

M.Sc. Botany

Semester I

MARKS: 400

Course No.	Title of Course	Marks
I	BIOLOGY AND DIVERSITY OF ALGAE AND FUNGI	60
II	BIOLOGY AND DIVERSITY OF MICROBES AND PLANT PATHOGENS	60
III	BIOLOGY AND DIVERSITY OF BRYOPHYTES AND PTERIDOPHYTES	60
IV	PLANT RESOURCE UTILIZATION AND BREEDING	60
	PRACTICAL I-IV (20 MARKS Each)	80
	INTERNAL ASSESSMENT (15 Marks Each)	60
	ATTENDANCE (5 Marks Each)	20
	TOTAL	400

Semester II

MARKS: 400

Course No.	Title of Course	Marks
V	CELL AND MOLECULAR BIOLOGY (COMMON COURSE)	60
VI	BIostatISTICS & COMPUTER APPLICATIONS (COMMON COURSE)	60
VII	BIOLOGY AND DIVERSITY OF GYMNOSPERMS	60
VIII	BIOLOGY AND DIVERSITY OF ANGIOSPERMS I	60
	PRACTICAL V-VII (20 MARKS EACH)	80
	INTERNAL ASSESSMENT (15 MARKS EACH)	60
	ATTENDANCE (5 MARKS EACH)	20
	TOTAL	400

Semester III

MARKS: 400

Course No.	Title of Course	Marks
IX	CYTOGENETICS AND EVOLUTION (COMMON COURSE)	60
X	IMMUNOLOGY AND BIOTECHNOLOGY (COMMON COURSE)	60
XI	BIOLOGY AND DIVERSITY OF ANGIOSPERMS II	60
XII	PLANT PHYSIOLOGY	60
	PRACTICAL IV-XII (20 MARKS EACH)	80
	INTERNAL ASSESSMENT (15 MARKS EACH)	60
	ATTENDANCE (5 MARKS EACH)	20
	TOTAL	400

Semester IV

MARKS: 300

Course No.	Title of Course	Marks
XIII	BIOCHEMISTRY (COMMON COURSE)	60
XIV	ECOLOGY (COMMON COURSE)	60
XV	SPECIAL PAPER	60
	PRACTICAL XIII-XV (20 MARKS EACH)	60
	INTERNAL ASSESSMENT (15 MARKS EACH)	45
	ATTENDANCE (5 MARKS EACH)	15
	TOTAL	300

Grand Total: 1500

Special Paper: 1. Advanced Topics in Mycology 2. Advanced Topics in applied Microbiology 3. Advanced Topics in Plant Pathology 4. Wood Sciences, Forest Biodiversity and Plant Resources 5. Biodiversity, Bioprospecting, Ethnobotany and Sustainable Utilization of Plant Resources 6. Plant Reproduction, Tissue Culture and Horticultural Sciences 7. Advanced Plant Physiology and Biochemistry.

Semester I

Course I: -

BIOLOGY AND DIVERSITY OF ALGAE AND FUNGI

Algae:

1. Algae in diversified habitats (terrestrial, fresh water, marine)
2. Thallus organization in algae
3. Cell ultra-structure
4. Reproduction (Vegetative, asexual, sexual) and patterns of life cycle.
5. Criteria for classification of algae (pigments, reserved food, flagella).
6. Fine structure of algal plastids.
7. Algal blooms.-
8. Algal biofertilizers
9. Economic importance of algae
10. General account of lichens and their economic importance

Suggested Reading:

Fritsch, F. E. The structure and reproduction of algae. Vol. I & II, London, Cambridge Univ. Press (1971-72)

Kamat, N. D. (1982), Topics in algae, Sai Kirpa Prakashan, Aurangabad.

Kumar, H. D. (1988). Introductory Phycology. Affiliated East-West Press limited, New Delhi.

Round, F. E (1986). The biology of algae. Cambridge University Press, Cambridge.

Kumar, H. D.. (1985). Algal cell Biology. Affiliated East-West Press Limited, New Delhi.

Morris. I. (1967). An Introduction to the Algae. Hutchinsen University Library, London.

Fungi:

- i) Introduction to Mycology: General characteristics of fungi, their significance to human, organization of fungal cell, thallus and modifications thereof; ultrastructure, reproduction (vegetative, asexual, sexual), recent trends in classification.
- ii) Comparative study of habit, habitat, somatic organization, anamorphs, teleomorphs and evolutionary tendencies ,in any of these phases in the life cycle of the members of Dictyosteliomycota and Myxomycota (Dictyostelium, physarum) Chytridiomycota and Oomycota (olpidium, synchytrium, Allomyces, Plasmodiophora, Saprolegnia, Pythium, Pyttophora and Downy mildews), Zygomycota (within members of Zygomycetes), Ascomycota (Ascocarp development, ascocarp types, centrum types and their bearing on classification, with emphasis on Protomyces, Taphrina, Yeast, Penicillum, Aspergillus, Chaetomium, Neurospora, Claviceps and Venturia; and general account of powdery mildews and Discomycetes, Basidiomycota, (basidiocarp types, development, general account of **Hymenomycetes, Ustilaginomycetes and urediniomycetes, Alternaria, Helminthosporium, Cercospora, Colletotrichum, Pyricularia, Fusarium**

- iii) Sex hormones in fungi, Heterothallism and parasexual cycle in fungi, nutrition in fungi (saprophytes, parasites, predators, symbionts).
- iv) importance of Fungi in different microbiological and Biotechnological processes fungi in food and food industry, as agents of biodeterioration and biodegradation, in agriculture, in medical biotechnology and as agents of biotransformation, biosorption and biomineralization.

Suggested Books :

1. Ainsworth, G. C., Sparrow, F. K. and Sneath, A. F. S. The fungi- an advanced treatise Academic Press, 1973.
2. Alexopoulos, C. J. and Mims, C. W. Introductory mycology, 3rd Edition, Wiley- Eastern, New Delhi
3. Alexopoulos, C. J. and Mims, C. W. and Blackwell, M, Introductory mycology. John Wiley and Sons. 1996
4. Deacon, J. W. Introduction to Modern Mycology ELBS.
5. Moore- Landercker, E. J. 1972. Fundamentals of the fungi. Prentice hall, Englewood Cliffs.
6. Burnett, H. L. Fundamentals of Mycology. Edward Arnold, London.
7. Aneja Krand Mehrotra R. S. Introductory Mycology.
8. Dube, R. and Mukerji, K. G. 2001. Microbial Technology A. P. H. Publishing corporation, New Delhi.
9. Gupta, R and Mukerji, K. G. 2001 Microbial Technology A. P. H. Publishing Corporation, New Delhi.

Course II: BIOLOGY AND DIVERSITY OF MICROBES AND PLANT PATHOGEN

1. History of plant pathogens, concept, diagnosis, classification, importance and identification of unknown diseases; symptomatology and disease development.
2. Host- pathogen interaction at plant and cellular level: Mechanism of pathogen attack and defense: Physical, Physiological, biochemical and molecular aspects.
3. Host-pathogen- interaction at population level: Transmission and spread of plant pathogens, disease epidemics, modeling and disease forecasting to control crop losses.
4. Management of plant disease: Chemical, Biological, IPM system, development of transgenics, biopesticides, plant diseases clinics, quarantine.
5. Genetics of plant disease: Gene for virulence and avirulence. Their application in resistance and susceptibility, induced resistance (immunization)
6. Specific plant disease caused by diverse pathogens: Black wart disease of potato, Club root of crucifers, damping of seedlings, late blight of potato, downy mildew of grapes and bajra, stem gall of coriander, peach leaf curl, powdery mildew of wheat and apple, apple scab, general account of rusts, smut and bunts, Fusarial wilt of tomato, rhizome rot of ginger, tikka disease of groundnut, red rot of sugarcane, brown leaf spot and blast of rice. Bacterial blight bean, common scab of potato, fire blight of apple, citrus canker, potato leaf roll, potato spindle tuber, tobacco mosaic virus.

Suggested Books:

1. Agrios, G. N. Plant Pathology, Academic Press, 1988
2. Butler, E. J and Jones, S. G. Plant Pathology, Periodical Expert Book Agency Delhi, 1986
3. Mehrotra, R. S. Plant pathology. Tata Mc Graw- Hill. Publishing Company, New Delhi
4. Bilgrami, K. S. and Dubey, H. C. text Book of modern Plant pathology, Vikas, New Delhi, 1980
5. Mundkar, B. b. Fungi and Plant Diseases. Mc Millan, 1967
6. Wood, R. K. S. Physiological plant Pathology. Blackwell Scientific Publications, 1967
7. Tarr, S. A. J Principles of Plant pathology. Mc Millan, 1972

8. Horsfall, J. G. and Dimond, E. Plant Pathology, Academic Press, New York
9. Horsfall, J. G. and Cowling, E.B. Plant Disease Vol. I-V. Academic Press, New York

MICROBES:

1. History and scope of microbiology, landmarks in microbiology, major groups of microorganism, characterization, identification and classification of microorganism
2. **Structure of Bacteria** : Structure and fine structure of cell and of internal and external structure to cell wall, spores and cysts. Nutrition of bacteria: modes of nutrition, nutritional types, growth characteristic, reproduction and genetic recombination: Binary fission, resting structure, conjugation, transformation and transduction; mechanism of antibacterial action.
3. General account of Rickettsia, Chlamydeae, Mollicutes and disease caused by them
4. **Virus**: History, structure and classification, plant and animal viruses, nature and transmission, genome organization (TMV, CMV, CAMV and Gemini viruses), isolation and purification, detection, identification and economic importance; Bacteriophages, viroids and prions nature and importance
5. Viruses in cancer; Principles of immunology: general account of immunity, allergy antigen- antibody, serology and types of vaccines.
6. Applications of microbes in agriculture (Biofertilizers, biopesticides), industry (alcoholic beverages, citric acid, penicillin production), environment (pollution indicator and control), and genetic engineering.

Suggested Reading:

1. Stanier, R. Y. General Microbiology MacMillan, 1970
2. Pelezzar, M. J. Reid, R. D. and Chan, E. C. S. Microbiology, Tata McGraw Hill, 1977
3. Kumar, H. D and Rai, D. C. microbes and Microbial processes East West 1990
4. Ketchum, P. A. Microbiology- concepts and applications, Wiley, New York 1980
5. Tauro, P. Kapoor, K. K. and Yadav, K. s. An Introduction to Microbiology. Wiley Eastern Ltd. 1996
6. Schlegel, H. G. General Microbiology. Cambridge University Press 1996
7. Gupta, R. and Mukerji, K. G. 2001 Microbial Technology. A. P. H. Publishing Corporation New Delhi.
8. Tortora, G. J. Funke, B. R. and case, C. L. Microbiology –An Introduction, Addison Wesley Longman, Inc. California.

Course III: BIOLOGY AND DIVERSITY OF BRYOPHYTES PTERIDOPHYTES

BRYOPHYTES:

1. General Introduction and Salient feature of Bryophytes. Comparison among Cryptogamous plants.
2. Classification of Bryophytes into Liverworts, Hornworts and Mosses.
3. A general account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales (emphasis is not to be placed on Families or type Studies)
4. A general account of Peristome in Mosses
5. Origin of land Plants including Fossil evidence.
6. Primitive versus Advanced /Derived feature and Evolutionary Lines within Bryophytes.
7. Alteration of generation in Bryophytes.
8. Morphogenesis in Bryophytes.
9. Distribution and Ecology of Bryophytes in India with particular reference to Himachal Pradesh.
10. Ecological importance of Bryophytes.
11. Economic importance of Bryophytes.

Suggested Readings:

Cavers, F. 1911. The inter- relationship of Bryophyta. *Newe Phytology Reprint No. 4:1-203*

Chopra, R.S 1976. Inter- elationship of Indian Bryophytes. *The Chronica Botanica*, New Delhi

Chopra, R. S and Kumar, S. S. 1976. Musci of fteh Western Himalyas and the Punjab plains. *The chronic Botanica*, New delhi

Parihar, N. S. 1972. An Introduction to Embryophyta vol I. *Bryophyta Central Book Depot*, Allahbad

Puri, p. 1981 *Bryophytes: Morphology, Groeth and differentiation Atma Ram and Sons*, Delhi and Lucknow

Rashid, A. 1998. An Introduction too Bryophyta (Diversity, Development and Differentiation). *Vikas Publishing House Pvt. Ltd. New Delhi*, 298pp.

Udar, R. 1976 *Bryology in India. The Chronica Botanica*, New Delhi

Watson, E. V. 1971. *The Structure an dlife of Bryophytes. Hutchinson University Library*, London.

PTERIDOPHYTES :

1. General introduction and salient feature of pteridophytes; comparision among archegoniatae.
2. Classification of Pteridophytes.
3. Introduction to Palaebotany, some basic principles and techniques.
4. A general account of the following fossils pteridophytes: Rhynia, Horneophyton, Trimerophyton, Psilophyton, Zosterophyllum, Asteroxylon, Lepidodendron, Sigillaria, Pleuromeia, Nathorstiana, sphenophyllum, sphenophyostachys, Calamites, Cladoxylon, Etaupteris, Ankyropteris and Osmundites
5. Salient feature of Psilopsida, Lycopsida, Sphenopsida and Pteropsida (Emphasis is not to be placed on orders, Families or Types studies.
6. Structure and Evolution of Stelar system in Pteridophytes.
7. Telome Theory or the Evolution of Sporophyte in Pteridophytes.
8. Alteration of Generations in Pteridophytes.
9. Natural and Induced Implications of Apogamy in Pteridophytes.
10. Natural and Induced implications of Appspory in Pteridophytes.
11. Heterospory and seed habit in Pteridophytes
12. Distribution and Ecology of the Ferns of the Himalayas with particular reference to Himachal Pradesh.
13. Cytological Evolution in Pteridophytes .
14. Economic importance of Pteridophytes.

Suggested Reading:

Andrews, H. N. 1961. *Studies in Palaenobotany. John wiley and sons, Inc, Neew York and London*

Khullar, S. P. 1994, *An illustrated fern flora of west Himalaya Vol I Inteenational book Distributors, Dehradun, India 506 pp.*

Khullar, S. p. 2000. An illustrated fern flora of West Himalaya Vol. II. In International Book distributors, Dehradun, India, 538pp.

Parihar, N. S 1996. The Biology and Morphology of Pteridophytes. Central book Depot, Allahabad, 777pp.

Rashid, A. R 1999 Introduction to Pteridophyta- Diversity, Development and Differentiation. 2nd Revised Edition. Vikas Publishing Co. New Delhi, 426pp.

Seth, M. K., Kumari, A., Tahkur. R., Khullar, S. P. 2003. Pictorial Guide to Common Himalayan Pteridophytes Vol I Pteridophytes of Shimla

Sharma, O. P. 1990. Text book of Pteridophytes. Mc Millan India Ltd. New Delhi, 360pp.

Smith, G.M. 1971. Cryptogamic Botany, Vol II. Bryophytes and Pteridophytes

Tata Mc Graw Hill Publishing Co. New delhi, 546 pp

Sporne, K. R. 1982. The Morphology of Pteridophytes. Hutchinson University Library, London (Reprinted in 1991 by B. I. Publishing Pvt. Ltd. , Bombay)

Stewart, W. N. and Rothwell, G. W. 1993 Palaeobotany and the evolution of plants Cambridge University Press, London

Course IV: PLANT RESOURCES UTILIZATION AND BREEDING

1.Forest Products Wood and Timber: General Introduction, Formation and Composition of wood, Difference between softwoods and hardwoods, Sapwood and Heartwood, Storied and Nonstoried wood, and between Ring porous and Diffuse porous woods, Definitions of various types of annual Rings; Properties and seasoning of woods; uses of woods, structure and identification important timber plants namely Pinus, Cedrus, Tectona and Populus.

2.Nonwood forest Products I- Bamboo- The **Green Gold of India, Its structure , Properties and uses**

3. Nonwood Forest products II- Cork – Its structure, properties and uses

4. Nonwood Forest products: III- Tannins and Dyes :A general account

5. Nonwood Forest products IV- Gums and Resins – A general account

6. Plant resources I – Aromatic Plants- a general account, essential oils and Perfumery

7. Plant resources II- Psychoactive drugs and poisons from plants: a general Account

8. Plant resources III- Fruits and Nuts- a list of important fruits and nuts with particular reference to Himachal Pradesh. (Details are not required)

9. Plant resources IV- Underexploited/ underutilized plants- Winged or Goa Bean (*Psophocarpus tetragonium*); Jojoba or hohba (*Simmondisa chinensis*), Guayule or Wuyule (*Parthenium argentatum*), Leucaena or subabul (*Leucaena leucocephala*) and Triticale (*Triticosecale*). A general account , of Edible wild plant.

10. Plants resources V- Ornamental Plants- A list of important ornamental plants of himachal Pradesh. Economic importance of flowers.

11. Plant resources VI- Bioenergy (biofuels) of plant origin- A general account of fuel wood, energy Plantations, organic waste materials for energy, petroleum plants. Alcohol Fuel and Biogas.

12. A general account of the origin of cultivated Plants with special reference to Vavilov's centres of origin.

13. A general account , of Plant introduction and Acclimatization.

14. Methods and modes of reproduction in relation to breeding Self pollinated, Cross pollinated, Vegetatively propagated and Apomictic Plants.

15. A general account of Inbreeding Depression and Heterosis; Exploitation of Hybrid Vigour; Production of Hybrids, Composites and Synthetics.

Suggested Readings:

Anonymous, 1970, 1972, 1983. Indian Forest Utilization. Vols. I-II, Controller of Publications, Delhi and Forest Research Institute and Colleges, Dehradun, I-360, 361-642

Anonymous, 1975, Underexploited Tropical Plants with Promising Value. National Academy of Sciences. Washington, D.C. 1990pp.

Anonymous 1980. Firewood crops: Shrubs and Tree Species for Energy Production. National Academy of Sciences, Washington, D.C. 237pp.

Arora, R. K. and Pandey, A. 1996. Wild Edible Plants of India: Diversity, Conservation and Use. ICAR, NBPGR, New Delhi, 294pp.

Chaudhari, H. K. 1971., 1986. Elementary principles of Plant Breeding. Oxford and IBH Publishing CO., Pvt. Ltd., New Delhi, 327pp.

Chopra, V. L. 2001. Plant Breeding: Field Crops. Oxford and Pvt. Ltd., New Delhi.

Kocchar, S. L. 1998. Economic Botany of the Tropics, 2nd Ed. Macmillan India Ltd., Delhi.

Poehlmann, J. M. and Sleeper, D. R. 1995. Breeding Field Crops. Panima Publishing House, New Delhi.

Sambamurthy, A. V. S.S. and Subramanyam, N.S. 1989. A Textbook of Economic Botany. Wiley Eastern Ltd., New Delhi

Seth, M. K., Channel., S. and Thakur, R. 2002. Pictorial Guide to some Common Ornamental Plants in the Himalayas.

Sharma, J. R. 1994. Principles and Practices of Plant Breeding. Tata Mc Graw Hill Publishing Co., New Delhi, 599pp.

Sharma, O. P. 1996. Hills economic Botany (By Late Dr. A. F. Hill and Adapted By Dr. O. P. Sharma) Tata Mc Graw Hill Co. Ltd., New Delhi, 731pp.

Simpson , B. B. and Conner- Ogorzaly, M. 1986. Economic Botany- Plants in our World. Mc. Graw Hill, New York, 640pp.

SEMESTER II

COURSE V: CELL AND MOLECULAR BIOLOGY (COMMON COURSE)

1. **Structural organization of plant and animal cell :**

- i) Cell Wall: structure, function and biogenesis
 - ii) Plasma membrane: structure , models, functions, sites for ATPases, ion carries, channels and pump
 - iii) Plasmodesmata: structure, role improvement of molecules, comparison with gap junctions.
 - iv) Plant vacuole: Tonoplast membrane, ATPase as storage organelle.
 - v) Structure and functions of microbodies: Golgi apparatus, lysosomes, endoplasmic reticulum
2. **Chloroplast and mitochondria:** Structure, genome organization, gene expression, nucleochloplastic interactions, biogenesis of mitochondria
3. **Nucleus:** structure, nuclearpores, nucleosome organization, nucleolus.
4. **The cytoskeleton:** Organization and role of microtubules and microfilaments, motor movements, implications in flagellar and other movements.
5. **Cell cycle and apoptosis:** Control mechanism, role of cyclins, cyclin- dependent linases, cytokinesis and cell plate formation, mechanism of programmed cell death.
6. **Gene expression:**
- i) DNA structure; A,B, and Z forms; replication, damage and repair
 - ii) Transcription, promoters and transcription factors, splicing, mRNA transport, rRNA biosynthesis, difference in prokaryotes and eukaryotes.
 - iii) Transcription: structure of ribosome, mechanism of translation, initiation, elongation and termination, structure and role of RNA.
7. Regulation of gene expression in prokaryotes and eukaryotes.
8. Protein sorting: Targeting of proteins to organelles.

Suggested Reading:

Lewin, B 2000 Vil Offord University Press, New York.

Alberts, B., Bray, D, Lewis, j. Raff, M., Roberts, K, K and Watson, J. D. 1999 Molecular biology of the cell. Ga land Publishing, Inc., New York.

Wolfe, S. L. 1993. Molecular and Cell biology, Wordsworth Publishing Co., California, USA.

Buchana, B, B., Gruissem, W. and Jones , R. I. 2000. Biochemistry and molecular biology of plants, American society of plant physiologist, Maryland, USA.

Frifelder, D. molecular biology. John and Bartlette Publisheres, inc., Boston , USA

COURSE VI: BIOSTATISTICS AND COMPUTER APPLICATION: (COMMON COURSE)

1. Brief description and tabulation of data and its graphical representation
2. Measures of central tendency and dispersion: mean, median, range, standard deviation and variance. Correlation and simple linear regression
3. Sampling: Sampling Techniques, sampling errors , Framing Hypothesis, level of significance, test of significance (F & t test), chi-square test.
4. Introduction of digital computers; Organization; low-level and high level languages; binary number system.
5. Flow charts and programming techniques.
6. Introduction to programming in Q Basic.
7. Introduction to data structure and database concepts; introduction to internet and its application
8. Introduction to MS OFFICE software, covering word processing; Spreadsheets and presentation software.
9. Computer Oriented Statistical Techniques.
Frequency table of single discrete variable, Computation of mean, variance and standard deviation; t-test, correlation coefficient.
10. Bioinformatics

CORSE VII: BIOLOGY AND DIVERSITY OF GYMNOSPERMS

1. General Introduction and Salient feature of Gymnosperms.
2. Comparison among Tracheophyta
3. Classification of Gymnosperms
4. Introduction too Palaeobotany, some basic principles and techniques.
5. A general account oof the following Fossil Cycadopsida: Archeopteris, Tetrasticha, Heterangium, Lyginopteris, Sphaerostoma, Telangium, Crossotheca, Medullosa, Pachytosta, Whittlesey, Aulotheca, Doleerotheca, Calamopitys, Glossopteris, Hirsutum, Caytonia, Williamsonia, wiellandiella, Cysadeoidea, Pentoxylon and Palaeocycas.
6. A genereal account of following fossil Coniferopsida: Eristophyton, Mesoxylon, Cordaites, Fossil Conifers and Trichophys.
7. Salient feature of living Cycadales, Coniferales (including Taxus) and Ginkgoales (Emphasis is not to be placed on families or Type Studies.)
8. A general account of Ephedrales, Welwitschiales and Gnetales.
9. Distribution of Conifers in India with particular reference to Himachal Pradesh.
10. Economic Importance of Gymnosperms
11. Structure, Identification and Evolution of wood in Conifers.
12. Structure, Properties and Uses of the following commercial timbers: Blue Pine, Chir pine, Deodar, Cypress and Yew.
13. Structure, Identification and Evolution of Bark in living gymnosperms.
14. Comparative account of the Leaf Anatomy of the living gymnosperms
15. Comparative study of Males cones of living gymnosperms
16. Pollination mechanism in living gymnosperms
17. Comparative study of Female Cones of living Gymnosperms
18. Comparative study of Males Gametophytes of living Gymnosperms
19. Comparative study of Females Gametophytes of living Gymnosperms

20. Structure and evolution of Archegonium in Gymnosperms

21. Cytological Evolution in Gymnosperms.

SUGGESTED READING:

Andrew, H. N. 1961. Studies in Palaeobotany. John Wiley and Sons, Inc. New York and London

Biswas, C And Johri, B. M 1997. The Gymnosperms. Narosa Publishing House, New Delhi, 494pp.

Bhatnagar, S. P; and Moitra, A. 1996, Gymnosperms, New Age International Pvt. Ltd., New Delhi, 470pp.

Chamberlain, C. J. 1934. Gymnosperms structure and evolution. Chicago (Reprinted 1957, New York).

Coulter, J. m. and Chamberlain, C. J. 1917 Morphology of Gymnosperms. Chicago (Reprinted 1974, Central Book Depot, Allahbad)

Datta, S. C. 1966. An Introduction too Gymnosperms. Asia Publishing House, Bombay

Kakakr, R. K. And Kakkar, B. R. 1995. The Gmnosperms (Fossils and Living). Central Publishing House, Allahabad, 777pp.

Mehra, P. N. 1998. Inmdian conifers, Gnetophytes and Phylogeny of Gymnosperms. Raj Bandhu Industrial Co., New Delhi, 264pp.

Raizada, M. B. and Sahni, K. C. 1960 Living Indian Gymnosperms. Part I (Cycadales, Ginkogoales and coniferales) Indian Forest Records. N. S. Botany 5:i-iv, 73-150, Forest Research Institute, Dehradun

Sahni, K. C. 1990 Gymnosperms of India Adjacent countries. Bishen Sinng Mahendra Pal Singh, Dehradun, 169pp. +48plates+ 9 Photographs.

Singh, H 1c978. Encyclopedia of Plant Anatomy. Part X. Embryology of Gymnosperms, Gebruder Bortaeger, Berlin, Stuttgart.

Sporne, K. R 1965. The Morphology of Gymnosperms. Hutchinson and Co. (Publishers)

COURSE VII: BIOLOGY AND DIVERSITY OF ANGIOSPERMS-I

(MORPHOLOGY, TAXONOMY AND PLANT RESOURCE CONSERVATION)

Morphology:

1. Fossil Angiosperms
2. Origin and evolution of Angiosperms (Special reference to Bennettitalea, Gnetalean, Caytonialean and herbaceous origin theories)

Taxonomy:

1. Systems of angiosperem classification
 - i) Phenetic vs Phylogenetic system
 - ii) Relative merits and demerits of major systems of classification.

2. International code of Botanical Nomenclature

- i) History
- ii) Principles and rules
- iii) Type method
- iv) Principles of priority and its limitation V
- v) Names of Hybrids and cultivars

3. The Species Concept

- i) Taxonomic hierarchy, species, genus, family and other categories
- ii) Principles used in assessing relationship, delimitation of taxa and attribution of rank

4. Modern Taxonomy

- i) Inputs for taxonomy
- ii) Taxonomy in relation to anatomy, embryology, palynology, cytology, secondary metabolites in Plants

5. Numerical taxonomy

- i) Concepts, Characters and attributes
- ii) OTU's
- iii) Cluster analysis
- iv) Cladistics

6. Systematic in practices

- i) Importance and role of herbarium, specimens and their preparation
- ii) Botanical Garden, Importance and role
- iii) Value of computers and databases for identification

7. Concepts of Phytogeography

- i) Endemism, hotspots and hottest hotspots
- ii) Plant exploration, invasion and introductions
- iii) Local plant diversity and its socio-economic importance

Plant Resource Conservation

- i) Principles of conservation
- ii) Extinctions
- iii) Environmental Status of plants based on I. U. C. N
- iv) Strategies for *In-situ* and *Ex-situ* conservation Principles and practices

Practical:

Based on the above topics

Suggested Readings:

Coble, A. J. 1969. Numerical Taxonomy. Academic Press, London

Davis, P. . & Heywood, V. H. 1973. Principles of angiosperms Taxonomy. Robert E. Kreuger Pub. Co., New York

Eames, A. J. I 1961. Morphology of the Angiosperms. McGraw- Hill, New York.

Harrison, H. J. 1971. New concepts in Flowering Plant Taxonomy. Hieman, London

Heywood, V. H. & Moore, D. M 1984. Current Concepts in Plant Taxonomy Academic Press, London. Global

Heywood, V. 1995. Global Biodiversity Assessment Cambridge Univ., Cambridge.

Radford, A. E. 1986 Fundamentals of Plant Systematics- Harper & Row, USA

Stace, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London

Takhtajan, A. L. 1997. Diversity and Classification of Flowering Plants Columbia University Press, New York.

Woodland, D. W. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey

SEMESTER III

COURSE IX: CYTOGENETICS & EVOLUTION (COMMON COURSE)

1. Chromosome Organization:

- 1.1 Structure of chromosomes, DNA packaging and DNA replication
- 1.2 Metaphase chromosomes, centromere, Kinetochore, Telomere and its importance
- 1.3 Heterochromatin and euchromatin
- 1.4 Chromosome banding
- 1.5 Polytene and lampbrush chromosomes

2. Sex chromosomes, sex determination and dosage compensation in Drosophila and human.

3. Mendelian and non-Mendelian Inheritance:

- 3.1 Mendelian inheritance and its modification
- 3.2 Maternal effect
- 3.3 Epigenetic inheritance
- 3.4 Extra nuclear inheritance

4. Variation in Chromosome structure and number

5. Brief description of gene expression:

- 5.1 Genetic code
- 5.2 Transcription and translation
- 5.3 Regulation of gene expression

6. Gene mutation and DNA repair:

- 6.1 Consequences of Mutations
- 6.2 Occurrence and causes of gene mutation
- 6.3 DNA repair

7. Quantitative genetics:

- 7.1 Quantitative traits
- 7.2 Polygenic inheritance
- 7.3 Heritability

8. Population genetics and evolution:

- 8.1 Gene in populations
- 8.2 The Hardy- Weinberg Equilibrium
- 8.3 Factors that changes allele frequencies in populations:

a) Mutations b) Migration c) Natural selection d) Randoim genetic drift e) Genetic load.

9. Origin and evolution of species:

- 9.1 Biological species concept
- 9.2 Anagenesis and cladogenesis
- 9.3 Allopatric, parapatric and sympatric speciation
- 9.4 Gradualism and pubctuated equilibrium
- 9.5 Neo- Darwinism
- 9.6 The shifting- Balance Theory of Evolution

10. Molecular evolution:

- 10.1 Experimental approaches used to compare species at molecular level
- 10.2 Phylogenetic trees
- 10.3 Molecular drive- a cohesive mode of species evolution
- 10.4 Neutral theory of Molecular Evolution

Suggested Readings:

1. Gardener, E. J., Simmon, M. J and Snustad, D. P. Principles of Genetics. John Wiley & Sons, Inc. NY
2. Weaver, R. F and Hedrick, P. W Genetics Wm. C. Brown Publishers
3. Brown, T. A. Genetics- A Molecular Approach. Chapman & Hall
4. Mitra, s. Genetics- A Blueprint of Life. Tat mc Graw Hill
5. Dobzhansky, Th; Genetics and origin of Species. Columbia University Press.
6. Dobzhansky, Th; Ayala, F. J; Stebbins, G. L. and Valentine, J. M. Evolution . Surjeet Publishers Delhi
7. Futuyama, D. J. evolutionary Biology, Suinuaer Associations. INC Publishers .Dunderand.
8. King, M. species evolution- the role of chromosomal change. The Cambridge Univeristy Press, Cambridge.
9. Merrel, D. J. Evolution and Genetics Holt. Richart and Winston Inc.
10. Strikbergeer, M, W, Evolution. Jones and Barlett Publishers. Boston London.

COURSE X: IMMUNOLOGY AND BIOTECHNOLOGY :COMMON COURSE)

Introduction to Immunology:

Innate and acquired immunity, characteristics if immune response, humoral and cellular immunity, benefits and damaging effects of immunology

Cell and tissues of immune system:

Cell of immune system, primary and secondary lymphoid organs

Antigens:

Immunogenes, major classes of antigens, physical and chemical properties of antigens.

Immunoglobulins:

Structure and functions of immunoglobulins, classes and subclasses of human immunoglobulins, polymorphism, primary and secondary immune response.

Complement System:

Complement proteins, pathways of complement activation

Antigen- antibody reaction

Precipitation, agglutination, Immunofluorescence, radioimmunoassay, ELISA, immunoblotting.

Monoclonal antibodies:

Hybridoma, Isolation and characterization of monoclonal antibodies.

Hypersensitivity

Anaphylaxis, antibody-mediated cytotoxic and immune complex reactions, delayed –type hypersensitivity.

BIOTECHNOLOGY:

Biotechnology: Scope, significance, microbes and microbial systems and their improvement for biotechnological use.

Principles and techniques of plant and animal cell culture.

Principles and applications of DNA recombinant technology to agricultural and human diseases. Aims, strategies for development of transgenics (with suitable examples), intellectual property rights, possible ecological risk and ethical concerns. Construction of genomic/c DNA libraries, PCR and DNA finger printing.

Fermentation technology, design, process, scale up downstream processing, production of antibiotics, beverages, enzymes; Ethanol and methane from biomass; bioremediation, biopesticides and biosensors, single cell protein.

Suggested Reading:

1. Immunology by Jaris Kuby
2. Immunology by J. A. Bellanti
3. Fundamentals of Immunology by W. e. Paul
4. Essential Immunology by J. M. Roitt
5. Immunology by E.S. Golub
6. Immunology by E. Benjamini, R Coice and G. Sunshine
7. Walker, J. M. And Gungold, E. B Eds.) Molecular Biology and Biotechnology, Royal Society of Chemistry, Cambridge, 1990
8. Maniatis. T, N. ; Fritsch, E,. F. and Sambrook, T. molecular Cloning A laboratory Manual, cold spring Harbor, New York, 1990
9. Domain, A. L. and Solomon, N.A (eds.) Manual of Industrial. Microbiology and Biotechnology. American Society of Microbiology Washington, 1986.
10. Ptimrose, S. B., Molecular biotechnology (second Edition), Blackwell Scientific Publications, Oxford, 1991.
11. Kumar, H. D.; A text Book onn Biotechnology, affiliates East West Press Pvt. Ltd., New Delhi, 1993.

CORSE XI: BIOLOGY AND DIVERSITY OF ANGIOSPERMS –II

(PLANT DEVELOPMENT, REPRODUCTION BIOLOGY, PALYNOLOGY, TISSUE CULTURE)

Plant Development:

1. Apical, lateral and intercalary meristems- their ultra structure, histochemistry and organogenesis.
2. Anomalous growth-stem
3. Ecological anatomy

Reproductive Biology:

1. Male Gametophytes
 - i) Structure of anthers ii) Microsporogenesis ii) Role of tapetum iv) Pollen development
 - v) Male sterility vi) Sperm dimorphism vii) Pollen tube growth and guidance

2. Female Gametophytes:

i) Ovule development ii) Megasporogenesis iii) Structure and organization of the embryo sac iv) Nutrition of the embryo sac.

3. Pollen pistil interaction fertilization

Pollen –stigma interaction, sporophytic and gametophytic self incompatibility (Cytological, biochemical and molecular aspects; *In vitro* fertilization)

4. Seed Development

- i) Endosperm development during early, maturation and desiccation stages
- ii) Embryogenesis, ultrastructure and nuclear cytology; cell lineage during late embryo development
- iii) Embryo culture

5. Seed Dormancy

- i) Importance and types of Dormancy
- ii) Overcoming seed dormancy

Palynology:

- i) Basic techniques to study pollen
- ii) Pollen viability and storage
- iii) Pollen allergy

Tissue Culture:

- i) Methods of tissue culture
- ii) Haploid induction; fundamental aspects
- iii) Protoplasts; their isolation, culture and fusion
- iv) Applied aspects of tissue culture
 - a) Clonal propagation
 - b) Propagation of pathogen-free plants
 - c) Germplasm storage and conservation

Practicals: Based on the above topics

Suggested Readings:

- Bhojwani, S. S & Bhatnagar, S. P. 2000. The Embryology of Angiosperms , Vikas
- Bhojwani, S. S & Radan , M. K. 1983. Plant Tissue Culture : Theory and Practices Elsevier, Amsterdam
- Burgess, J. 1985 An Introduction to Plant Cell Development Cambridge Univ. Press, Cambridge.
- Fahn, A. 1982 Plant Anatomy. Pergamon Press, Cambridge
- Falk. D. A., Olwell., M & Millan, C 1996. Restoring Biodiversity. Columbia, USA
- Howell, S. H. 1998. Molecular Genetics and Plant Development Cambridge Univ., Cambridge.
- Lydon, R. F. 1999 Plant Development. The Cellular Basis, Unwin Human, London
- Raghavan, V 1999. Development Biology of Flowering Plants. Springer Verlag New York
- Shivanna, K. R & Rangaswamy, N. S. 1992. Pollen biology: A Laboratory Manual. Springer Verlag, Berlin
- Shivanna, K. R & Johri, B. M 1985. The Angiosperms pollen: Structure and Function. Wiley Eastern Ltd. , New York.

COURSE XII: PLANT PHYSIOLOGY

1. Plant –water relations, transport of solutes: Physicochemical properties of water, water potential, apparent free space, bulk movement of water, SPAC, passive and active solute transport.
2. Stomatal physiology: Chemiosmotic mechanism of stomatal movements, hormonal regulation and significance of calcium ions.
3. Photochemistry and Photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, Photooxidation of water, mechanism of electron and proton transport, carbon assimilation: the calvin cycle, photorespiration and its significance, the c4 cycle, the CAM pathways, biosynthesis of starch and sucrose, physiological and ecological considerations.
4. Respiration : Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, structure and functions of ATP, pentose phosphate pathways, glyoxylate cycle, alternative oxidase system
5. Nitrogen fixation, nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulphate uptake, transport and assimilation.
6. Sensory photobiology: History of discovery of phytochromes and cryptochromes, their photochemical and biochemical properties, photobiology of light- induced responses, cellular localization, molecular mechanism of action of photomorphogenetic receptors, signaling and gene expression
7. Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid.
8. The flowering process: Photoperiodism and its significance, endogenous clock and its regulation , floral induction and development- genetic and molecular analysis, role of vernalization.

Suggested Reading:

Buchanan, BB. Gruissem, W. and Jones R. L. 2000. Biochemistry and molecular biology of plants. American society of Plant Physiologists, Maryland, USA

Goodwin, T. W. and Mercer, L. E. 1989 Introductory Plant Biochemistry, Pergamon Press, New York, USA

Moore, T. C. 1989 Biochemistry and Physiology of plants hormones (2nd edition) Springer Verlag, New York, USA

Salisbury, F. B. and Ross, C. W. 1992. Plant Physiology (4th edition) Wadsworth publishing company, California, USA

Taiz, I. and Zeiger, E. 1998. Plant Physiology (2nd edition) Sinauer Associates Inc. Publishers, Massachusetts, USA

Wilkins, M. B. (ed.) 1984 Advanced plant physiology, ELBS, Longman, UK.

Semester IV

Course XIII: Biochemistry (Common Course)

1. A review of laws of thermodynamics, redox potentials.
2. Carbohydrate- classification, occurrence, structure and function of monosaccharides, oligosaccharides.
3. Lipids- classification, occurrence structure and importance of acyl lipids and phosphates, biosynthesis of fatty acids, β - oxidation and role of polyunsaturated fatty acids.
4. Outlines of Nitrogen fixation, symbiotic and non- symbiotic.
5. Amino acids, peptides and proteins. Occurrence, structure and function of amino acids, stereoisomers. Synthesis of amino acids by reductive amination, GS-GOGAT system, transamination, classification of proteins according to solubility, structure and function of proteins. Conjugate proteins, lectins and their importance, protein synthesis, transcription, translation degradation, and protein folding.
6. Protein- ligand, protein- protein, nucleic acid-protein and nucleic acid-ligand interactions. Enzyme- classification, mode of action. enzyme kinetics (Michaelis- Menten Constant), Enzyme inhibition. Coenzymes, cofactors, Ribozymes.
7. Nucleic acid bases-their structure. Structure and function of DNA, genetic code, different kinds of RNA and their origin. Role in protein, synthesis and in reverse transcription. DNA polymorphism.
8. Biosynthesis and function of secondary metabolites phenolics, flavonoids, terpenoids.
9. Alkaloids and steroids, saponins.
10. Importance of Acetyl Co. A and Shikimic acid in intermediary metabolism.
11. Chemical foundations of biology e.g. pH, acids, bases, buffers, weak bonds, free energy, resonance, isomerisation etc.

Suggested Reading:

1. Zubay, G. 1988, Biochemistry (2nd ed.) Macmillan Publ. House N. Y.
2. Mahler, H. R. and Cori E. H. 1971. Biologist chemistry, Harper International
3. Lehinger A. 1. 1978. Biochemistry Kalyani Publishers, Ludhiana
4. Goodwin T.W. and Meriar L. e. I. 1989 Introductory plant Biochemistry Pergamon Press NY.
5. Conn, E. E. and Shimada P. K. 1976. Outlines of Biochemistry Wiley Eastern.
6. Stryer, Biochemistry.
7. Freifelder Molecular biochemistry.

Course XIV: Ecology (Common Course)

1. Climate, soil and vegetation patterns and organization : Life zones, major biomes, vegetation, soil types, concepts of community, ecological succession.
2. Ecosystem organization : Structure and functions, primary production, energy dynamics, litter fall and decomposition, global biogeochemical cycles, minerals cycles in terrestrial and aquatic ecosystems.
3. Population growth and dynamics: Models of population growth (Stochastic and time lag), reproduction strategies, mating preference, spacing r and k selection, case studies in population dynamics.
4. Predation: Predators- Prey interaction, Host parasite interaction, role of predation in nature.
5. Competition and Mutualism: Types and theories of competition, commensalism and mutualism, Plant-Pollinator and animal interaction, Niche theory.
6. Biological diversity: Concepts and levels, role of biodiversity in ecosystem functions and stability, speciation and extinction, IUCN categories of threat, distribution and global patterns, Terrestrial biodiversity hot spots.
7. Environmental pollution: Types, sources, effects on plant and animal ecosystems, Greenhouse gases, Ozone layer ozone hole, consequences of climatic change.
8. Ecological management: Concepts, sustainable development, sustainability indicators, degraded ecosystem and their regeneration with special reference to waste lands, forests and aquatic ecosystems.

Suggested Reading:

Begon and Mortimer: Population Ecology

Horace and Quick: population Ecology

Elseth, G. D. : Population Biology

Thomas C. E. Population Biology

Kerbs C J Ecology

Kerbs CJ: Ecological Methodology

Slanden & Bang: Biology of populations

Hillary S E: Ecology 2000

Merritt Emlen J: An evolutionary approach

Brewer: Principles of Ecology

Price P W: Slobodchikoff and Gand W. S: A new Ecology

Odum: Fundamnetlas oof Ecology

H. D. kumar – General Ecology- 1997

J. Merritt Emlen ecology – 1973

ADVANCED TOPICS IN MYCOLOGY

1. Ecology of fresh water fungi, thermophiles and psychrophiles
2. Domestication and Mycophagy: edible and poisonous mushrooms, mushroom toxins, cultivation technology for button and oyster mushrooms, diseases and pests of button mushrooms, nutritive value of mushrooms.
3. Growth, nutrition, differentiation and metabolites of fungi.
4. Mycotoxins and their medical and veterinary effects.
5. Effect of plant parasitic and their other fungi on man.

Suggested Reading:

1. Ainsworth, G. C. and Sussman, A. S. The fungi, Academic Press, New York. 1968
2. Alexopoulos, C. J. and Mims, C. W. 1979. And Blackwell, M. Introductory Mycology, Wiley Eastern limited, New Delhi.
3. Burnett, J. H. 1976. Fundamentals of Mycology, Edw and Arnold, London.
4. Alexopoulos, C. J., Mims, C. W. And Blackwell, M. Introductory Mycology. John Wiley and Sons.
5. Deacon, J. W. Introduction to Modern Mycology. ELBS.
6. Horsfall, J. G. and Cowling, E. B. Plant Disease Vol. I-V. academic Press, New York.
7. Moore- Landeckar, E. J. 1972. Fundamentals of the fungi. Prentice hall, Englewood Cliffs.
8. Burnett, H. L. Fundamentals of Mycology. Edward Arnold, London.
9. Aneja K. R., and Mehrotra, R. S. introductory Mycology.
10. Dube, H. C. an introduction to fungi. Vikas Publ. New Delhi.

COURSE XV: ADVANCED TOPICS IN APPLIED MICROBIOLOGY

1. Food Microbiology:

- i) Types of microorganisms in food
- ii) Food spoilage
- iii) Methods of food preservation
- iv) Food poisoning
- v) Microbiology of milk and milk products.

2. Industrial Microbiology:

- i) Types of fermentation
- ii) Fundamentals of Bioreactor design
- iii) Microbial production of acetic acid, alcohol, cyanocobalamin, citric acid and penicillin.
- iv) Yeast as fermentative agent in food and beverage production.

3. Environmental and agricultural Microbiology:

- i) Microbiology of air, Water and sewage.
- ii) Microbial degradation of organic matter in soil.
- iii) Nitrogen fixation by microorganisms.
- iv) Microbial pesticides.

4. Medical Microbiology:

- i) Brief account of causal agents, main symptoms, route of infection and control of following disease: Cholera, diphtheria, leprosy, syphilis, tetanus, tuberculosis, typhoid, whooping cough, dysentery (Amoebic and bacterial), kala azzar, AIDS, rabies, Japanese- Encephalitis.
- ii) Mechanisms of microbial pathogenecity
- iii) Host- parasite interactions.

5. Immunology:

- i) Nature of antigen and antibody
- ii) Types of immunoglobulins
- iii) Types of immunity: Brief account of active, passive, innate, and acquired immunity
- iv) Common antigen: antibody reactions agglutination, precipitation, complement fixation, immunofluorescence, radioimmunoassay, enzyme, linked immunonosorbant assay (ELISA), neutralization
- v) Brief account of hypersensitivity and autoimmunization.

Suggested Books:

1. Jay, J. M. 1987. Modern food Microbiology, CBS Publisheers and Distributors, New York.
2. Casida, L. E. 1968. Industrial Microbiology, Wiley, 1968.
3. Stolp, H. 1988. Microbial ecology: Organisms, Habitats & Activities. Cambridge University Press, Cambridge. University Press Cambridge.
4. Ananthanaryan, R. and Jayram paniker, C. K. 1986. A text Book of microbiology, 3rd limited, Edition. Orient Long man Madras.
5. Joshi, K.. R. and Osamo, N. O. 1992. Immunology, agro Botanical Publishers (India) Bikaner.
6. Frazier, W. C. and Westhoff, d.C. Food Microbiology tata Mc Graw- hill Publishing Company Ltd. New Delhi. 1995
7. Precott, L. M, Harley, J. p. and Klein, D. A. Microbiology. WCB Brown Publishers.
8. Tortora, G. j., Funke, B. R. and case, C. L. Microbiology- An Introduction. Addison Wesley Longman, Inc. California.

ADVANCED TOPICS IN PLANT PATHOLOGY

1. Disease due to non-parasitic agents: Adverse climatic conditions, mechanical and chemical injury, adverse soil conditions. Disease due to deficiency, excess or imbalance of the elements essential to plant growth, correction of deficiency disease. Toxicity diseases. Angiosperms, algae and protozoa as plant pathogens, plant injury due to insects, mites nematodes and other pests.
2. Roots diseases: Pre-emergence killing, damping off, seedling blight, root rots caused by cortical parasites, vascular wilt diseases. Hypertrophy disease. Non-parasitic root pathogens, predisposing factors. Control of root diseases.
3. Diagnosis and management of plant diseases.
4. Mechanism of disease induction by fungi, bacteria, mycoplasma and viruses.
5. Mechanism of action fungicides.

Suggested Book:

1. Agrios, G. N. Plant Pathology, Academic Press, 1988.
2. Baker, F. and Cook, R. J. 1974. Biologist Control of Plant Pathogen. W. H. Freeman & Co. San Francisco.
3. Bilgrami, K. S. and Dubey, H. C. text Book of modern, Plant pathology, Vikas, New Delhi; 1980.
4. Horsfall, J.G. and Cowling, E. B. Plant pathology- An Advanced Treatise. Vol- III Academic Press, New York.
5. Horsfall, J. G. and Cowling, E.B. Plant Disease Vol. I-V. Academic Press, New York.
6. Mehrotra, R.S Plant Pathology, tata Mc Graw Hill Publishing Company, New Delhi.
7. Tarr, S. A. J. Principles of Plant Pathology Mc Millan, 1972.
8. Wood, R. K. S. Physiological Plant Pathology Blackwell Scientific Publications, 1967.

COURSE XV: SPECIAL PAPER

WOOD SCIENCE, FOREST BIODIVERSITY AND PLANT RESOURCES:

1. Structure of Vascular Cambium and its role on wood formation:
2. Biochemical components of wood and their distribution in woody cell wall.
3. Basic Structure, Formation and Modifications of the Woody cell Wall.
4. Structure, Identification and Evolution of Coniferous woods with particular reference to Chir Pine, Blue Pine, Deodar, Fir, Spruce, Cypress and Yew.
5. Structure, Identification and Evolution of Dicot woods with particular reference to Sal, Teak, Shisham, Walnut, Mulberry, Indian Oak, Toon and Himalayan poplar.
6. A general account of texture, figure, spiral grain and knots in woods
7. **FOREST DIVERSITY:** A general concepts of forest biodiversity, sustainable development and conservation of plant resources,. Endemism and importance of wild plants.
8. **PLANT RESOURCES I-VASCULAR CRYPTOGRAMS:** Economic Importance and distribution of Vascular Cryptogams in the Himalaya with particular reference to Himachal Pradesh.
9. **PLANT RESOURCE II- GYMNOSPERMS-** Economic importance and Distribution of Gymnosperms of India with particular reference to Himachal Pradesh.
10. **Plant Resource III- Woody Plants (Shrubs, Lianas and Trees)-** Economic importance of woody plants and their distribution in Himachal Pradesh.
11. **Forest Conservation :** Factors contribution to the loss of forest biodiversity, IUCN categories of threat and Red Data Books; Principles and Practices for Conservation.

Suggested Readings:

Agrawal, H. O. and Seth, M. K. 2000. Sericulture in India Vols. I-IV. Bishen Singh Mahendra Pal Singh, Dehradun, 984 pp.

Bawa, R and Khosla, P. K. 1998. Biodiversity of Forest Species (A Community Forestry Approach) Bishen Singh Mahendra Pal, Dehradun, 218pp.

Carquist, S. 1988, Comparative wood Anatomy- Systematic, Ecological and Evolutionary Aspects of Dicotyledonous woods. Springer Veerlag, Berlin.

Dhar, U(Ed.) 1993. Himalayan Biodiversity. Him Vikas Publication No. 3, Gyanodya Prakashan, Nainital, 543pp.

Heywood, H. H. and Waston, R. T. 1995. Global Biodiversity Assessment, UNEP, Cambridge University Press, Cambridge, U. k.

Jane, F. W. 1970. The Structure of wood. Adam and Charles Blanck London.

Kothari,, A. 1997. Understanding Biodiversity: Life Sustainability and Equity. Orient Longman.

Krattiger, A. F. et. Al: (Eds.). 1994. Widening Perspectives on Biodiversity. Natraj Publishers, Dehradun, 473pp.

Nair, M. N. B. 1998. Wood Anatomy and Major Uses of Woods. Faculty of Forestry, University Putra, Malaysia, 434 PM Serdong, Selangor, Malaysia.

Nair, M. N. B. et. Al. (Eds.) 1998. Sustainable Management of Nonwood Forest Products. Faculty, University Putra Malaysia, 434004 PM Serdong, Selangor, Malaysia.

Panshin, A. J. and deZeeuw, C. Textbook of Wood Technology. Vol. I. Mc Graw Hill Book Co. , New York.

Rao, R. R. 1994 Biodiversity in India (Floristic Aspect) Bishen Singh Mahendra Pal Singh, Dehradun, 315pp.

Seth, M. K. 2002. Tress and Their Economic importanc.

Seth, M. K., Kumari, A., Takur,, R and Khullar, S. P. 2002.. Pictorial Guide to Common Himalayan Oteridophytes. Vol. I. Pteridophytes of Shimla.

Seth, M. K., Chandel,, S and Thakur, R. 2002 Shrubs and their Economic importance.

Prof. S. p. Khullar's Festschrift volume.

Seth, M. K., Sharma, S.. and Thakur, R. 2002. Pictoral Guide to some common shrubs of the Himalaya Vol. I.

Timell, T. E. 1986. Compression wood in Gymnosperms. Vols. I-III. Springer- Verlag

Berlin, Heidelberg, New York, Tokyo.

COURSE XV: SPECIAL PAPER

BIODIVERSITY, BIOPROSPECTING, ETHNOBOTANY AND SUSTAINABLE UTILIZATION OF PLANT RESOURCES

1. Biodiversity
Concepts, Extent and status of biodiversity in India, Cause of biodiversity loss
Mechanism for sustainable utilization of Biological resources
2. Himalayan Plant Resources
3. Wasteland Management in Himalayan region
4. Strategies for in situ and ex situ conservation of Biodiversity
5. Remote sensing and Bioresources
6. Bio-indicators
7. Red Data Book
8. Traditional Botanical Knowledge
9. Methods of Research in Ethnobotany
10. Sources in informatics of Medicinal Plant
11. Global importance of Medicinal Plant
12. Economic aspects of Exploitation of Medicinal plants
13. Conservation of plant genetics resources: The role of Biotechnology

Practicals:

1. Visits to tribal areas and collection of plant material used by tribes
2. Identification and description of 10 plants of ethnobotanical value
3. Identification and description of 10 plants used by tribal for their house hold
4. Collection of plants used by tribals in their socio-cultural customs and tabbos
5. Collection of 5 plants used by the tribals in their magico-religious belief.

Books:

Cotton, C. M. 1996. Ethnobotany- Principles and applications John Heywood, Wiley, V.(ed.) 1995. Global Biodiversity Assessment . Cambridge Univ. , Camb.

Jaon, S. K. (ed.) A. Manual of Ethnobotany Scientific

Pub., Jodhpur. Jain, S. K. (ed.) 1989. Methods and Approaches in Ethnobotany, Surya

Pub, Dehradun Swaminathan, M. S & Kocchar, S. L.(eds.) 1989. Plants and Society

Macmillan, Wagner, H., Hikino, H & Farnswarth, N. 1989. Economic and Medicinal Plant Research. Vils.1-3. Academic Press, London.

COURSE XV: SPECIAL PAPER

PLANT REPRODUCTION, TISSUE CULTURE AND HORTICULTURAL SCIENCES

1. Role of tapetum in pollen development
2. Subcellular detail of constituent cell of embryo sac.

3. Post- fertilization structural changes in embryo sac.
4. Intra-ovarian pollination
5. Gametic transformation
6. Cellular totipotency
7. In vitro- pollination
8. Nutrient media used for in vitro culture of plant tissues
9. Special methods of propagation
10. Applied aspects of cultivated plants
11. Growth regulators and their use in horticulture
12. Weed control
13. Packing systems
14. Principles of landscaping

Practicals: Based on the above topics

Suggested Reading:

Davis, H. & Heywood, V. H. 1963. Principles of angiosperm Taxonomy. Oliver & Boyd Edinburgh & London

Hartman H & Kester, D. E. 1972. Plant Propagation –m Principles and practices. Prentice Hall. Embryology of Angiosperms. Springer Verlag, New York.

Raghavan, V. 1976. Experimental Embryogenesis in Vascular plants. Academic Press, London

Stanley, R. G. & Linskens, H. F. 1974. Pollen- biology, Biochemistry, Management, Springer
Berlin- Heidelberg New York.

COURSE XV: SPECIAL PAPER

ADVANCED PLANT PHYSIOLOGY

1. Some important phytochemical techniques: Principles and applications of chromatography, electrophoresis, centrifugation and tracer techniques.
2. Physiology and biochemistry of phytochrome: Structure, biosynthesis, metabolism, transport, function and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroid, polyamines, jasmonic acid and salicylic acid.
3. Synthetic growth regulators: Discovery, chemical nature, effects on growth and development and mechanism of action of cycocel, Phosphon D, B-nine, AMO 1618, morphactin, phenolics.
4. Signal transduction: Overview, receptors and G proteins, phospholipid signaling, role of cyclic nucleotides, calcium- calmodulin cascade, diversity in protein kinases and phosphatase, sucrose- sensing mechanism.
5. Seed Physiology: Seed viability, longevity, biochemical deterioration, seed dormancy, metabolism of germination seeds, environmental and hormonal control of seed dormancy/germination
6. Senescence: Physiological and biochemical basis of senescence.

7. Stress Physiology: Concept of biological stress, plant responses and mechanism of tolerance of various abiotic stresses- Water- deficit stress, salinity stress, heavy metal toxicity and stress, freezing and heat stress, oxidative stress.

Suggested Readings:

Annual reviews of plant physiology and plant molecular biology

Aspinall D. and Paleg, L. G. (eds.) 1981. The physiology and biochemistry of drought resistance in plants, academic Press. London

Bewley, J. D. and Black, m. 1982 Physiology and biochemistry of seeds (vol 1 & 2) Springer Verlag

Buchana B. b., Grissem, W and Jones, R. I. 2000. Biochemistry and molecular biology of plants. American Society of plant physiologists, Maryland, USA

Freifelder, D. Physical biochemistry

Goodwin, T. W. and Mercer L. E. 1989. Introductory Plant Biochemistry, Pergamon Press, New York, USA

Moore, T. C. 1989 biochemistry and physiology of plant hormones (2 nd edition), Springer Verlag, New York, USA

Salisbury, F. B and Ross, C. W. 1992 Plant Physiology (4 th edition), Wadsworth Publishing company California, USA

Taiz, L. and Zeiger, E. 1998 Plant Physiology (2nd edition), Sinauer Associates Inc. Publishers, Massachusetts, USA

Wilkins M. B.(ed.) 1984.Advanced Plant physiology ELBS, Longman, U, K.