumar, 1988, *Biology of Bryophytes*. Wiley Eastern Ltd. New Delhi.
- 3) Parihar, N.S. *An Introduction to Bryophyta* Central Book Depot, Allhabad, 1965.
- 4) Shaw.J.A. and Goffinet B., 2000, *Bryophyte Biology*, Cambridge University Press.
- 5) Smith G.M. 1938, *Cryptogramic Botany Vol.II. Bryophytes and Pteridophytes*. Mc Graw Hill Book Company, London.
- 6) Sporne K.R.,1967, *The Morphology of Bryophytes*. Hutchinson University Library, London.

- 7) Vasishta B.R. *Bryophyta*. S. Chand and Co. New Delhi.
- 8) Watson E.V. 1971, *The structure and life of Bryophytes*. Hutchinson University Library, London.

PTERIDOPHYTES

- 1) Bierhorst, D.W 1971 *Morphology of Vascular Plants* MacMillan Co., N.Y. & Collier-MacMillan Ltd., London.
- 2) Parihar, N.S. 1996. *The Biology and Morphology of Pteridophytes*. Central Book Depot, Allahabad.
- 3) Sharma, O.P 1990 *Textbook of Pteridophyta* MacMillan India Ltd., Delhi
- 4) Sporne, K.R. 1970 *The Morphology of Pteridophytes* (The Structure of Ferns and Allied Plants) Hutchinson University Library, London
- 5) Sundara Rajan, S. 1994 *Introduction to Pteridophyta* New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi,
- 6) Vashista, P.C. 1997 *Botany for Degree Students-Pteridophyta*. S. Chand & Co., New Delhi,
- 7) Zashhed, A 1999 *An Introduction to Pteridophyta* Vikas publishing Co., New Delhi,

GYMNOSPERMS

- 1) Bhatnagar, S.P and Alok Moitra 1997 *Gymnosperms* New Age International (P)Ltd., Publisher, New Delhi,
- 2) Sharma, O.P. 1997 *Gymnosperms* Pragati Prakashan, Meerut, India.
- 3) Sporne K.R. 1967, *The Morphology of Gymnosperms*, Hutchinson and Co. Ltd. London.
- 4) Sreevastava H.N. 1980, *A Text Book of Gymnosperms*. S. Chand and Co. Ltd., New Delhi.
- 5) Srivastava, H.N.1998 *Gymnosperms* Pradeep Publications, Jalandhar, India-
- 6) Vashista, P.C. 1996 *Botany for Degree Students – Gymnosperms (2nd Edition)* S. Chand & Co.,New Delhi
- 7) Vasishta P.C. 1980, *Gymnosperms*. S. Chand and Co., Ltd., New Delhi.

PALAEOBOTANY

- 1) Clark DL 1976 *Fossils, Palaeobotany and Evolution* W.M.C. Brown Company New York.
- 2) Meyen SV., 1978 *Fundamentals of Palaeobotany* Chapman and Hall London
- 3) Misra SP and Shukla AC 1982 *Essentials of Palaeobotany* Vikas Publishing House, New Delhi
- 4) Steward WN and Rothwell GW 1993 *Palaeobotany and the Evolution of Plants* Publ. Cambridge University Press, London
- 5) Surnage KR 1966 *Indian Fossil Pteridophytes* C.S.I.R. New Delhi
- 6) Thomas BA and Spice RA 1986 *The Evolution and Palaeobotany of land Plants* Publ Crom Helm London & Sydney

PRACTICALS

Course No: **BOT-202** **BIODIVERSITY II (Archegoniatae) AND PALAEOBOTANY**
30 HOURS

Preparation of stain

Single and Double staining technique

Technique on preparation of permanent slide

Study of habit, Vegetative thallus organization and structure, reproductive structures of the following taxa through temporary mounts and permanent slides

Bryophytes: *Riccia*, *Marchantia*, *Anthoceros*.

Pteridophytes: *Psilotum*, *Selaginella*, *Equisetum*, *Marsilea*,

Gymnosperm: *Cycas* (coralloid root, T.S. of coralloid root, T.S. of leaflet, petiole, male cone and L.S. of male cone, microsporophyll, megasporophyll, T.S. of microsporophyll, ovule, L.S. of ovule and seed.)

Pinus (T.S. of stem and needle, male cone and female cone, L.S. of male cone and female cone, seed)

Gnetum (Stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed)

Study of fossil specimens

Course No: BOT-203

REPRODUCTIVE BOTANY (Embryology and Palynology)

UNIT 1: INTRODUCTION AND ANTHER

History and Scope of embryology
Typical Angiosperm Flower
Structure of stamen
Microsporogenesis
Microgametogenesis
Dehiscence

6 HOURS

UNIT II: OVULE AND EMBRYOGENY

Structure of carpel
Types of Ovule
Megasporesogenesis,
Megagametogenesis (monosporic, bisporic and tetrasporic types).
Structure of typical embryo sac, (Polygonum, Allium and Adoxa type)

6 HOURS

UNIT III: POLLINATION AND FERTILIZATION

Pollination,
Pollen tube entry (Types)
Syngamy and triple fusion,
Double fertilization
Development of Endosperm

6 HOURS

UNIT IV: POST-FERTILIZATION

Types of endosperm
Haustoria
Functions of suspensors and synergids,
Apomixis
Polyembryony.
Fruit-development and maturation

6 HOURS

UNIT V: PALYNOLOGY

Pollen- pistil interaction,
Compatibility and incompatibility
Types of Pollen production and dispersion in time and space,
Pollen/spore morphology and its role in taxonomy
Pollen allergy.

6 HOURS

Suggested Readings

- 1) Bhojwani, S.S. and Bhatnagar SP 2004 *The Embryology of Angiosperms*, Vikas Publishing House
- 2) Davis C.L. 1965. *Systematic Embryology of Angiosperms*. John Wiley, New York.
- 3) Eames M.S 1960. *Morphology of Angiosperms* Mc Graw Hill New York.

- 4) Erdtman G 1952. *Pollen Morphology and plant Taxonomy Part I*. Almqvist & Wicksell Stockholm
- 5) Erdtman G 1969. *Hand Book of Palynology*. National Botanical Gardens Publication, Lucknow
- 6) Johri BD 1984 (ed.) *Embryology of Angiosperms* Springer Verlag, Berlin.
- 7) Johri, B.M. 1984 *Embryology of Angiosperms*, Springer-Verlag, Netherlands.
- 8) Maheswari P. 1985. *Introduction to Embryology of Angiosperms* Mac Graw Hill, New York. House (P) Ltd.
- 9) Nair P .K .K *Pollen Morphology of Angiosperms* Scholar Pub: House, Lucknow
- 10) Raghavan, V. 1997 *Molecular embryology of flowering plants*. Cambridge, University Press.
- 11) Raghavan, V. 2000 *Developmental Biology of Flowering plants*, Springer, Netherlands.
- 12) Shivanna, K.R. 2003 *Pollen Biology and Biotechnology*, Science Publishers.

PRACTICALS

Course No: **BOT-204** **REPRODUCTIVE BOTANY (Embryology and Palynology)**

30 HOURS

1. Study the types of ovules
2. Study female gametophyte through permanent slides/ photographs: types and ultrastructure of mature embryo sac.
3. Study of dicot and monocot embryo of Angiosperms
4. Study of the different stages of anther development.
5. Study the pollen morphology of available plants by acetolytic method.
6. Pollen germination test.
 - a. in vitro germination using sugar solution. (cavity slide method)
 - b. Tetrazolium test
7. Dissect and display different stages of embryo development
8. Dissections of developing seeds for endosperm with haustoria types (temporary slides).

SEMESTER III

Course No: **BOT-301 MORPHOLOGY, ANATOMY AND ANGIOSPERMIC TAXONOMY**

UNIT 1: VEGETATIVE MORPHOLOGY

Plant Habit

Root: Types, Modification for Storage, physiological and mechanical purposes.

Stem: Habit, types modification of stem for food, mechanical and underground modification of stem.

Leaves: Types, phyllotaxy, Venation, lamina; parts, shapes and modifications, leaf surface features and appendages.

Fruits: Structure, types and classification with examples

Detail Seed structure: dicot and monocot, albuminous and exalbuminous.

11 HOURS

UNIT II: FLORAL MORPHOLOGY

Types of inflorescence and specialized inflorescence

Flower: Flower as a modified shoot

Detailed structure of flowers

Floral parts, arrangement, relative position, numeric plan, cohesion and adhesion of floral parts,

Types of aestivation and placentation

Floral diagram and floral formulae

10 HOURS

UNIT III: PLANT ANATOMY-TISSUES

Classification and structure of tissues;

Simple tissue: Structure occurrence and function (parenchyma, collenchyma, sclerenchyma)

Complex tissues Definition Structure, Origin and function (Xylem & Phloem, tracheary elements and Sieve elements)

Secretory tissues: (glands, glandular hairs, nectaries, hydathodes, schizogenous and lysigenous ducts, resin ducts, mucilage ducts, kinoveins, laticifers)

Vascular bundle: Types (conjoint, collateral, bi-collateral, open closed, radial, concentric amphicribal and amphivasal.)

Stomatal complex

13 HOURS

UNIT IV: PLANT ANATOMY-STEMS AND ROOTS

Shoots: Theories on apical organisation (Apical cell theory, Histogen theory, Tunica-carpus theory)

Shoot chimeras

Arrangement of primary tissues in the Dicots and Monocots stem and leaves

Secondary growth and anomalous secondary growth (Amaranthus, Mirabilis and Dracaena.)

Roots: Organization of root apex (apical cell theory, Korper-kappe theory)

Root cap;

Arrangement of primary tissues in the Dicots and Monocots roots

Secondary growth in roots

12 HOURS

UNIT V: ANGIOSPERMIC TAXONOMY

Principles of systematic

Concept of species, genus and family

Nomenclature

Overview on types of classification; Sexual, natural, phylogenetical and modern system of classification

Comparative study of classification systems of

- i. Bentham and Hooker,
- ii. Engler and Prantle
- iii. and Hutchinson.

Taxonomic studies of the following families (Bentham and Hooker)

Dicots: Rununculaceae, Malvaceae, Leguminaceae, Compositaceae, Solanaceae, Cucurbitaceae

Monocots: Orchidaceae, Gramminae

14 HOURS

Suggested Readings:

1. Cronquist, A. (1981). *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York.
2. Datta S C., 1988 *Systematic Botany*, 4th Ed, Wiley Estern Ltd., New Delhi
3. Eames A. J. 1981 *Morphology of Angiosperms* - McGraw Hill, New York.
4. George, H.M. Lawrence. 1951. *Introduction to Plant Taxonomy*. Mac Millan comp. Ltd., New York.
5. Gifford EM. And Foster AS., 1989 *Morphology and Evolution of Vascular Plants* W.H.Freeman, New York
6. Naik V.N., 1991 *Taxonomy of Angiosperms* Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
7. Pandey, S. N, and S.P. Misra (2008) *Taxonomy of Angiosperms* Ane Books India, New Delhi.
8. Prithipalsingh (2007), *An introduction to Biodiversity*, Ane books India, Delhi.
9. Simpson, M.G. 2006. *Plant Systematics*. Elsevier Academic Press, London
10. Singh G.1999. *Plant systematics: Theory and Practice*. Oxford and IBH Pvt.Ltd.New Delhi.
11. Sivarajan V. V - *Introduction to Principles of taxonomy* Oxford &I B H New Delhi.
12. Stussy, T.F. 1990. *Plant Taxonomy*, Columbia University Press, USA.
13. Takhtajan *Flowering Plants* Edinburg, Oliver & Boyd.
14. Vashishta P. C *Taxonomy of Angiosperms* Chand & Co, Meerut.
15. Vasudevan Nair, R *Taxonomy of Angiosperms* APH Pub. New Delhi
16. Cuttler, E.G. 1971. *Plant Anatomy, Part III Organs* Edward Arnold Ltd., London.
17. Cuttler, EG. 1969. *Plant Anatomy Part I Cells & Tissue*. Edward Arnold Ltd., London.
18. Eames, AJ and LH MacDaniels 1987 *An Introduction to Plant Anatomy*. Tata MacGraw-Hill Publishing company Ltd. New Delhi.
19. Esau k 1985 *Plant Anatomy 2nd Edition* Wiley Eastern, New Delhi.
20. Fahn A 1997 *Plant Anatomy* Aditya Books (P) Ltd. New Delhi.
21. Fahn A 2000. *Plant Anatomy*. Permagon Press.
22. Sen DN 1974. *Anatomy of Angiosperms*. S. Nagini & Co.
23. Vasishta P.C. 1974. *Plant Anatomy*, Pradeep Publication, Jalandhar.

PRACTICALS

Course No: **BOT-302 MORPHOLOGY, ANATOMY AND ANGIOSPERMIC TAXONOMY**
30 HOURS

Study of vegetative and floral characters of species of the families studied in theory.

Identification of selected taxa upto Genus using taxonomic keys.

Herbarium technique

Familiarity with local flora and preparation of herbarium sheet

Microscopic studies on: types of stomata, (Monocot and dicot)

Anatomical study of stem and root (Dicots and Monocots) by making double stained temporary/permanent slides

Anatomical studies of anomalous secondary structure in stem of *Mirabilis*, *Bignonia*, *Bougainvillea* and *Dracaena* by making double stained permanent slides

Course No: **BOT-303 ETHNOBOTANY, ECONOMIC BOTANY AND BIOMETRIC**

UNIT 1: ETHNOBOTANY

Ethnobotany and its significance,

Study and Classification of some plants used by tribals of North-Eastern India as

- i. food,
- ii. clothing
- iii. shelter, and
- iv. medicines.

6 HOURS

UNIT II: ECONOMIC BOTANY I

Plants for man –

- i. Cereals
- ii. Pulses
- iii. Fibres
- iv. fats and
- v. oils
- vi. spices and condiments,
- vii. beverages

6 HOURS

UNIT III: ECONOMIC BOTANY II

Origin and cultivation of

- i. Rice
- ii. Jute
- iii. Sugarcane
- iv. Mustard
- v. Potato.

History, cultivation and processing of

- i. Tea and
- ii. Rubber.

6 HOURS

UNIT IV: ECONOMIC BOTANY III

Characteristics and uses of timber yielding plants

- i. Teak
- ii. Sal
- iii. Bamboo

A general account and identification of locally available plants used as

- i. Spices
- ii. fruits and
- iii. ornamentals.

6 HOURS

UNIT V: BIOMETRICS

Collection of data,

Sampling theory and methods; mean, mode, median.

Standard deviation and standard error

Coefficient of variation, probability, addition, and multiplication laws, normal and binomial distribution

t- test and chi-square test

6 HOURS

Suggested Readings

- 1) Arora PN and PK Malhan, 2002 *Biostatistics* Himalaya Publishing House
- 2) Ashok Bendre and Ashok Kumar 1998-99 *Economic Botany* Rastogi Publications, Meerut, India
- 3) Edmondson A and D. Druce 1996 *Advanced Biology Statistics* Oxford University Press
- 4) Govinda Praksh and Sharma SK 1975 *Introductory Economic Botany* Jai Prakash Nath & Cosec Meerut, India
- 5) Gupta, S.K. and Kaushik MP 1973 *An Introduction to Economic Botany* K. Nath & Co., Meerut, India
- 6) Hill AW 1952 *Economic Botany* McGraw Hill Book Co., New York
- 7) Jain SK 1981 *Glimpses of Indian Ethnobotany* Oxford & IBH, New Delhi
- 8) Jain SK 1987 *A Manual on Ethnobotany* Scientific Publisher Jodhpur
- 9) Jain SK and Mundgal 1999 *Handbook of Ethnobotany* London
- 10) Mandal and Nambiar *Agricultural Statistics*, Agrobios Publications, Jodhpur
- 11) Palanichamy S and Manoharan M *Statistical methods for Biologists*, Palani Paramount publications, New Delhi
- 12) Pandey BP 2000 *Economic Botany* S. Chand & Co., New Delhi
- 13) Parihar P *Biostatistics & Biometry*, Agrobios Publications, Jodhpur
- 14) Ramakrishnan N. *Fundamentals of Biostatistics*, Sarao Publications, Naaagercoil
- 15) Sambamurthy, AVVS and Subrahmanyam, NS 1989 *A Text Book of Economic Botany* Wiley Eastern Ltd., New Delhi,
- 16) Sen. S 1992 *Economic botany* New Central Book Agency, Calcutta
- 17) Verma, V 1974 *A Text Book of Economic Botany* Emkay Publications, New Delhi

PRACTICALS

Corse No: **BOT-304** **ETHNOBOTANY, ECONOMIC BOTANY AND BIOMETRIC**

30 HOURS

- 1) Submission of economically important plants and plants products (Cereals, Pulses, Spices, Fibers and Condiments)
- 2) Field trip to important place
- 3) Collection, description and Submission of at least 5 plants of ethnobotanical Importance
- 4) Work out problems on measures of central tendencies, measures of dispersion.

SEMESTER IV

Course No: **BOT-401 PLANT PHYSIOLOGY AND ECOLOGY**

UNIT 1: UNIT 1: PLANT WATER RELATIONS AND MINERAL NUTRITION

Structure and properties of water

Absorption of water (active and passive),

Ascent of sap; Pathway of water movement; concepts of symplast and apoplast,

Guttation and transpiration, Significance of transpiration

Physiology role of stomata

Macro and Micro nutrients; Role of essential nutrients in plant metabolism and their deficiency symptoms.

Absorption of mineral elements-

- i. Active and passive absorption
- ii. Simple and facilitated diffusion
- iii. Donnan equilibrium
- iv. Role of ATP,
- v. Carrier systems, proton pump and ion flux

Outline of Nitrogen fixation and Nitrogen Assimilation,
Transamination and deamination,

12 HOURS

UNIT II: PHOTOSYNTHESIS AND RESPIRATION

Definition and Significance

Site of photosynthesis,

Photochemical phase

- i. Electron transport chain.
- ii. Photophosphorylation- (cyclic and non cyclic)
- iii. Z Scheme of Photosynthetic Electron Transfer

Biosynthetic phase,

- i. Benson and Calvin cycle
- ii. Hatch and Slack pathway
- iii. Crassulacean acid metabolism
- iv. Photorespiration

Law of limiting factors.

Source sink relationship. Mechanism of phloem transport. Phloem loading and unloading
Glycolysis

Oxidative decarboxylation of pyruvate into acetyl CoA

TCA cycle

Oxidative phosphorylation, and factors affecting oxidative processes

14 HOURS

UNIT III: PLANT GROWTH AND DEVELOPMENT

Physiological effect of Auxin. Cytokinins, Gibberellins and Ethylene and their role in plant development.

Physiology of senescence and abscission

Brief outlines on

- i. Photoperiodism
- ii. Vernalization.
- iii. Phytochrome,

10 HOURS

UNIT IV: ECOLOGY

Basic concept of Ecology

Ecological factors, (Light, Temperature, Moisture, Edaphic, Physiographic and Biotic.)

Ecological adaptations of Hydrophytes, Xerophytes, Epiphytes and Halophytes.

Community structure (Qualitative analytic and synthetic characters) and development (Primary and secondary succession)

Productivity (Primary and secondary productivity)

Trophic structure, trophic levels and ecological pyramid.

12 HOURS

UNIT V: BIODIVERSITY

Biodiversity, Hotspots, keystone species, flagship species

Values of biodiversity, equitability

Attributes of population,

Population growth and interaction.

Air and water pollution and their abatement.

Phytogeographic regions of India with special reference to North East India.

12 HOURS

Suggested Readings:

- 1) Daubenmier, R.F. 1970, *Plant Communities*, Wiley Eastern Private Limited
- 2) Daubenmier, RF.1970. *Plants and Environment: A text book of Plant Autoecology*, Wiley Eastern Private Limited
- 3) Dennis, D.T., Layzell, D.B., Lefebre, D.D. and Turpin, D.H. (1997) *Plant Metabolism*. Addison Wesley Longman.
- 4) Hopkins, W.G. and Huner, P.A. (2008) *Introduction to Plant Physiology*. John Wiley and Sons.
- 5) Kandya AK and Gupta A 2007 *Advancing frontiers of Ecological Researches in India*
- 6) Kaul RP (2009) *Plant Metabolism*. Swastik Publishers and Distributors.
- 7) Koromondy EJ 1996 *Concepts of Ecology 4th Edition* Prentice-Hall of India Pvt. Ltd. New Delhi
- 8) Misra KC 1988 *Manuals of Plant Ecology (3rd Edition)* Oxford and IBH Publishing Co., New Delhi.
- 9) Mukherjee S., Ghosh AK., 2006 *Plant Physiology* New Central Book Agency Calcutta
- 10) Nelson, D.L., Cox, M.M. (2004) Lehninger *Principles of Biochemistry, 4th Edition*, WH Freeman and Company, New York, USA.
- 11) Odum EP 1983 *Basic Ecology 5th Edition* Thomson Business International Waldis Pvt Ltd. Baricahd
- 12) Odum, EP. (2008) *Ecology*. Oxford and IBH Publisher.

- 13) Salisbury, F.B. and Ross, C.W. (1991) *Plant Physiology*, Wadsworth Publishing Co. Ltd.
- 14) Sharma, P.D. (2010) *Ecology and Environment, (8th Edition)* Rastogi Publications, Meerut.
- 15) Singh, JS., Singh, SP. and Gupta, S. 2006 *Ecology Environment and Resource Conservation* Anamaya Publications, New Delhi
- 16) Sinha RK., 2007 *Modern Plant Physiology* 2nd Edition Tata McGraw, New Delhi.
- 17) Taiz, L. and Zeiger, E. (2006) *Plant Physiology*, 4th Edition Sinauer Associates Inc. Publishers, Massachusetts, USA
- 18) Wilkinson, D.M. 2007. *Fundamental Processes in Ecology. An Earth System Approach.* Oxford.

PRACTICALS

Course No: **BOT-402** **PLANT PHYSIOLOGY AND ECOLOGY** **30 HOURS**

PHYSIOLOGY

1. Preparation of solutions of various concentrations of a few selected solutes.
2. Study of transpiration rate in dorsiventral and isobilateral leaves by Blackman's apparatus.
3. Separation of plant pigments by paper chromatography.
4. Determination of photosynthetic activity by Wrinkler's method.
5. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophytes.
6. Study of the mechanism of stomatal opening and closing
7. Rate of photosynthesis under varying HCO_3 concentration in an aquatic plant using bicarbonate and to find out the optimum and toxic concentration.

ECOLOGY

1. Study of adaptive anatomical and morphological features of Hydrophyte, Epiphytes and Xerophytes
2. Study of Soil pH
3. Estimation of soil carbonate content by qualitative method
4. Determination of requisite size and number of quadrat for the study of plant community
5. Study of structure of plant community by determining frequency, density and abundance of quadrat method.

Course No: **BOT-403 ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY**

UNIT 1: INTRODUCTION

Environmental Biology

Dynamics of environment and interaction among various environmental factors.

Concept on carrying capacity, biological diversity and ecological stability.

General idea of natural resources

- v. forest,
- vi. grassland
- vii. water and
- viii. energy

Productivity of natural and agro-ecosystem,

6 HOURS

UNIT II: MAN AND ENVIRONMENT

Man in the environment: utilization of resources and its effect on environment

- i. Greenhouse effect and global warming;
- ii. climate change;
- iii. ozone layer
- iv. Depletion of forests;
- v. Loss of biodiversity and extinction of species, Red data book

Efforts to control these effects (Vienna Convention, Montreal Protocol, Earth summit, Kyoto Protocol, World Summit on sustainable development, 2002 Carbon trade);
IPCC

6 HOURS

UNIT III: ENVIRONMENTAL MANAGEMENT

Concept and principles of environmental management

Principle of optimized use and sustainable development,

Threats to sustainable development

Ecological footprint,

National Environmental Policy

Management of

- i. Forest and
- ii. degraded lands

6 HOURS

UNIT IV: CONSERVATION BIOLOGY

Concepts and Principles of Environmental Management

Social forestry and Joint forestry Management

Convention on Biological diversity

National Parks

Wildlife Sanctuaries

Biosphere Reserves

6 HOURS

UNIT V: PHYTOGEOGRAPHY

Definition, scope and importance of Phytogeography

Dispersal of plants (Wind, water, Ice, Animals, Mechanical and Human factors)

Barriers to plants dispersal

Floristic regions of India, Endemism

6 HOURS

Suggested Readings

- 1) Chapman, J.L., Reiss, M.J. 1999. *Ecology: Principles and applications (2nd edition)* Cambridge University Press.
- 2) Cunningham W.P. and M.A. Cunningham 2003. *Principles of Environmental Science: Inquiry and Applications*. Tata McGraw Hill Pub. New Delhi
- 3) Divan Rosencraz, *Environmental laws and policies in India*, Oxford Publication.
- 4) Dix J.H. 1989 *Environmental Pollution Atmosphere, Land, Water and Noise*. Wiley Chichester.
- 5) Ghosh, S.K., Singh, R. 2003. *Social forestry and forest management*. Global Vision Publishing House.
- 6) Good, R 1997 *The Geography of flowering Plants (2nd Edition)* Allied Science Publishers, New Delhi
- 7) Joseph, B., *Environmental studies* Tata McGraw Hill.
- 8) Khitoliya R.K. 2007. *Environmental Pollution – Management and Control for Sustainable development* S. Chand and Company Ltd., New Delhi.
- 9) Mathur HS 2003 *Essentials of Biogeography* Pointer Publisher, Jaipur.
- 10) Michael Allabay *Basics of environmental science*, Routledge Press.
- 11) Miller, G.T. 2002. *Sustaining the earth, an integrated approach. (5th Edition)* Books/Cole, Thompson Learning, Inc.
- 12) Mishra DD 2008. *Fundamental Concepts in Environmental Studies*. S. Chand & Co.,
- 13) Mishra SP and S.N. Pandey 2008. *Essential Environmental Studies*. Ane Books Pvt. Ltd. Thiruvananthapuram.
- 14) Rana SVS, *Environmental Pollution – health and toxicology*, Narosa Publication.
- 15) Ronald Good, 1947. *The Geography of Flowering Plants*. Longmans, Green and Co, New York
- 16) Sharma PD, 2009, *Ecology and Environment*, Rastogi Publications, Meerut
- 17) Singh, J.S., Singh, S.P. and Gupta, S. 2006 *Ecology Environment and Resource Conservation* Anamaya Publications, New Delhi
- 18) Sinha, S. 2010. *Handbook on Wildlife Law Enforcement in India*. TRAFFIC, India.
- 19) Thakur IS, *Environmental Biotechnology*, I K Publication.

PRACTICALS

Course No: **BOT-404 ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY**
30 HOURS

- 1) Study of the spatial and temporal variation in climatic factors; Light, temperature and relative humidity.
- 2) Determine the B.O.D of pond or stream water sample
- 3) Field trip to a National Park/Biosphere reserve/Wild life Sanctuary (Student should submit a detailed project report based on the field trip. Evaluation of the project will be based on the detailed report and presentation)
- 4) Project work on a particular ecosystem/Polluted Site/ Level of Pollution in the City or Town/Land use site.

SEMESTER V

Course No: **BOT-501** **BIOCHEMISTRY AND PLANT BREEDING**

UNIT 1: CONCEPT OF BIOCHEMISTRY

Biomolecules (The primordial biomolecules, the origin of biomolecules, the fitness of biomolecules, Hierarchy of Biomolecules)

The laws of thermodynamics

Bioenergetics (Entropy, Free energy change and equilibrium constant Activation energy)

Redox potential

Discovery and structure of ATP

Hydrolysis of ATP and role of ATP in Biological reactions **10 HOURS**

UNIT II: BIOMOLECULES (Carbohydrate)

Carbohydrates- Simple sugars, reducing and non-reducing sugars.

Classification into monosaccharides, oligosaccharides and polysaccharides.

Mutarotation and inversion.

Derivatisation in glycoprotein and Glycolipids

Biosynthesis and degradation of sucrose and starch. **12 HOURS**

UNIT III: BIOMOLECULES (Lipids and Nucleic acids)

Lipids- Classification and structure of lipids

Fatty acids- saturated and unsaturated, triacyl glycerols, phospholipids and sphingolipids

Fatty acids biosynthesis

Oxidation of fatty acids

Storage and mobilization of fatty acids and lipids.

Nucleic acid- Bases, Nucleoside and Nucleotide

Phosphodiester bonds, Hydrogen bonding.

DNA structure: DNA double helix (Watson and Crick model),

Super-coiling, Properties of DNA

Denaturation

Structure of t-RNA **15 HOURS**

UNIT IV: BIOMOLECULES (Proteins)

Proteins- Structure and classification of amino acids based on polarity

Zwitter ion nature; properties of amino acids

Peptide bond formation

Classification and Structure of proteins (Primary, secondary, tertiary and quaternary)

Conformation and Denaturation **11 HOURS**

UNIT V: PLANT BREEDING

Principles of plant breeding

Plant introduction and acclimatization

Hybridization: Technique and Significance

Heterosis

Brief account of

- i. mass selection,
- ii. pure line selection and

- iii. clonal selection.
- iv. Mutation breeding,
- v. Polyploidy breeding.

12 HOURS

Suggested Readings:

1. Berg, J.M., Tymoczko, J.L., Stryer, L. 2006, *Biochemistry 6th Edition*, W.H. Freeman and Company, New York.
2. Buchanan, B., Gruissem, W. and Jones, R. 2000 *Biochemistry and Molecular Biology of Plants* American Society of Plant Biologists.
3. Conn, E.E., Stumpf, P.K. and Bruening, G. 2006 *Outlines of Biochemistry 4th Edition*, John Wiley and Sons Inc.
4. Donald Voet, Judith.G. Voet and Charlotte W. Pratt (2006) *Fundamentals of Biochemistry*, 2nd Edition, John Wiley and Sons Inc.
5. Elliot 2009 *Biochemistry and Molecular Biology* Oxford Publishers.
6. Harper, 2003, *Biochemistry*, McGrawHill.
7. Keith Wilson and John Walker 2005 *Principles and Techniques of Biochemistry and Molecular Biology(6th Edition)*, Cambridge University Press, USA
8. Nelson, D.L., Cox, M.M. 2004 *Lehninger Principles of Biochemistry*, 4th edition, W.H. Freeman and Company, New York, USA.
9. Stryer, L., 2002, *Biochemistry*, W.H. Freeman.
10. Voet & Voet, 2000, *Biochemistry*, John Wiley, New York
11. Wilson K and Walker J., 2008 *Principles and techniques of Biochemistry and Molecular Biology*. Cambridge University Press.
12. Zubay, 1995, *Biochemistry*, Brown Publishers
13. Allard. R.W. 1960 *Principles of Plant breeding*, John Wiley & Sons, Inc, New York.
14. Chaudhari HK. *Elementary Principles of Plant breeding*, Oxford & IBH Publishers.
15. Singh,BD 2005 *Plant Breeding Principles & methods*, Kalyani Publishers, New Delhi.
16. Sinha U. and Sunitha S 2000 *Cytogenetics, Plant breeding & Evolution*, Vikas Publishing House.

PRACTICALS

Course No: **BOT-502**

BIOCHEMISTRY AND PLANT BREEDING

30 HOURS

- 1) Preparation of Molar, Normal and percent solutions
- 2) Preparation of Phosphate buffer.
- 3) Separation of amino acids by paper chromatography
- 4) Identification tests for carbohydrates (Fehling's test, Benedicts test) and proteins (Ninhydrin test, Xanthoproteic test).
- 5) Chemical separation of chloroplast pigments and determination of their absorption spectra.
- 6) Preparation of standard curve for estimation of soluble proteins in plant materials by Bradford method
- 7) To study the effect of various factors (temperature and substrate concentration) on the activity of amylase enzyme
- 8) Separation and identification of amino acids by thin layer chromatography.
- 9) Emasculation, bagging, tagging and pollination in self-pollinated plants.

Course No: **BOT-503 MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

UNIT 1: INTRODUCTION

One Gene one polypeptide concept, The Central Dogma, Semi-conservative replication, DNA double helix (Watson and Crick model), Salient features of double helix, Types of DNA, denaturation and renaturation, Structure of RNA, Mitochondria and chloroplast DNA **5 HOURS**

UNIT II: CHROMOSOME

Genome Sequence and Chromosome Diversity, Chromatin structure; Euchromatin, Heterochromatin (Constitutive and Facultative heterochromatin) Regulation of Chromatin Structure and Nucleosome Assembly. Organization of Chromosomes, Genetic Code, **4 HOURS**

UNIT III: DNA REPLICATION, TRANSCRIPTION AND TRANSLATION

The Replication of DNA (Prokaryotes and Eukaryotes), Mechanism of Transcription in Prokaryotes and Eukaryotes, RNA processing (concept of introns and exons, removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, RNA editing, and mRNA transport) Various steps in protein synthesis. (aminoacylation of tRNA, translation, Fidelity of translation. Inhibitors of protein synthesis) Operon Concept (Regulation of gene expression in prokaryotes) **9 HOURS**

UNIT IV: BIOTECHNOLOGY

Plant biotechnology; cellular differentiation and totipotency, callus, organogenesis and embryogenesis, artificial seeds. Haploids and its importance. Protoplast isolation and culture, somatic hybridization, clonal propagation, genetic engineering of plant. Vectors for gene delivery, selectable markers and reporter genes, method of gene delivery, *Agrobacterium*-the natural genetic engineering, salient achievements in crop biotechnology(with suitable examples) and prospect. **7 HOURS**

UNIT V: MOLECULAR TECHNIQUES

Recombinant DNA technology; restriction endonucleases, Genomic and cDNA libraries Southern and northern blotting, DNA fingerprinting (RFLP, RAPD, AFLP), Polymerase chain reaction, DNA sequencing. **5 HOURS**

Suggested Readings

- 1) Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. *The World of the Cell. 7th Edition*. Pearson Benjamin Cummings Publishing, San Francisco.
- 2) Brown, T. A. *Gene cloning and DNA analysis: An Introduction*. Blackwell Publication.
- 3) Buchanan, B., Gruissem, W. and Jones, R. 2000 *Biochemistry and Molecular Biology of Plants*. American Society of Plant Biologists.
- 4) Chrispeel, M.J. and Sadava, D.E. 1994 *Plants, Genes and Agriculture*. Jones and Barlett Publishers.
- 5) Cooper, G.M. and Hausman, R.E. 2009 *The Cell: A Molecular Approach. 5th edition*. ASM Press & Sunderland, WashinPTon, D.C.; Sinauer Associates, MA.

- 6) De Robertis, E.D.P. and De Robertis, E.M.F. 2006. *Cell and Molecular Biology 8th edition*, Lippincott Williams and Wilkins, Philadelphia.
- 7) Elliot 2009 *Biochemistry and Molecular Biology*. Oxford Publishers.
- 8) Glick, B.R., Pasternak, J.J. 2003. *Molecular Biotechnology: Principles and Applications of recombinant DNA*. ASM Press, WashinPTon.
- 9) Karp, G. 2010. *Cell and Molecular Biology: Concepts and Experiments. 6th edition*. John Wiley & Sons. Inc.
- 10) Lewin 2008, *Genes IX* Jones & Bartlett
- 11) Lodish *et al* 2008 *Molecular Cell Biology* Freeman & Company
- 12) Rastogi. VB 2008. *Fundamentals of Molecular Biology*, Ane Books India.
- 13) Reinert, J. and Bajaj, Y.P.S. 1997 *Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture*. Narosa Publishing House.
- 14) Russell, P.J. 2009 *Genetics – A Molecular Approach*. 3rd Edition. Benjamin Co.
- 15) Sambrook and Russel. *Molecular Cloning: A laboratory manual*. (3rd edition)
- 16) Slater, A., Scott, N.W. & Fowler, M.R. 2008 *Plant Biotechnology: The Genetic Manipulation of Plants*, Oxford University Press.
- 17) Smith, R. 2000 *Plant Tissue Culture: Techniques and Experiments, 2nd edition*, Academic Press
- 18) Upadhyaya A. and K Upadhayayo 2005, *Basic Molecular Biology* Himalaya Publishers.
- 19) Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 *Molecular Biology of the Gene 6th Edition*. Cold Spring Harbour Lab. Press, Pearson Pub.
- 20) Wilson K and J Walker 2005, *Principles and Techniques of Biochemistry and Molecular Biology 6th edition*, Cambridge University Press, USA

PRACTICALS

Course No: **BOT-504 MOLECULAR BIOLOGY AND BIOTECHNOLOGY**

30 HOURS

1. Micropropagation of orchid seeds using MS media.
2. Preparation of artificial seeds
3. Estimation of soluble protein from a selected plant and separation by SDS-PAGE
4. Estimation of RNA by orcinol method
5. Isolation of plasmid DNA and genomic DNA together from E.coli.
6. Estimation of size of a DNA fragment after electrophoresis using DNA markers.

SEMESTER VI

Course No: **BOT-601** **CELL BIOLOGY AND GENETICS**

UNIT 1: INTRODUCTION IN CELLBIOLOGY

Introduction to cell theory

Comparison of a generalized prokaryotic and eukaryotic cell

Elementary idea on Microscopy

Elementary idea on micrometry and Cell fractionation

8 HOURS

UNIT II: ORGANIZATION OF A CELL

Extranuclear

- i. Elementary knowledge of structure and function of plasma membrane
- ii. Introduction to endomembrane system; endoplasmic reticulum, Golgi complex, lysosome, peroxisome
- iii. Introduction to cytoskeleton
- iv. Structure and functions of mitochondria
- v. Structure and function of plastids

Nuclear

- i. Nuclear envelope, nucleolus and Ribosome
- ii. Interphase chromatin and metaphase chromosome
- iii. Introduction to polytene and lampbrush chromosomes

16 HOURS

UNIT III: CELL CYCLE

Basic features of the cell cycle

Process and phases of Mitosis, mitotic spindle and chromosome movement

Process and phases of meiosis and its significance

Programmed Cell Death, Stem Cells

11 HOURS

UNIT IV: INTRODUCTION TO GENETICS

Mendel's laws of inheritance-Law of dominance, law of segregation, law of independent assortment, deviations from Mendel's laws (Neo-Mendelism)

Interaction of genes- Intragenic and intergenic interactions, incomplete dominance, lethal genes, complementary genes, supplementary genes, inhibitory genes, duplicate genes, epistatic genes

Linkage and crossing over- Interrelationships and importance, crossing over and meiosis, cytological basis of crossing over (Holiday's Model), crossing over and linkage maps, linkage groups, interference

Sex determination: Chromosome theory of sex determination, sex determination in plants

13 HOURS

UNIT V: CHROMOSOMAL ABBERATIONS

Mutations- Point mutation-Transition, Transversion and Frame shift mutation.

Molecular mechanism (tautomerisation, alkylation, deamination, base analogue incorporation, dimerisation),

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation,;

Gene mutations

Physical and chemical mutagens,

DNA repair mechanisms.

Chromosome theory of heredity, Chromosomal aberrations
Aneuploidy and Polyploidy
Extrachromosomal Inheritance: (Chloroplastic and Mitochondrial) Maternal Effect
12 HOURS

Suggested Readings:

- 1) Alberts *et al* 1998 *Essential Cell Biology* Garland Publishers
- 2) Alberts *et al* 2008 *Molecular Biology of the Cell* Garland Publishers
- 3) Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. *The World of the Cell. 7th edition.* Pearson Benjamin Cummings Publishing, San Francisco.
- 4) Brooker 1999 *Genetics : Analysis and Principles* Addison-Wesley
- 5) Cooper, G.M. and Hausman, R.E. 2009. *The Cell: A Molecular Approach. 5th edition.* ASM Press & Sunderland, WashinPTon, D.C.; Sinauer Associates, MA.
- 6) De Robertis, E.D.P. and De Robertis, E.M.F. 2006. *Cell and Molecular Biology. 8th edition.* Lippincott Williams and Wilkins, Philadelphia.
- 7) Gardner, E.J., Simmons, M.J., Snustad, D.P. 2008. *Principles of Genetics.8th Edition* Wiley India.
- 8) Griffiths, AJF., Wessler, SR., Lewontin, RC. and Carroll, SB.. *Introduction to Genetic Analysis. IX Edition* W.H. Freeman and Co.
- 9) Hartl & Jones 2002 *Essential Genetics: A Genomic Perspective* Jones & Bartlett
- 10) Karp, G. 2010. *Cell and Molecular Biology: Concepts and Experiments. 6th Edition.* John Wiley & Sons. Inc.
- 11) Klug, WS., Cummings, MR, Spencer, CA. 2009. *Concepts of Genetics. XI Edition.* Benjamin Cummings.
- 12) Lewin 2008, *Genes IX* Jones & Bartlett
- 13) Lodish *et al* 2008 *Molecular Cell Biology* Freeman
- 14) Russell, PJ.2009. *Genetics: A Molecular Approach. III Edition.* Benjamin Cummings.
- 15) Snustad, D.P., Simmons, M.J. 2009. *Principles of Genetics. V Edition.* John Wiley and Sons Inc.

PRACTICALS

Course No: **BOT-602** **CELL BIOLOGY AND GENETICS** **30 HOURS**

- 1) Study of meiosis through temporary smear of flower buds.
- 2) Study of mitosis and meiosis through permanent slides
- 3) Genetic problems on dihybrid inheritance
- 4) Allelic and Non allelic gene interactions.
- 5) Mendelian laws and gene interaction using *Drosophila* crosses.
- 6) Study of Hardy-Weinberg Law using simulations (seeds).
- 7) Chi square analysis and probability factor of Genetics

Course No: **BOT-603 CHOICE BASED CREDIT PAPER (PAPERS OFFERED)**

- a) TAXONOMY
- b) METHODOLOGY AND PERSPECTIVES OF SCIENCE
- c) PLANT BIOTECHNOLOGY
- d) FORESTRY
- e) MUSHROOM CULTIVATION
- f) HORTICULTURE

Course No: **BOT-603 (a)** **TAXONOMY**

UNIT 1: INTRODUCTION

Scope and importance of Taxonomy. Brief account on pre-Darwinian and post - Darwinian theories of classification - Essentialism, Nominalism, Empiricism, Evolutionary and Phylogenetic Systematic.

Field inventory, Herbarium preparation and management; important herbaria and botanical gardens of the world and India

Concept of taxa; categories and hierarchy; species concept (taxonomic, biological, evolutionary).

Definition and use of terms - Primitive and Advanced; Homology and Analogy; Parallelism and Convergence; Monophyly and Polyphyly

8 HOURS

UNIT II: BOTANICAL NOMENCLATURE

History of nomenclature - Polynomial and binomial systems, Brief outline of ICBN, Classification by Bentham and Hooker, Engler and Prantl & Takhtajan; brief reference of Angiosperm Phylogeny Group (APG) Classification.

Principles and rules of nomenclature; ranks and names; type method, author citation, valid publication; rejection of names, principle of priority and its limitation; names of hybrids and cultivars.

9 HOURS

UNIT III: SOURCES OF TAXONOMIC EVIDENCES

Cytology, Biochemistry and Embryology as sources of taxonomic characters. Other sources of taxonomically useful information - Ecology, Plant geography, co- evolution of parasites and pathogens. Comparative study of traditional and biosystematic approaches in plant taxonomy - Traditional and Biosystematic categories

8 HOURS

UNIT IV: PHYLOGENY OF ANGIOSPERMS

Terms and concepts (homology, analogy, parallelism, convergence, monophyly, polyphyly, clades); origin & evolution of angiosperms; co-evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram)

7 HOURS

UNIT V: TAXONOMIC REVIEW OF SELECTED FAMILIES

Critical study of the following families with emphasis on identification of local members using flora, economic importance, inter relationships and evolutionary trends

Ranunculaceae, Capparidaceae, Sterculiaceae, Rutaceae, Meliaceae, Combretaceae, Myrtaceae, Lythraceae, Apocynaceae, Scrophulariaceae, Convolvulaceae, Bignoniaceae, Acanthaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Urticaceae, Amaryllidaceae, Arecaceae, Araceae, Poaceae

13 HOURS

SUGGESTED READINGS

1. Angiosperm Phylogeny Group (2003). *An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG II*. Botanical Journal of the Linnean Society 141: 399-436.
2. Crawford, D.J. (2003). *Plant Molecular Systematics*. Cambridge University Press, Cambridge, UK.
3. Cronquist, A. (1981). *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York.
4. Hollingsworth, P.M., Bateman, R.M. and Gornall, R.J. (1999). *Molecular Systematics of Plant Evolution* Taylor and Francis, London.
5. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. and Donoghue, M.J. (2008). *Plant Systematics- A Phylogenetic Approach*. Sinauer Associates Inc, Massachusetts, USA.
6. Simpson, M.C. (2006). *Plant Systematics*. Elsevier, Amsterdam.
7. Stussy, T.F. 1990. *Plant Taxonomy*, Columbia University Press, USA.
8. Forman, L. & D. Bridson. 1989. *The herbarium Hand Book*. Royal Botanic Gardens, Kew
9. Sivarajan, V.V. 1991. *Introduction to Principles of Plant Taxonomy*. Oxford & IBH, New Delhi.
10. Sporne, K.R. 1974. *Morphology of Angiosperms*. Hutchinson University Press London.
11. Radford, A.E. 1986. *Fundamentals of plant systematics*. Harper & Row Publishers, New York.
12. Naik, V.N. *Taxonomy of Angiosperms*. TATA McGraw Hill, New Delhi
13. Burkill, I.H. 1965. *Chapters on the History of Botany in India*, Delhi.
14. Gurucharan Singh, 2001. *Plant systematics Theory and Practice*. Oxford & IBH, New Delhi.
15. Davis, P.H. & V.H. Heywood, 1963. *Principles of Angiosperm Taxonomy*. Oliver & Boyd Ltd., London.
16. Henry, A.N. & Chandrabose *An aid to International Code of Botanic Nomenclature*.
17. Jeffrey, C. 1968. *An introduction to Plant Taxonomy*, London.
18. Simpson, M.G. 2006. *Plant Systematics*. Elsevier Academic Press, London
19. Stressy, T.F. 1990. *Plant Taxonomy – The systematic evaluation of Comparative data*. Columbia University Press, New York.
20. Sharma, B.D. et al. (Eds.) *Flora of India vol. I*. Botanical Survey of India, Calcutta.
21. Pandey, S.N. & S.P. Misra. 2008. *Taxonomy of Angiosperms*. Ane Books India, NewDelhi.
22. Sharma, O.P. 1996. *Plant Taxonomy*. TATA McGraw Hill, New Delhi

Course No: **BOT- 603(b) METHODOLOGY AND PERSPECTIVES OF SCIENCE**

Unit - I: Science and scientific studies

What is science? What is not science?

Science as a human activity, Scientific temper, Empiricism, Vocabulary of science, Science disciplines; Revolutions in science, Science and technology. Types of knowledge:- Practical, Theoretical and Scientific knowledge, Information. **(9 hrs.)**

Unit - II: Experimentation in science

Design of an experiment; Experimentation:- Selection of controls, Observational requirements, Instrumental requirements.

Types of experiments:- Experiment to test a hypothesis, to measure a variable or to gather data by preliminary and explorative experiments. Observations:- Direct and indirect observations, Controlled and uncontrolled observations, Human and machine observations. Data collection and representations:- Graphs, Tables, Histograms and Pie diagrams (both manual and using computer).

Interpretation and deduction of data, Significance of statistical tools in data interpretation, Errors and inaccuracies.

Necessity of units and dimensions; Repeatability and replication of experiments.

Documentation of experiments, Record keeping. **(9 hrs)**

Unit - III: Methods in Biological Science

Solutions:- Types of solutions. Representation of concentrations: Molarity, Normality, Percentage and ppm.

Acids and bases:- Buffers and pH, Measurement of pH. Preparation and applications of buffers in biological studies.

Photometry:- Colorimetry and Spectrophotometry, Principle, Working and uses.

Autoradiography:- Principle, mechanism, and significance Centrifugation:- Principle, types of centrifuges and their applications

Chromatography: - Principle, types:- Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Molecular sieving. **(9 hrs)**

Unit -IV: Statistical methods

Measures of central tendency:- Mean, Median and Mode

Measures of dispersion:- Range, Mean Deviation, Variance, Standard Deviation, Coefficient of variation.

Correlation and regression (brief account).

Probability:-Laws of probability. Addition theorem and Multiplication theorem. Probability

Distribution:- Binomial Distribution, Normal Distribution and Poisson distribution Test of hypothesis:- Null hypothesis, Alternate hypothesis Chi-square test and t-test **(9 hrs)**

Unit- V: Application of Information and Communication Technology in lifescience

Internet as a knowledge repository, data and metadata.

Searching the internet: Browsers, search engines, Meta search engines, Boolean searching.

IT in teaching, learning and research: Web page designing and web hoisting. Academic web sites, e-journals, Open access initiatives and open access publishing, education software, academic services - INFLIBNET, NICNET, BRNET. Networking- LAN and WAN; Intranet and Internet. Internet protocols-IP address, and Domain Name System, URL.

Health issues: etiquettes/ guidelines for proper usage of computers and internet. **(9 hrs)**

Course No: **BOT-603(c)** **PLANT BIOTECHNOLOGY**

UNIT 1: INTRODUCTION TO PLANT TISSUE CULTURE

Introduction to Biotechnology - History, Definition, scope, significance
Plant Tissue Culture - History, Principle - Totipotency, differentiation, dedifferentiation, redifferentiation. Facilities of Tissue culture laboratory,
Media - MS medium composition, Preparation, Sterilization techniques, Explant selection, sterilization and Inoculation.
Types of culture - Meristem culture, Organ culture; Callus culture; Cell suspension culture; Protoplast culture
Isolation of protoplasts, somatic hybridization and its significance; Somatic embryogenesis and synthetic seeds.
Haploid production - Anther and pollen culture, its significance; Embryo culture and Embryo rescue
Micropropagation - Multiple shoot culture and large scale propagation of crop plants, Somaclonal variation - Disease free plants; Production of secondary metabolites in Bioreactors Application of tissue culture in Biodiversity and conservation

9 HOURS

UNIT II: RECOMBINANT DNA TECHNOLOGY

Tools: Enzymes- Exonucleases; Endonucleases; Restriction endonucleases Type I,II&III; Ligases; Reverse Transcriptase, Terminal transferase, Polymerase, Alkaline phosphatase
Vectors- General account of plasmids, cosmids, bacteriophages, Phasmids - Advantages and disadvantages; Structure of pBR 322; Artificial chromosome vectors - BAC, YAC, Shuttle vectors
Artificial gene synthesis; cDNA library - cDNA synthesis, genomic DNA library- identification and isolation of the gene from cDNA, Genomic DNA or Libraries using probes, PCR, RACE. DNA Ligation - Linkers, adaptors, Homopolymer tailing **9 HOURS**

UNIT III: GENE MANIPULATION

Transformation, selection of transformed bacteria - antibiotic selection, reporter genes - GUS, GFP, colony hybridization and immunological tests Heterologous protein expression, purification and characterization
Direct methods of gene transfer - Biolistics, Lipofection, Electroporation, microinjection - Advantages and disadvantages
Vector mediated gene transfer-Agrobacterium mediated gene transfer - T DNA, Ti plasmid and Ri plasmid derived vector systems
Process of transfer - Bacterial colonization, Induction of virulence, generation of TDNA transfer complex, T-DNA transfer, Integration of TDNA into plant genome

9 HOURS

UNIT IV: BIOTECHNOLOGICAL TECHNIQUES

Polymerase chain reaction - Principle, types of primers, Taq polymerase, protocol, Application and problems, Reverse Transcriptase PCR and Real Time PCR
DNA sequencing - Maxam Gilbert's method, Sanger's method, Automated DNA sequencing

Molecular Analysis of gene and gene products - Southern, Northern and Western blotting, ELISA, RIA

Molecular markers - RAPD, RFLP, AFLP, Brief account of DNA Finger printing and Bar coding of plants

Brief account of: Antisense RNA technology - FLAVR SAVR Tomato; Gene Silencing; RNA interference; miRNA. **9 HOURS**

UNIT V: APPLICATIONS OF BIOTECHNOLOGY

Medical Biotechnology: Disease diagnosis - Infectious diseases and genetic diseases; Therapeutics-Antisense oligonucleotides, RNAi as therapeutics; Endogenous therapeutics - Insulin, somatostatin, Interferons, Antibiotics, Vaccines, Biopolymers, Designer drugs, Gene therapy, Stem cells and their relevance

Agricultural Biotechnology: Applications of plant tissue culture, Application of transgenic plants Bt cotton, Golden rice; Biosafety concern

Environmental Biotechnology: Biodiversity and conservation; Waste management and Bioremediation

Industrial Biotechnology: Large scale production of beverages, pharmaceuticals, hormones.

Food biotechnology: SCP, Improved food and food products **9 HOURS**

Suggested Readings

1. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. *The World of the Cell. 7th Edition*. Pearson Benjamin Cummings Publishing, San Francisco.
2. Brown, T. A. *Gene cloning and DNA analysis: An Introduction*. Blackwell Publication.
3. Buchanan, B., Gruissem, W. and Jones, R. 2000 *Biochemistry and Molecular Biology of Plants*. American Society of Plant Biologists.
4. Chrispeel, M.J. and Sadava, D.E. 1994 *Plants, Genes and Agriculture*. Jones and Bartlett Publishers.
5. Cooper, G.M. and Hausman, R.E. 2009 *The Cell: A Molecular Approach. 5th edition*. ASM Press & Sunderland, WashinPTon, D.C.; Sinauer Associates, MA.
6. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. *Cell and Molecular Biology 8th edition*, Lippincott Williams and Wilkins, Philadelphia.
7. Elliot 2009 *Biochemistry and Molecular Biology*. Oxford Publishers.
8. Glick, B.R., Pasternak, J.J. 2003. *Molecular Biotechnology: Principles and Applications of recombinant DNA*. ASM Press, WashinPTon.
9. Karp, G. 2010. *Cell and Molecular Biology: Concepts and Experiments. 6th edition*. John Wiley & Sons. Inc.
10. Lewin 2008, *Genes IX* Jones & Bartlett
11. Lodish *et al* 2008 *Molecular Cell Biology* Freeman & Company
12. Rastogi, V.B. 2008. *Fundamentals of Molecular Biology*, Ane Books India.
13. Reinert, J. and Bajaj, Y.P.S. 1997 *Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture*. Narosa Publishing House.
14. Russell, P.J. 2009 *Genetics – A Molecular Approach. 3rd Edition*. Benjamin Co.
15. Sambrook and Russel. *Molecular Cloning: A laboratory manual. (3rd edition)*

16. Slater, A., Scott, N.W. & Fowler, M.R. 2008 ***Plant Biotechnology: The Genetic Manipulation of Plants***, Oxford University Press.
17. Smith, R. 2000 ***Plant Tissue Culture: Techniques and Experiments, 2nd edition***, Academic Press
18. Upadhyaya A. and K Upadhyayo 2005, ***Basic Molecular Biology*** Himalaya Publishers.
19. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 ***Molecular Biology of the Gene 6th Edition***. Cold Spring Harbour Lab. Press, Pearson Pub.
20. Wilson K and J Walker 2005, ***Principles and Techniques of Biochemistry and Molecular Biology 6th edition***, Cambridge University Press, USA

Course No: **BOT-603(d)**

FORESTRY

UNIT 1: GENERAL INTRODUCTION

Types of forest; Natural and Manmade; Tropical, temperate, evergreen semi-evergreen, deciduous; Monoculture, multipurpose, social and industrial. Forest and gene conservation.

7 HOURS

UNIT II: SILVICULTURE

Concept and scope of study of natural and artificial regeneration of forests. Clear felling, uniform shelter, wood selection, coppice and conservation systems. Silviculture of some of the economically important species in India such as *Azadirachta indica*, *Tectona grandis*, *Mahagoni*, *Dalbergia sisso* and *Havea brasilensis*.

8 HOURS

Wood: Homogenous and heterogenous- spring and autumn wood- Porous and non porous wood- Heart and sap wood. Identification of wood- preparation of key and their uses

3 HOURS

UNIT III: SOCIAL AND AGRO FORESTRY

Selection of species and role of multipurpose trees. Food, fodder and energy. Social forest- Avenue plantation. Sacred plants- definition, importance of sacred trees like *Ficus religiosa*, *Embllica officinalis*, *Aegle marmelous*.

9 HOURS

UNIT IV: SEEDS

Seed orchards, seed dormancy- Types of dormancy, physical and chemical methods to overcome seed dormancy. Forest laws- necessity, General principles, Indian forest act 1927 and their amendment.

9 HOURS

UNIT V: FOREST RESOURCES AND UTILIZATION

Forest products- timber, pulp wood, secondary timbers, non timber forest products (NTFPs). Definition and scope (brief outline) - Gums, resins, fibers, oil seeds, nuts, rubber, canes and bamboos, medicinal plants, charcoal.

9 HOURS

Suggested Readings

1. Anil Kumar Dhiman. 2003. *Sacred plants and their medicinal uses*. Daya publishing house, New Delhi.
2. B.S. Chundawat and S.K.Gautham. 1996. *Text book of Agroforestry*. Oxford and IBH Publishing house, New Delhi.
3. Kollmann and Cote 1988. *Wood science and Technology*. Vol.I & II Springer verlag.
4. Sagreiya, K.P. 1994. *Forests and Forestry (Revised by S.S. Negi)*. National book trust. New Delhi.
5. Sharma P.D. 2004. *Ecology and Environment*. Rastogi publications, Meerut
6. Singh M.P. and Vinita Vishwakarma. 1997. *Forest environment nd Biodiversity*. Daya publishing house, New Delhi.
7. Tiwari K.M. 1983. *Social forestry in India*.
8. Tribhawan Mehta, 1981. *A handbook of forest utilization*. Periodical Expert Book Agency, New Delhi.

Course No: **Bot-604 (e)**

MUSHROOM CULTIVATION

UNIT 1: INTRODUCTION

History and introduction. Importance, Nutritional value, medicinal value .Edible mushrooms and Poisonous mushrooms. **7 HOURS**

UNIT II: CLASSIFICATION

Systematic position, morphology, distribution, structure and life cycle of Agaricus and Pleurotus
Types of Mushroom **7 HOURS**

UNIT III: CULTIVATION

Equipments for Mushroom spawn, Laboratory, culture room, spawn production Mushroom farm layout and mushroom shed.

Paddy straw mushroom – substrate, spawn making. Methods – bed method, polythene bag method, field cultivation.

Oyster mushroom cultivation –Substrate, spawning, pre-treatment of substrate. Maintenance of mushroom.

Cultivation of white button mushroom – Spawn, composting, spawning, harvesting. **12 HOURS**

UNIT IV: DISEASE MANAGEMENT

Diseases- Common pests, disease prevention and control measures.

Processing - Blanching, steeping, sun drying, canning, pickling, freeze drying.

Storage – short term and long term storage. **10 HOURS**

UNIT V: MARKETING

Common Indian mushrooms. Production level, economic return, Foreign exchange from Mushroom cultivating countries and international trade. **9 HOURS**

Suggested Reading

1. Pandey B P 1996. *A textbook of fungi*. Chand and company N Delhi.
2. Kaul T N 2001. *Biology and conservation of mushrooms*. Oxford and IBH publishing company N.Delhi
3. Gupta P.K. *Elements of Biotechnology*.
4. Harander Singh. 1991. *Mushrooms- The Art of Cultivation*- Sterling Publishers.
5. Indian Journal of Mushrooms. Published by I.M.G.A. *Mushroom Research Laboratory*. College Agriculture, Solan
6. Peter Oei 2000 *Mushroom Cultivation III Edition*, Backhuyes Publisher USA
7. Tripathi DP., 2005 *Mushroom Cultivation* Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi
8. Krishnamoorthy AS., Marimuthu T and Nakkern S 2005 *Mushroom Biotechnology* TNAU Press, Coimbatore, India
9. Nita Bahl 1988 *Handbook of Mushroom* Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi

Course No: **Bot-604 (f)**

HORTICULTURE

UNIT 1: INTRODUCTION

Origin of Horticulture, definitions, scope and impact of horticulture.

Classification of horticultural crops – pomology, olericulture, spices and planting, ornamental horticulture

Methods of propagation-Seeds and Vegetative (cutting, layering and grafting). Propagation by specialized stem and roots- bulbs, corms, tubers, rhizomes and pseudo bulbs).

Micro and Macro nutrient,

common media for propagation- soil, sand, peat, sphagnum moss, vermiculite. Soil mixture and nursery beds, Manures: Organic and inorganic; Irrigation methods.

9 HOURS

UNIT II: GARDENING AND PEST MANAGEMENT

Types of gardens-Indoor garden, Kitchen garden and public garden

Arboriculture and role of trees in landscaping. Green house.

Importance and Scope of medicinal plants; Current status; Herbal trade; Role of MNCs in herbal product; Organic production and certification;

Identification of major insect pests and diseases of vegetables, fruit crops and other horticultural crops.

Identification of different classes of pesticides including bio-pesticides. Identification of bio-control agents. Preparation and application spray solution and dusts.

10 HOURS

UNIT III: OLERICULTURE AND POMOLOGY

Olericulture- Definition- Importance of vegetables- Production technology- Cultivation, harvesting and storage of vegetables- Bhindi, Brijal, Bitter gourd, Snakegourd, Cucumber, Pumpkin, Colocasia, Tapioca and Tomato.

Pomology- Definition and Importance-Cultivation, harvesting and storage of fruits- Banana, Pineapple and mango. Sapota, apple, orange & jackfruit.

Growth regulators in horticulture. Plant protection measures for horticultural crops.

9 HOURS

UNIT IV: FLORICULTURE

Floriculture- Definition and Importance- Soil and Climate; Varieties; Propagation; Nursery practices; Planting methods

Cultivation, harvesting and storage of flowers- Rose, Lilium, and Anthurium. Identification and control of diseases associated with the plants studied

Cut flowers- Flower arrangement and Bonsai.

9 HOURS

UNIT V: HARVESTING AND POST HARVEST HANDLING

Crop loading, Maturity indices, Harvesting method for Climacteric and non- Climacteric fruits, Grading and sorting, Preservation of fruits and vegetables; Quarantine and regulatory measures.

8 HOURS

Suggested Readings

1. Adams, C.R. and M. P. Early. 2004. *Principles of horticulture*. Butterworth – Heinemann, Oxford University Press.
2. Allan M. Armitage and Judy M. Laushman “*Speciality Cut Flowers*”, *Second Edition*, Published by Timber press 2003, ISBN - 0881925799
3. Bhattacharjee, S.K and De L.C (2003) *Advanced Commercial Floriculture Vol. (1)* Aavishkar publishers, Distributors, Jaipur.
4. Bhattacharjee, S.K and De L.C (2005) *Medicinal Herbs & Flowers*, Aarishkar, Jaipur.
5. Bhattacharjee, S.K., 2004. *Hand book of medicinal plants*, Pointer publications, Jaipur.
6. Bose, T.K., Yadav, L.P., Pal. P., Parthasarathy, V.A., Das. P., 2003. *Commercial flowers. Vol. I and II*. Naya udyog, Kolkata-6.
7. Chadha, K.L. 2001, *Handbook of Horticulture*, ICAR, New Delhi.
8. Chandra, R. and M. Mishra. 2003. *Micropropagation of horticultural crops*. International Book Distributing Co., Lucknow.
9. Chattopadhyaya, P.K.2001. *A text book on Pomology (Fundamentals of fruit growing)* Kalyani Publication, New Delhi
10. Christopher, E.P. 2001. *Introductory Horticulture*, Biotech Books, New Delhi
11. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. *Fundamentals of Horticulture*, Tata MC. Graw Hill Publishing Co. New Delhi
12. George Acquaah, 2002, *Horticulture-principles and practices*. Prentice-Hall of India pvt. Ltd., New Delhi.
13. Hartman, H.T. and Kester, D.E. 1986. *Plant propagation – Principles and Practices –* Prentice Hall of India Ltd., New Delhi.
14. Jain S K.1996. *Ethnobotany in human welfare*. Deep publishers. New Delhi
15. Jitendra Singh. 2006. *Basic Horticulture*. Kalyani Publishers, New Delhi.
16. Jyothiprakash E J 2006. *Medicinal botany and pharmacognosy*. Emkay Publishers New Delhi
17. Kumar, N.1997. *Introduction to Horticulture*, Rajalakshmi Publication, Nagercoil.
18. Rajan, S. and B.L. Markose. 2007. *Propagation of horticultural crops*. New India Publishing, New Delhi.
19. Ravindrasharma (2004) *Agro techniques of Medicinal plants*. Daya publishing, New Delhi.
20. Shanmugavelu, K.G., N. Kumar and K.V. Peter. 2005. *Production technology of spices and plantation crops*. Agrobios, Jodhpur.
21. Singh, N.P. 2005. *Basic concepts of fruit science*. International Book Distributing Co., Lucknow.
22. Surendra Prasad and U. Kumar. 1999. *Principles of horticulture*, Agro-botanica, Bikaner, India.
23. Trivedi PC. (2004) *Medicinal Plants: Utilization and Conservation*, Aavishkar Publisher, Distributors, Jaipur.

Course No: BOT-604 PROJECT WORK

**The following project works may be taken up which are corresponding to the CBCP
A brief outline for the project works is given below;**

BOT – 604 (a) TAXONOMY

Students are expected to do field study @ 1hr/week and the observations must be recorded in the field note. Each student shall submit a minimum of 15 properly identified herbarium specimens in the standard format (cultivars and ornamentals should be avoided)

They are also expected to visit at least one research station and should submit a duly certified study tour report along with herbarium sheets and field notes for external evaluation.

BOT- 604 (b) METHODOLOGY AND PERSPECTIVES OF SCIENCE

1. Preparation of solutions of known concentrations using pure samples and stock solutions
2. Preparation of buffers (phosphate/ acetate buffer)
3. Measurement of pH using pH meter.
4. Paper chromatographic separation of aminoacids
5. Demonstration of the working of different kinds of centrifuges
6. Preparation of standard graph and determination of the concentration using colorimetry.
7. Work out the problems related to mean, median, mode, standard deviation, probability, Chi-square test, t-test and correlation.
8. Technique of data representation (tables, bar-diagram, histogram, pie-diagram and frequency curve (manual and using computer).

BOT- 604 (c)

PLANT BIOTECHNOLOGY

1. Preparation of plant tissue culture medium
 2. Demonstration of the technique of organ culture
 3. DNA isolation
 4. Restriction mapping - problem
 5. Sequence reading - Sanger method/Maxam Gilbert method - problem
 6. Demonstration of preparation of synthetic seeds
 7. Visit to a leading biotechnology institute - submission of report
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BOT - 604 (d)

FORESTRY

Visit to a plywood factory to have knowledge of wood based industry. Prepare project report on the visit.

Determination of seed viability and rate of germination of economically important trees by maintaining a nursery. Submit a project report on the experiments conducted.

BOT- 604 (e)

MUSHROOM CULTIVATION

1. Study of Mushroom Morphology and identification of edible and poisonous mushrooms.
2. Practical method of mushroom cultivation.

BOT-604 (f)

HORTICULTURE

Cultivation of an important horticultural crop or a flower or a medicinal plant and prepare a project report on the same.
