

# DEPARTMENT OF BOTANY

## SYLLABUS FOR M.Sc IN BOTANY

( CHOICE BASED CREDIT SYSTEM )

W.e.f. 2015-16



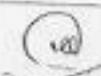
RAJIV GANDHI UNIVERSITY  
RONO HILLS::DOIMUKH

**Course Structure for CBCS in M.Sc. Botany (w.e.f 2015-2016)**

Semester	Course Code	Course Title	Teaching Hours/wk (L:T:P)	Credits	Total Credit
I	BOT- 411	Phycology and Bryophytes	3:1:0	4	22
	BOT- 412	Mycology and Plant Pathology	3:1:0	4	
	BOT- 413	Pteridophytes, Gymnosperms and Palaeobotany	3:1:0	4	
	BOT- 414	Angiosperms	3:1:0	4	
	BOT- 415	Practical I	0:0:6	3	
	BOT- 416	Practical II	0:0:6	3	
II	BOT- 421	General Microbiology	3:1:0	4	22
	BOT- 422	Bioresources Utilization	3:1:0	4	
	BOT- 423	Ecology and Environment	3:1:0	4	
	BOT- 424	Cell Biology and Genetics	3:1:0	4	
	BOT- 425	Practical III	0:0:8	4	
	BOT- 426	Field Report	0:0:4	2	
III	BOT- 531	Plant Physiology and Biochemistry	3:1:0	4	20
	BOT- 532	Practical IV	0:0:8	4	
	BOT- 533	Departmental Elective I	3:1:0	4	
	BOT- 534	Departmental Elective II	3:1:0	4	
	BOT- 535	Open Elective Biodiversity and Sustainable Development	3:1:0	4	
IV	BOT- 541	Molecular Biology	3:1:0	4	24
	BOT- 542	Plant Biotechnology	3:1:0	4	
	BOT- 543	Practical V	0:0:4	2	
	BOT- 544	Departmental Elective III	3:1:0	4	
	BOT- 545	Departmental Elective IV	3:1:0	4	
	BOT- 546	Departmental Elective V: Dissertation	0:0:12	6	
<b>Total Credit</b>					<b>88</b>

**Course Structure for CBCS in M.Sc. Botany**  
(w.e.f 2015-2016)

Semesters	Course Codes	Course Titles	Teaching Hours/wk (L:T:P)	Credits	Total Credits
I	BOT-411	Phycology and Bryophytes	3:1:0	4	22
	BOT-412	Mycology and Plant Pathology	3:1:0	4	
	BOT-413	Pteridophytes, Gymnosperms and Palaeobotany	3:1:0	4	
	BOT-414	Angiosperms	3:1:0	4	
	BOT-415	Practical I	0:0:6	3	
	BOT-416	Practical II	0:0:6	3	
II	BOT-421	General Microbiology	3:1:0	4	22
	BOT-422	Bioresources Utilization	3:1:0	4	
	BOT-423	Ecology and Environment	3:1:0	4	
	BOT-424	Cell Biology and Genetics	3:1:0	4	
	BOT-425	Practical III	0:0:8	4	
	BOT-426	Field Report	0:0:4	2	
III	BOT-531	Plant Physiology and Biochemistry	3:1:0	4	20
	BOT-532	Practical IV	0:0:8	4	
	BOT-533	Departmental Elective I	3:1:0	4	
	BOT-534	Departmental Elective II	3:1:0	4	
	BOT-535	Open Elective Biodiversity and Sustainable Development	3:1:0	4	
IV	BOT-541	Molecular Biology	3:1:0	4	24
	BOT-542	Plant Biotechnology	3:1:0	4	
	BOT-543	Practical V	0:0:4	2	
	BOT-544	Departmental Elective III	3:1:0	4	
	BOT-545	Departmental Elective IV	3:1:0	4	

  
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545 546				
BOT- 546	Departmental Elective V: Dissertation	0:0:12	6	
<b>Total Credit</b>				<b>88</b>

**BPGS Members:**

(Prof. D.K. Jha)  
External Member

(Prof. Rakhi Chaturvedi)  
External Member

(Prof. A. P. Das)  
External Member

(Prof. D. N. Das)  
Member, Allied Subject

(Prof. H. Sarma)  
Member, Allied Subject

(Dr. O.D. Nimasow)

(Prof. R. K. Singh)

(Dr. A.V. Singh)

(Prof. A. K. Das)  
HOD (I/C) & Chairman



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# SEMESTER - 1

## BOT 411 : Phycology & Bryophytes

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

### Unit I

Classification of algae; Chloroplasts & eyespots; Chromatic adaptation. Cell structure, Thallus organization & reproduction in Cyanophyta. ☺

### Unit II

Chlorophyta: General account of thallus organization; Reproduction; Life cycles and Alternation of generations. A brief account of Charophyta. ☺

### Unit III

Brief accounts of Charophyta, Xanthophyta and Bacillariophyta.

Phaeophyta and Rhodophyta: General characters, range of thallus organization, reproduction; Life cycle patterns and alternation of generations. ☺

### Unit IV

Bryophyta: Classification, Ecological significance. Comparative morphology and affinities of Hepaticopsida, Anthocerotopsida and Bryopsida. Evolution of Sporophyte in Bryophytes ☺

### Recommended Books

C.V.D. Hoek, D.G. Chapman	Algae: an introduction to phycology (1995), Cambridge University Press.
D.H. Campbell	The Evolution of Land plants (Embryophytes)
F.E. Fritsch	The structure and the reproduction of the algae, Vol. I & II, Vikas Publication House, New Delhi.
F.O. Bower	Primitive Land Plants
Gangulee and Kar	College Botany, Vol. II(1989), New Central Book Agency
H.C. Hoek, D.G. Mann & H.H. Johns	Introduction to Algae, 2 <sup>nd</sup> Edition, Prentice Hall of India, New Delhi.
Robert Edward Lee	Phycology 4th Ed., Cambridge Univ. Press
H.D. Kumar	Algal Cell Biology, Affiliated East West pvt. Ltd.
Ian Morris	An Introduction to The Algae (1973), Hutchinson University Library, London.
J.D. Dodge	Fine Structure of the Algal Cells, Academic Press
K. R. Sporne	The Morphology of Bryophytes.
N.S. Parihar	An introduction to Bryophytes
P. Puri	Bryophytes: Morphology, Growth and Differentiation.
S. R. Kashyap	Liverworts of the western Himalayan and Punjab Plains.
Alain Vanderpoorten & Bernard Goffinet (Eds.)	Introduction to Bryophytes, Cambridge University Press, 2009



विद्यया ऽमृतमश्नुते  
असतो ऽस्य मातृभ्यो  
ब्रह्म ऽस्य विश्वः  
Head

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# SEMESTER – I

## BOT 412 : Mycology & Plant Pathology

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

### Unit I

Classification of fungi. Life cycles. Sexuality in fungi. A general account of Myxomycota. Thallus organization and Reproduction in Chytridiomycota and Oomycota. A general account of Zygomycota. R

### Unit II

A general account of Ascomycota with reference to Saccharomycetales, Eurotiales, Erysiphales, Sphaeriales and Pezizales. Anamorphic forms of Ascomycota.

A general account of Basidiomycota with reference to Uredinales, Ustilaginales, Agaricales, Aphyllorphorales and Lycoperdales. R

### Unit III

Parasitism and Disease Development, Role of enzymes and toxins in plant diseases, Physiology of diseased plant, Defense mechanism of the host; Structural and chemical defense. T

### Unit IV

Management of plant diseases.

Study of symptoms, casual organisms, disease cycle and control measures of some important diseases of following plants in north-east India – Rice, Potato, Timber plants, and tea. T

### Recommended Books

Alexopoulos and Mims	Introduction Mycology, 4 <sup>th</sup> Edition (1996), Wiley
B. K. Bakshi	Forest Pathology: Principles and Practice in Forestry, FRI, Dehradun
C.J. Moore – Landecker	Fundamentals of the Fungi, 4 <sup>th</sup> Edition (1996), Prentice Hall.
G. Rangaswami	Diseases of crop Plants of India, 3 <sup>rd</sup> edition 1988, Prentice Hall, India.
G. N. Agrios	Plant Pathology, 3 <sup>rd</sup> Edition (1997), Academic Press.
H.C. Dubey	An Introduction to Fungi, 4 <sup>th</sup> Ed., Scientific Publishers, New Delhi, 2012
J. Webster	Introduction to Fungi (1980), Cambridge University Press.
J. W. Deacon	Introduction to Modern mycology (1988), E. Arnolds.
R. S. Mehrotra	Plant Pathology (1980), Tata-Mc Graw Hill.
R.S. Singh	Plant Diseases, Oxford & IBH, New Delhi.

  
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# BOT 413 : Pteridophytes, Gymnosperms & Palaeobotany

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

## Unit I

Pteridophytes : Classification, Life cycle patterns; Origin and evolution of Sporophytes; Diversity in Gametophytic and Sporophytic structure; evolution of Soral structures.  $\Delta \checkmark \checkmark$

## Unit II

Morphological, anatomical and reproductive characteristics of *Psilopsida*, *Lycopsida*, *Sphenopsida* and *Pteropsida*  $\Delta \checkmark \checkmark$

## Unit III

Palaeobotany: A general concept; Geological Time Scale; Process of Fossilization; Form taxa.

Study of following types and important groups: *Rhynia*, *Astroxylon*, *Psilophyton*, *Calamites*, & *Sphenophyllum*; Seed ferns; Cordaitales; Bennettitales and Pentoxylales  $\checkmark$

## Unit IV

Diversity, distribution and comparative study and general characteristics of Cycadales, Coniferales, Taxales, Ginkgoales & Gnetales  $\Delta \checkmark$

## Recommended Books

Banks, H.P. 1970	Evolution and Plants of the Past, Wadsworth.
Bierhost, D.W. 1971	Morphology of Vascular Plants, MacMillan Co., New York.
Chamberlain, C.J. 1935	Gymnosperms, structure & evolution, University of Chicago Press.
Copeland, E.B.	Genera Fillicum.
Dyer, A.C. 1979	The experimental Biology of Ferns, Academic Press, London.
Eames, E.J. (Ed.) 1998	The families & genera of vascular plants, Vol. 1, Pteridophytes & Gymnosperms, Norosa Publishers, New Delhi.
Foster, A.S. & E.M. Grifford 1974	Comparative Morphology of Vascular Plants, Freeman.
Maheswari, P. & V. vasil	Gnetum, CSIR, New Delhi
Parihar, N.S. 1990	An Introduction to Embryophyta, Vol. I, Pteridophytes & Gymnosperms, Norosa Publishers, New Delhi.
Raashid	An introduction to Pteridophytes.
Seward, A.C. 1978.	Cambridge Botanical Handbooks, Vol. I-III.
Sharma, O.P.	Textbook of Pteridophytes.
Sporne, K.R. 1971	The Morphology of Pteridophyta.
Wilson NS & Rothwell WG (2005)	Paleobotany & Evolution of Plants. Foundation Books Pvt Ltd, New Delhi

# SEMESTER – I

## BOT 414 : Angiosperms

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

### Unit I

International Code of Nomenclature; Nomenclatural Rules; Identification Keys

Classifications: Cronquist and APG III; Comparative Morphology; Concept of Biosystematics; Character Concept; Taximetric & Cluster Analysis; Dendrogram and Cladogram

### Unit II

Dicotyledons: Evolution, Phylogeny & Range of Floral Structure in Magnoliales, Malvales, Rosales, Leguminales, Asterales

### Unit III

Monocotyledons: Evolution, Phylogeny & Range of Floral Structure in Orchidales, Poales, Zingiberales, Liliales

### Unit IV

Origin and geographical distribution of Angiosperms; Concept of Endemic & Exotic species; IUCN Red list Categories; Significance of the flora of Northeast India

### Recommended Books

S S Bhojwani and S.P Bhatnagar	Embryology of Angiosperms, Vikash Publishing House, New Delhi
Grant, W.F. 1984	Plant Biosystematics. Academic Press, London.
Heywood, V.H. & Moore, D.M. 1984	Current Concepts in Plant Taxonomy. Academic Press, London.
Jain, S.K. & R.R. Rao (1977)	Field & Herbarium Methods, Today & Tomorrow's Printer & Pub., Delhi.
Jones, S.B., Jr and Luchsinger, A.E. 1986	Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
Radford, A.E. 1986	Fundamentals of Plant Systematics. Harper & Row Publications, USA.
Sivarajan, V.V (1999)	Principles of Plant Taxonomy, Oxford & IBH, New Delhi.
Pandey BP (1998)	Taxonomy of Angiosperm. S. Chand & Co. New Delhi
Stace, C.A. 1989	Plant Taxonomy and Plant Biosystematics (2nd Ed). Edward Arnold Ltd., London.
Stebbins	Flowering Plant-Evolution Above Species Level. Edward Arnold Ltd., London
Woodland, D.W. 1991	Contemporary Plant Systematics. Prentice Hall, New Jersey.
Gurcharan Singh (1998)	Plant Systematic: Theory & Practices. Oxford & IBH, New Delhi
G.M. Lawrence	Taxonomy of Vascular Plants
Cronquist	An Integrated System System of Classification of Flowering
BSI	Flora of India (all Volumes), BSI Publication, Kolkata
Pandey AK & Das AP	Plant Taxonomy: Advances & Relevances, Bishen Singh & Mahindra Pal Singh, Dehradun



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## SEMESTER – I

### BOT 415 : PRACTICAL I (Phycology & Bryophytes; Mycology & Plant Pathology)

End Semester Exam.: 80 Marks Internal Assessment Exam.: 20 Marks Pass Marks: 40% Each

Credit: 3

1. Phycology & Bryophytes : 35 Marks
  - (i) Thallus organization and reproductive structure of some important algal genera (Fresh water and Marine forms)
  - (ii) Vegetative, reproductive and anatomical structures of some important genera of Bryophytes
  
2. Mycology & Plant Pathology : 35 Marks
  - (i) Vegetative and reproductive structures of some important fungal genera.
  - (ii) Disease symptoms, casual organisms of some important plant diseases.
  
4. Practical Records : 10 Marks
  
5. Viva-Voce : 10 Marks

#### Recommended Books

S. C. Santra, T. P. Chatterjee and A. P. Das.	College Botany Practical, Volume I & II, CBS Publishers, Kolkata.
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## BOT 416 : PRACTICAL II (Pteridophytes, Gymnosperms & Paleobotany; Angiosperms)

End Semester Exam.: 80 Marks Internal Assessment Exam.: 20 Marks Pass Marks: 40% Each

Credit: 3

1. Pteridophytes, Gymnosperms and Paleobotany : 35 Marks
  - (i) Morphology and anatomy of sporophytes of some living Pteridophytes
  - (ii) Morphology and anatomy of vegetative and reproductive parts of some Gymnosperms
  - (iii) Study of some fossil forms and slides
2. Angiosperms : 35 Marks
  - (i) Detailed Morphology and identification of Angiospermic plants
  - (ii) Temporary preparation and study of pollen types
4. Practical Records : 10 Marks
5. Viva-Voce : 10 Marks

### Recommended Books

SC Santra, T.P Chatterjee & A. P. Das	College Botany Practical, Volume I & II, CBS Pub., Kolkata.
Gurcharan Singh (1998)	Plant Systematics -Theory and Practices, Vikash Pub. House, Delhi
Wilson NS & Rothwell GW (2005)	Paleobotany & Evolution of Plants. Foundation Books Pvt. Ltd, Delhi
Sinha, RK (2009)	Practical Taxonomy of Angiosperm. IK Int. Pub. House, Delhi

**SEMESTER – II**  
**BOT 421 : General Microbiology**

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

**Unit I**

Bacteria –Cell structure, Capsule, Flagella, Pili/Fimbrac, Cell wall (Gram positive & negative), Spores and Cysts, Classification and nomenclature. Reproduction: Transformation; conjugation and transduction and recombination in bacteria.

**Unit II**

Characteristics of Archaeobacteria, Eubacteria and Actinomycetes; Characteristic and classification of Mycoplasma

Structure of different types of viruses (Helical, icosahedral, complex), DNA and RNA viruses. Bacteriophages, Viroids, Prions

**Unit III**

Isolation, cultivation and maintenance of microorganisms (fungi, bacteria & actinomycetes): Culture media, sterilization and disinfection, batch culture, synchronous culture and continuous culture. Growth curve and factors affecting growth rates

**Unit IV**

Food Microbiology: Spoilage and preservation of food, Fermented food products, Food poisoning. Alcoholic fermentation. Production of acetic acid. Some industrially important microbial enzymes and antibiotics; Extremophiles and their biotechnological applications

**Recommended Books**

D. K. Maheswari and R C Dubey	Microbiology , S. Chand & Co., Delhi
H.G. Schlegel	General Microbiology. Cambridge University Press, UK.
P. Tauro, K.K. Kapoor and K.S. Yadav	An introduction to Microbiology. New Age International Pvt. Ltd., New Delhi.
Pelezar and Reid	Microbiology.
R.R. Mishra	Soil Microbiology. CBS Publishers and Distributors, New Delhi.
R.Y. Stanier et al.	General Microbiology. The McMillan Press Ltd., London.
Gerard J. Tortora	Microbiology - An Introduction 10th Ed., Pearson, 2010
Jacquelyn G. Black	Microbiology - Principles and Explorations 8th Ed., John Wiley & Sons.
N.J. Dimmock	Introduction to Modern Virology 6th Ed. , Blackwell Pub.
Michael T. Madigan	Brock Biology of Microorganisms 13th Ed. , Pearson International

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## SEMESTER – II

### BOT 422 : Bio-resources Utilization

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

#### Unit I

**Bioresources:** Basic concept of plant utilization; Ecological role plant world; Concept of sustainable utilization; Domestication of plants

#### Unit II

**Crop Diversity:** Food, forage and fodder crops; Cultivars and land races and their conservation and significance

Medicinal and aromatic plants: Diversity, distribution, status and their economic exploitation

#### Unit III

**Timber & non-timber forest products:** Wild edible plants and their commercial exploitation.

Important Horticultural, Floricultural, Plantation and Cash crops and their significance with particular reference to north east India

#### Unit IV

**Microbial Resources:** Commercial exploitation of algae as pigments, Fine chemicals, Biofuel, Bioremediation agents. Biofertilizer and Biopesticides; Industrial enzymes.

#### Recommended Books

Anonymous	The wealth of India, CSIR pub. New Delhi.
O.P. Sharma 1996	Hill's Economic Botany, Tata McGraw Hill, New Delhi.
S.L. Kocchar 1998	Economic Botany of the Tropics, 2 <sup>nd</sup> ed. MacMillan India Ltd., Delhi.
Purkayastha	Mushroom Cultivation
Pandey BP (1999)	Economic Botany, S.Chand & Co. New Delhi
Choudhery	Material for the Flora of Arunachal Pradesh
AP Das & AK Pandey	Advances in Ethnobotany - Bishen Singh & Mahendra Pal Singh, Dehra Dun
BSI	Flora of India Series (all Volumes)

## SEMESTER - II

### BOT 423: Ecology and Environment

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

#### Unit I

Ecosystem: Concept, structure and functions; Productivity and its measurements; Law of thermodynamics in Ecology, energy flow; ecological efficiency, nutrient cycling. Wetlands

#### Unit II

**Population Ecology:** Population growth and carrying capacity of environment; Population structure; biotic potential; population regulation; r and k selection; species interaction and competition, biotic interactions

#### Unit III

**Community Ecology:** Concept; Community analysis; analytical and synthetic characters; Species diversity and dominance (Simpson's and Shannon-Wiener diversity indices); Ecological niche; Community dynamics; Ecological succession; types and mechanism; Climax and stability

#### Unit IV

**Pollution:** Types, Sources, Impact and Control; Green house Gases, Ozone layer depletion; Climate change: factors and consequences; Environmental Impact Assessment and Management Plan

#### Recommended Books

Agarwal, S.K.	A Textbook of Plant Ecology
Ambasht and Ambasht	Environmental Pollution. Students Friends Publishers, Varanasi.
Ambasht, R.S. 1990	A Textbook of Plant Ecology, Students Friends Publishers, Varanasi.
Cutter, S.L. (Ed.) 2006	Environmental Risks & Hazards, Prentice Hall Pvt. Ltd., New Delhi.
Katyal, T. and Satake, M.	Environmental Pollution (1998), Anmol Publishers Pvt. Ltd., new Delhi.
Kormondy, E.J. 1996	Concepts of Ecology, Prentice-Hall of India Pvt. Ltd., new Delhi
Odum, E.P. 1996	Fundamentals of Ecology, Natraj Publishers, Dehra Dun.
Sahni, P., Dhameja, A. & medury, U.(Eds.) 2006	Disaster mitigation: Experiences & Reflection, Prentice Hall Pvt. Ltd., New Delhi.
Sharma, P.D.	A Textbook of Environmental Biology.
Ernst-Detlef Schulze	Plant Ecology, Springer
Singh, J. S.	Ecology, Environment and Resource Conservation, Anamaya Publishers, 2008
Eldon D. Enger	Environmental Science - A Study of Interrelationships 12th Ed., McGraw Hill
William P. Cunningham	Environmental Science - A Global Concern 12th Ed., McGraw Hill

  
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## SEMESTER – II

### BOT 424 : Cell Biology and Genetics

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0=4

#### Unit I

Plasma Membrane: Structure and chemical composition of plasma membrane, transport across membrane. Cytoskeleton. Protein modification in ER and Golgi. Vesicular transport, Secretory and Endocytic pathways

#### Unit II

Chloroplast: Structure and function, Thylakoid membrane; Photosynthetic pigments and light harvesting complexes; Mitochondria: Structure and function; Mitochondria and chloroplast genome. Targeting of proteins to chloroplast and mitochondria

#### Unit III

Nucleus: Nuclear pore complex; Nuclear matrix; Nucleolus & biogenesis of ribosome; Cell cycles, control mechanism, role of cyclins and cyclin-dependent kinases; mitotic apparatus; synaptonemal complex

Structure and organization of chromosome, Polythene & Lampbrush chromosomes, Karyotype.

#### Unit IV

Modifications of Mendelian inheritance; Linkage and crossing over, chromosome mapping; Cytoplasmic inheritance; Linkage groups; Sex-chromosomes and Sex-linked inheritance

Chromosomal Mutation: Structural & numerical changes in chromosome. Physical and Chemical mutagens, Spontaneous and induced mutations.

#### Recommended Books

Sharma, A.K.	Chromosome Technique: Theory & Practice
Cooper, G. M.	The Cell: a Molecular Approach, 5 <sup>th</sup> edition, ASM Press.
Damell et al.	Molecular Cell Biology, Freeman & Co.
Karp, G.	Cells and Molecular Biology: Concepts and Experiments, 7th Ed., 2013, John Wiley & Sons
Karp, G.	Cell Biology, 7 <sup>th</sup> Ed., John Wiley & Sons
Alberts, Bruce	Essential Cell Biology 4th Ed., Garland Science. Taylor and Francis
Wilson, John	Molecular Biology of the Cell - The Problems Book, Garland Science. Taylor and Francis
Lodish, Harvey	Molecular Cell Biology, 7 <sup>th</sup> Ed. W H Freeman

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**SEMESTER – II**  
**BOT 425 : PRACTICAL III**

**(Microbiology, Bio-resources, Ecology & Cell Biology and Genetics)**

End Semester Exam.: 80 Marks Internal Assessment Exam.: 20 Marks Pass Marks: 40% Each

Credit: 4

1. Microbiology : 25 Marks
  - (i) Gram staining, flagella and capsule staining
  - (ii) Isolation of Rhizobium from root nodules.
  - (iii) Media preparation, Isolation of microbes and culture
  - (iv) Pure culture preparation
  - (v) Effect of temperature, pH and Carbon source on bacterial growth
  - (vi) Phosphatase test of milk
  - (vii) Isolation of bacteria from water and milk
  - (viii) Antibiotics sensitivity test by paper disc method
2. Ecology & Environment : 25 Marks
  - (i) To find out minimum size of quadrats or sample size of plant community by Species Area Curve Method
  - (ii) Study of plant community by quadrat and Line Transect methods
  - (iii) Determination of Importance Value Index (IVI) of dominant species of protected and grazed grasslands
  - (iv) GPS Coordinates
  - (v) Physico-chemical analysis of
    - (a) Soil: pH, Nitrogen, Phosphorus, Bulk density, porosity and moisture content of soil samples.
    - (b) Water: pH, BOD, Total dissolved solids and DO
3. Bioresources : 10 Marks
  - (i) Germplasm collection of land races of food, forage and fodder crops including medicinal & aromatic plants
  - (ii) Study of characteristic features of selected fruit & seed types including seed biology
4. Cell Biology and Genetics : 20 Marks
  - (i) Study and permanent preparation of slides of mitotic and meiotic stages, Anaphase bridge and Translocation rings
  - (ii) Karyotype and Idiogram
  - (iii) Preparation of chromosome map with the help of data provided
4. Practical Records : 10 Marks
5. Viva-Voce : 10 Marks

**Recommended Books**

S. C. Santra, T. P. Chatterjee and A. P. Das.	College Botany Practical, Volume I & II, CBS Publishers, Kolkata.
D. K. Maheswari and R C Dubey	Practical in Microbiology, S. Chand & Co., Delhi
J.B.Harborne	Phytochemical Methods- Chapman & Hall Publishers
T.C Harborne	Phytochemical Methods: A Guide to Modern techniques of Plant analysis - Chapman and Hall, London
S.B Gokhale and C.K Kokate	Pharmacognosy - Pragati Prakasha
N. Raaman (2006)	Phytochemical Techniques - New India Publishing House, Delhi

  
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## SEMESTER – III

### BOT 531 : Plant Physiology & Biochemistry

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0=4

#### Unit I

Absorption and transport of water and solutes; mineral nutrition and deficiency symptoms;; mechanism of photosynthesis ( $C_3$ ,  $C_4$  and CAM metabolism); Respiration (Aerobic and Anaerobic)

#### Unit II

Photoperiodism; regulation of flowering; phytohormones; dormancy and vernalization; fruit ripening. Plant movements. Stress physiology

#### Unit III

Proteins, Lipids and Nucleic acids. Thermodynamics principles; Enzymes: classification, kinetics and inhibition; Control of enzyme action

#### Unit IV

Structure of Carbohydrates, Metabolism of Carbohydrates, Fatty acids and Lipids;

#### Recommended Books

Benner, J. and J.E. Varner	Plant Biochemistry, Academic Press, New York.
Bhal & Bhal	Biochemistry.
Donald Voet, Akif Uzman	Fundamentals of Biochemistry 4th Ed., John Wiley & Sons.
Hames, D.	Instant notes in Biochemistry, BIOS
Helgi Opik	The Physiology of Flowering Plants 4th Ed. Cambridge Univ. Press
K.V. Madhava Rao	Physiology and Molecular Biology of Stress Tolerance in Plants, Academic Press.
Lehninger Nelson & Cox	Principles of Biochemistry, CBS Publishers & Distributors, New Delhi.
Malik and Srivastava	Textbook of Plant Physiology, McMillan Press Ltd., New Delhi.
Pandey, S.N. and B.K. Sinha.	Plant Physiology, Vikash Publishing House Pvt. Ltd., New Delhi.
Salisbury, F.B. and W. Ross	Plant Physiology, CBS Publishers & Distributors, New Delhi.
Stryer, L.	Biochemistry, W.H. Freeman & Co., New Delhi.
Taiz, L and Zeiger, E.	Plant Physiology, 5 <sup>th</sup> Ed., 2010, Sinauer Associates
Weil, J.H.	General Biochemistry, New Age International Ltd. Publishers, New Delhi.
William G. Hopkins	Introduction to Plant Physiology 4th Ed. , John Wiley and Sons.
Zubay	Biochemistry 4th edition 1998 William C. Brown Publication

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## SEMESTER – III

### BOT 532: PRACTICAL IV (Plant Physiology and Biochemistry)

End Semester Exam.: 80 Marks Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 4

I (a) Plant Physiology: : 30 Marks

- (i) Extraction of pigments from leaves and preparation of absorption spectrum of chlorophylls and carotenoids
- (ii) Chromatographic separation and colorimetric estimation of photosynthetic pigments
- (iii) To determine chlorophyll a/ chlorophyll b ratio in  $C_3$  and  $C_4$  plants
- (iv) Extraction and estimation lycopene pigments by spectrophotometric method

I (b) Plant Biochemistry : 50 Marks

- (i) Estimation of carbohydrates, Protein, Nucleic acids and lipids.
- (ii) To extract enzymes & study their activity e.g. amylase, acid phosphatase.
- (iii) Effect of temperature, enzyme and substrate concentrations on enzyme activity
- (iv) Extract of substrate concentration on activity of any enzyme & determination of  $V_{max}$  &  $K_m$  by Michelis-Menton equation and Lineweaver Burk plots
- (v) TLC and Chromatographic separation of amino acids from plant tissue

3. Practical Records : 10 Marks

4. Viva-Voce : 10 Marks

#### Recommended Books

Harisha, S. | Biotechnology Procedures and Experiments Handbook, Infinity Science Press, New Delhi, India

  
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## SEMESTER – III

Students can choose any two papers from the following as Department Elective I/Department Elective II. One of the selected papers will be treated as BOT 533 and the second as BOT534.

### (BOT 533/BOT534 Departmental Elective I & II)

#### BOT 533/534 A : Biotechniques, Biostatistics and Bioinformatics

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

#### Unit I

Microscopy: Principles and techniques, Phase-Contrast, Fluorescence, SEM and TEM

Microtomy: Fixation and Staining techniques;

Chromatography: Principle, types and applications

Centrifugation: Principles and types

Electrophoresis: Principle, types and applications (Agarose Gel, PAGE & 2D)

#### Unit II

Blotting techniques, Polymerase chain reaction. Sequencing of DNA: dideoxy and pyrosequencing, Protein sequencing; Molecular techniques: Real time PCR, RFLP, RADP, AFLP, ISSR, Microarray technology.

Spectroscopy: Principle, types and applications (UV-VIS, Atomic absorption and Emission)

Application of Tracer technique in Biology; Autoradiography; Liquid scintillation counter.

#### Unit III

Sampling design, measurement of central tendency, measures of dispersion, Null hypothesis, t-test, chi square test, probability distribution, Correlation and regression, analysis of variance (one and two way), CD, LSD, Student's Newman Keul's Test, DMRT

#### Unit IV

Bioinformatics: Concept & Objectives; Genome project; Data base search; Data mining and analysis; Genomics & proteomics, Phylogenetic analysis.

#### Recommended Books

Steven E Ruzin	Plant Microtechnique and Microscopy, Oxford University Press 1999
John D. Bancroft and Marilyn Gamble, editors,	Theory & Practice of Histological Techniques, 6th Edition, Churchill Livingstone, 2002
Wayne Becker, Lewis J. Kleinsmith, Jeff Hardin	Guide to Microscopy, Benjamin-Cummings Pub Co, 2003
Keith Wilson & John Walker, 2004	Practical Biochemistry, Cambridge University Press, UK.
Normal T.J. Bailey, 2004	Statistical Methods in Biology, Cambridge University Press, UK.
Sundar Rao & Richard, J.	Introduction to Biostatistics & Research Methods, 4 <sup>th</sup> edition. Prentice Hall of India Pvt. Ltd., New Delhi.
Gomez K. A. and Gomez A. A	Statistical Procedures in Agricultural Research, 2nd edition, 1984, Wiley
Rodney Boyer	Biochemistry Laboratory: Modern Theory and Techniques, Pearson

✓ SEMESTER – III

**BOT 533/534 B : Fruit and Plantation Crops**

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0=4

**Unit I**

A general introduction of fruit and plantation crops; agro-climatic conditions; botany and varieties; traditional and advanced techniques of propagation; fertigation & organic certification

**Unit II**

Apple, Orange, Kiwi and Strawberry- cultivation techniques.

Coffee and Tea - cultivation and processing

**UNIT III**

Cashew, Rubber, Palmyra and oil palm –cultivation, harvesting, processing,

**UNIT IV**

Important diseases of plantation crops; Post-harvest fungal diseases of fruits,

Biochemical changes in fruits, Management of post harvest fungal diseases.

**Recommended books**

<i>Anonymous, 1985</i>	Rubber and its Cultivation. The Rubber Board of India
<i>Chopra VL &amp; Peter KV. 2005</i>	Handbook of Industrial Crops. Panima
<i>Harler CR. 1963</i>	The Culture and Marketing of Tea. Oxford Univ. Press
<i>Kurian A &amp; Peter KV. 2007</i>	Commercial Crops Technology. New India Publ. Agency
<i>Nair MK, Bhaskara Rao EYV, Nambiar KKN &amp; Nambiar MC. 1979</i>	Cashew, CPCRI, Kasaragod
<i>Peter KV. 2002</i>	Plantation Crops. National Book Trust
<i>Ranganathan V. 1979</i>	Hand Book of Tea Cultivation. UPASI, Tea Res. Stn. Cinchona
<i>Srivastava HC, Vatsaya B &amp; Menon KKG. 1986</i>	Plantation Crops – Opportunities and Constraints. Oxford & IBH

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SEMESTER – III (Departmental Elective II)

BOT 533/534 C: Medicinal and Aromatic Plants

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 2:1:1=4

Unit I

AKO Agrotechnology of Medicinal and Aromatic Plants: Cultivation, harvesting and crude drug processing methods of the following species: *Cinnamomum tamala*, *Adrographis paniculata*, *Curcuma longa* and *Paris polyphylla*

Unit II

HT Pharmacognostic studies of crude drugs: Standardization and quality control of crude drugs, economic valuation and market linkages studies of the following crude drugs- *Cinnamomum tamala*, *Adrographis paniculata*, *Curcuma longa* and *Paris polyphylla*

Unit III

AVS Extraction of crude drug: Methods, relevant tools and techniques, Phytochemical investigation (TLC studies of crude drug)

Unit IV

AVS Drug isolation from herbal sources: tools and techniques, formulation of herbal supplements for particular diseases/ailments, pharmacological studies of crude drug/formulated supplements on animal (rat) model

Recommended Books

Bishen Singh Mahendra Pal Singh	Demand & Supply of Medicinal Plants in India, National Medicinal Plants Board (2008).
Alice Kurian & M. Asha Sankar	Horticulture Science Series-2, New India Publishing Agency (2007).
Adam Stainton	Flowers of the Himalaya – A Supplement, Oxford University Press (1988).
Oleg Polunin & Adam Stainton	Concise Flowers of the Himalayas, Oxford University Press (1987).
Kamal Bawa, Sandesh Kadur	Ashoka Trust for Research in Education & the Environment (2013).
S.N. Hegde (ed) SFRI 2002	Arunachal Pradesh State Biodiversity Strategy & Action Plan, SFRI, Itanagar

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## SEMESTER – III (Departmental Elective II)

### BOT 533/534 D: Mushroom Cultivation

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 2:1:1=4

#### Unit I

Mushrooms: Habitats and distribution, Morphological characteristics, Life cycle, Nutritional and environmental requirements

Importance, Nutritional and medicinal values of mushrooms; Global and National production and marketing. Prospect of mushroom cultivation in Arunachal Pradesh

#### Unit II

Techniques of Mushroom Cultivation: Culture preparation and preservation techniques, Spawn production technology, Raw materials, Substrate preparation and supplementation; Crop management

#### Unit III

Cultivation technology of popular mushrooms: *Agaricus*, *Pleurotus*, *Volvariella*, *Flammulina*, *Lentinula* and *Ganoderma*

#### Unit IV

Diseases of mushrooms and their management; Post harvest technology

Farm design: Small and large scale cultivation units;

Economics of Cultivated Mushrooms

#### Recommended Books

Kaul, T.N. (1999)	Introduction to Mushroom science (systematic). Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi And Calcutta
Singh, Manjit, B.Vijay, S. Karnal & G.C. Wakchaure (2011)	Mushrooms, Marketing and Consumption. Directorate of Mushroom Research, ICAR, Chambaghat -Solan, (H.P)
Purkayastha, R.P. and Andrilla Chandra	Manual of Indian Edible Mushrooms. Today & Tommorrow's Printers and Publishers, 24-B/5, Desh Bandhu Gupta Road, New Delhi-110005
Dube, H.C.(2004)	An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., 576, Masjid Road, Jangpura, New Delhi-110014
Kapoor, J.N. (1999)	Mushroom Cultivation. Publications and Information Division, ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi-1100012

  
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## SEMESTER – III (Open Elective)

### BOT 535 : Biodiversity and Sustainable Development

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0 =4

#### Unit I HE

**Biodiversity:** Definition, perspective and overview; Concept of Hotspots; Megadiversity regions of the world; Biodiversity as a renewable resource; Linkages of biodiversity with development

#### Unit II

**Threat Factors:** Natural and anthropogenic factors of biodiversity loss; Habitat fragmentation; Threatened & endangered species; Extinction & extinction thresholds; Causes of extinction & species extinction rate

#### Unit III APD

**Conservation & Management of Biodiversity:** UN convention of Biological diversity; World Convention on Sustainable Development; Forest Conservation Act; National Biodiversity Act 2002; CITES, IUCN; PAN; EMP; Biodiversity Register; Concept of *in situ* & *ex situ* conservation

#### Unit IV

**Sustainable Development:** Concept of Sustainable Development; Sustainability; Substituting for Ecosystem Services; Biodiversity and Sustainable Forestry; Natural Disturbance Regimes; Community & Farmers' Rights; Customary Laws & Ethics

#### Recommended books

IUCN-Guidelines (1989)	International Union for Conservation of Nature and Natural Resources
CoB Report	Report on World Convention on Biodiversity 1992
Johannesburg Summit 2002	Report on World Convention on Sustainable Development, 2002
National Biodiversity Act, 2002	Reopt of the National Biodiversity Act 2003
Har Darshan Kumar (1999):	Biodiversity and Sustainable Conservation; Oxford & IBH publishing Co. Pvt. Ltd., New Delhi

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## SEMESTER – IV

### BOT 541 : Molecular Biology

Internal Assessment Exam.: 20 Marks

End Semester Exam.: 80 Marks

Credit: 3:1:0 =4

Pass Marks: 40% Each

#### Unit I

DNA supercoiling; Repetitive sequences, Reassociation kinetics and Cot curve; Organization of prokaryotic and eukaryotic genome. Transposable elements.

#### Unit II

DNA replication: Creation of replication fork. Models of DNA replication: Theta, Rolling circle and D-loop. DNA polymerases, ligases and topoisomerases. Telomere and telomerase, Reverse transcription.

Molecular basis of mutations, DNA repair mechanisms.

#### Unit III

Transcription: Chromatin remodelling complex; Mechanism of transcription in prokaryotes and eukaryotes; RNA processing; Classes of Introns, Ribozyme

Translation: Mechanism of Protein synthesis; Post-translational modification of proteins

#### UNIT IV

Regulation of gene expression in prokaryotes: Operon concept; attenuation and anti-termination; Regulation of Gene expression in eukaryotes: transcriptional, processing, transport and translation levels.

#### Recommended Books

Clark, D.	Molecular Biology, Academic Press, 2010
Karp, G.	Cells and Molecular Biology: Concept and Experiments. John Wiley & Sons.
Lewin, B.	Genes XI, Oxford University Press, New York.
Weaver, Robert F.	Molecular biology, 5th ed., McGraw-Hill
Lodish, H., Berk, A., et al. 2000	Molecular Cell Biology (4 <sup>th</sup> edition). W.H. Freeman and Co., New York.
Turner, P.	Instant notes in Molecular Biology, BIOS
Cooper, G. M.	The Cell: a Molecular Approach, 5 <sup>th</sup> edition, ASM Press.
Karp, G.	Cells and Molecular Biology: Concepts and Experiments, 7th Ed., 2013, John Wiley & Sons
Alberts, Bruce	Essential Cell Biology 4th Ed., Garland Science. Taylor and Francis
Wilson, John	Molecular Biology of the Cell - The Problems Book, Garland Science.
Lodish, Harvey	Molecular Cell Biology, 7 <sup>th</sup> Ed. W H Freeman
Brown, T.A.	Genomes 3, Garland Science.
Weising, Kurt., et al.	DNA Fingerprinting in Plants: Principles, Methods, and Applications, 2 <sup>nd</sup> Ed., 2005, CRC Press
Katoch, Rajan	Analytical Techniques in Biochemistry and Molecular Biology, Springer
Ahmed S	Basic Techniques in Biochemistry and Molecular Biology, Anmol Publications, New Delhi.

  
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## SEMESTER – IV

### BOT 542: Plant Biotechnology

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0=4

#### Unit I

Cellular totipotency; Micropopagation; Organogenesis; Somatic embryogenesis; mechanisms, techniques and utility. *In vitro* Haploid production: Androgenesis, Gynogenesis, Distant hybridization; Triploid production by Endosperm culture; Role of haploids & triploids in plant improvement

#### Unit II

Somaclonal variation; Protoplast isolation, fusion and culture, Hybridization and cybridization; Synthetic seed production & application. Cryopreservation

#### Unit III

Gene cloning: principles and techniques, cloning & expression vectors, host transformation & selection. Recombinant DNA libraries. Enzymes used in Gene cloning

#### Unit IV

Plant genetic Engineering: *Agrobacterium* mediated gene transfer, Ti plasmid, Co-integrate and binary vectors, Plant viruses as vector, Direct DNA transfer techniques. Advantages and disadvantages of transgenic plants. Molecular pharming. Edible vaccines

#### Recommended Books

Jha, T. B. & Ghosha, B.	Plant Tissue Culture: Basic and Applied, Universities Press, Hyderabad
Neumann, K., Kumar, A. & Imani, J.	Plant Cell and Tissue Culture - A Tool in Biotechnology, Springer
George, E. F. & Hall, M.A. (Ed)	Plant Propagation by Tissue Culture, 3rd Edition, (Volume 1 & 2), Springer
Smith, R. H.	Plant Tissue Culture: Techniques and Experiments, Academic Press, 2013
Primrose, S. B.	Gene Manipulation, Blackwell.
Clark, D. P. & Pazdernik, N. J.	Biotechnology, 2012 Elsevier Inc. 2012
Gupta, P.K.	Biotechnology, Rastogi Publication, Meerut.
John, C.K. and R.S. Nadgauda	Tissue Culture of Economic Plants, CSIR, New Delhi. 1997
Kumar, H.D.	A Textbook of Biotechnology. Satish Book Enterprise, Agra.
Singh, B.D.	Biotechnology, Kalyani publishers, 2010
Purohit, S.S. and S.K. Mathur	Biotechnology: Fundamental and Applications. Agro Botanica, India. 1990
Narayanan, P.	Bioinformatics, New Age International Publishers, New Delhi. 2005
Rastogi, Mendi Ratta & Rastogi	Bioinformatics: Methods and Applications – Genomics, Proteomics & Drug Discovery. Prentice Hall of India Pvt. Ltd., New Delhi.
Purohit, S.S.	Laboratory Manual of Plant Biotechnology. Satish Book Enterprise, Agra.
David R. Westhead	Instant Notes in Bioinformatics, BIOS
Bergeron, B.2006	Bioinformatics computing Prentice Hall of India Pvt. Ltd., New Delhi.

## SEMESTER – IV

### BOT 543 : Practical V (Molecular Biology; Plant Biotechnology)

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 2

1. Molecular Biology : 40 Marks
  - (i) Extraction of DNA and RNA
  - (ii) Amplification of DNA by PCR
  - (iii) Resolution of DNA through Agarose gel electrophoresis
  - (iv) Extraction of Proteins and its resolution through SDS-PAGE
2. Plant Biotechnology : 40 Marks
  - (i) Preparation of culture media
  - (ii) Techniques of tissue culture
  - (iii) Surface of sterilization of explants and transfer of culture media
  - (iv) Demonstration of callus formation and regeneration of plantlets
  - (v) Demonstration of auxin concentration from growth curve
3. Practical Records : 10 Marks
4. Viva-Voce : 10 Marks

#### Recommended Books

S. Harisha	Biotechnology Procedures and Experiments Handbook, Infinity Science Press, New Delhi, India
Sambrook, J., Fritsch, E.F., & Maniatis, T. (Eds)	Molecular Cloning: A Laboratory Manual, Vol (I-III), Cold Spring Harbor Laboratory Press

**SEMESTER – IV**  
**(Departmental Elective III)**

**BOT 544 A: Taxonomy of Angiosperms and Ethnobotany I**

End Semester Exam.: 80 Marks

Internal Assessment Exam.: 20 Marks

Pass Marks: 40% Each

Credit: 3:1:0=4

**Unit I**

**Taxonomy:** Taxonomic literatures; species concepts; herbarium techniques and botanic gardens;  
**ICN:** principles, articles, recommendations, problems in applying code; taxonomic hierarchy;  
nomenclature of cultivated and hybrid plants

**Unit II**

**Biosystematics:** Concept and application- palynology, karyomorphology, phytochemistry,  
molecular biology; character concepts; variations of characters – influence of habitat

**Unit III**

**Plant Classification:** recent trends; concise account on the phylogeny of some major taxa:

Magnoliidae, Rosidae, Zingiberidae, Liliidae

**Unit IV**

**Computer Applications:** numerical taxonomy, data analysis, construction of phylogenetic trees;  
application of remote sensing and GIS in vegetation mapping

**Recommended Books**

Gurcharan Singh (1999)	Plant Systematics: Theory & Practices. Oxford & IBH Publication, New Delhi
AK Pandey & AP Das	Plant Taxonomy: Advances & Relevance. Bishen Singh & Mahinder Pal Singh, Dehra Dun
B.P Pandey (1998)	Taxonomy of Angiosperms. S. Chand & Co., New Delhi
P.H. Davis & J. Cullen	The Identification of Flowering Plant Families
Jain, S.K. & R.R. Rao (1977)	Field & Herbarium Methods, Today & Tomorrow's Printer & Pub., New Delhi.
Raaman N (2006)	Phytochemical Techniques. New India Publishing Agency, New Delhi
Cronquist (1968, 1988)	The Evolution and Classification of Flowering Plants 2 <sup>nd</sup> edition, 1988).
Bentham & Hooker (1964)	Genera Plantarum, London
BP Pandey (1999)	Economic Botany. S.Chand & Co., New Delhi
Ashutosh Kar	Pharmacognosy & Pharmacobiotechnology. New Age International Publisher, New Delhi
J. Hutchinson	The Families of Flowering Plants (3 <sup>rd</sup> Edn.)
U. Kumar & M.J. Asija	Biodiversity – Principles and Conservation.
S.B. Jones & L.E. Luchsinger	Plant Systematics
Ronald Good (1974)	The Geography of the Flowering Plants. Longman Group United Kingdom
BSI	Flora of India (all Volumes)

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## SEMESTER - IV (Departmental Elective III)

### BOT 544 B : Microbiology I

Internal Assessment Exam.: 20 Marks

Credit: 3:1:0=4

End Semester Exam.: 80 Marks

Pass Marks: 40% Each

#### Unit I

**Microbial Diversity:** Concept, Estimation of total number of species, Culture dependent and independent methods, measures and indices of diversity, Recent concepts in microbial taxonomy  
Nutritional groups of Bacteria

#### Unit II

**Microbial Ecology:** Microbial diversity in soil, Microbial communities, Microbial interactions, Organic matter decomposition, Biogeochemical cycles (C, N, P & S). Rhizosphere and phyllosphere;

#### Unit III

**Agricultural microbiology:** Soil microorganisms in agro ecosystems; Role of microorganisms in soil fertility (symbiotic  $N_2$  fixation, mycorrhizae PGPR and phosphate solublizers), biological control of plant diseases, Effect of agricultural practices on soil organisms

#### Unit IV

**Immunology:** basic concepts, Cells and organs of the immune system; classes of Immunoglobulin; Polyclonal and monoclonal antibodies and their applications; Antibody-antigen reactions; Immunodiagnostics; Immune diseases (Hypersensitivity; Autoimmune diseases); vaccines, immunotherapy

#### Recommended Books

Michael T. Madigan	Brock Biology of Microorganisms 13 <sup>th</sup> Ed., Pearson International
C. H. Collins	Collins and Lyne's Microbiological Methods, 8 <sup>th</sup> Ed., Oxford University Press, 2004
Gerard J. Tortora	Microbiology - An Introduction 10 <sup>th</sup> Ed., Pearson, 2010
Kathleen Park Talaro	Foundations in Microbiology 8 <sup>th</sup> Ed. McGraw-Hill, 2012
Don J. Brenner, Noel R. Krieg, James T. Staley	BERGEY'S Manual of Systematic Bacteriology Second Edition (Vol. 1-V), Springer.
Stuart Hogg	Essential Microbiology, John Wiley & Sons.
Sheela Srivastava	Genetics of Bacteria, Springer
Simon Baker	Instant Notes Microbiology 4 <sup>th</sup> Ed., BIOS
Uma Shankar Singh	Introductory Microbiology, Oxford Book Co. Delhi
G.N. Cohen	Microbial Biochemistry 2 <sup>nd</sup> Ed., Springer
Larry L. Barton	Microbial Ecology, Wiley Blackwell
Amrita Rohilla	Handbook Of Bacteriology, Oxford Book Co. Delhi
Jacquelyn G. Black	Microbiology - Principles and Explorations 8 <sup>th</sup> Ed., John Wiley & Sons.
Jeremy W. Dale	Molecular Genetics of Bacteria 5 <sup>th</sup> Ed., Wiley Blackwell



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**Unit I**

**Floristic Regions:** India & world perspective; centers of origin of cultivated plants; endemism, migration, dispersal and discontinuous distribution of species

**Biodiversity Conservation:** IUCN Categories; Conventions on Biodiversity; Megadiversity Countries; Hotspots and Ramsar Sites; *in-situ* and *ex-situ* conservation; Protected Area concept

**Unit II**

**Ethnobotany:** definition, scopes, methods, ecological approach in ethnobotany, Ethnobotanical studies in India with particular reference to North-East India; Traditional Knowledge System, Intellectual Property Rights; Conservation ethics

**Unit III**

**Pharmacognosy:** concept, pharmacopoeia; classification of crude drugs; crude drug sources; pharmacognostic studies of crude drugs

**Unit IV**

**Phytochemistry:** Classification, structure and role of secondary metabolites; extraction and separation of herbal drugs through TLC/ GC-MS / HPLC / LC-MS

**Recommended Books**

Ashutosh Kar (2003)	Pharmacognosy & Pharmacobiotechnology, New Age International Publishers, New Delhi.
C.K. Kakoti	Practical Pharmacognosy, Nirali Pub. New delhi.
A.P. Das & A.K. Pandey (2007)	Advances in Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun
J.B. Harborne (1973)	Phytochemical Methods. Chapman & Hall International London.
N. Raaman (2006)	Phytochemical Techniques. New India Publishing Agency, New Delhi
Wallis (1985)	Textbook of Pharmacognosy 5th edition, CBS, Delhi.
G.E Trease and W.C Evans	Pharmacognosy. Bailliere Tindall Publishers
Garry J Martin	Ethnobotany: Manual Methods. Earth Scan Publisher
S.B Gokhale and C.K Kokate	Pharmacognosy. Pragati Prakashan, New Delhi
BP Pandey (1999)	Economic Botany. S.Chand & Co., New Delhi
Lehninger AL, Nelson DL & Cox MM	Biochemistry. CBS Publishers & Distributors, New Delhi

**SEMESTER – IV**  
**(Departmental Elective IV)**  
**BOT 545 B : Microbiology II**

End Semester Exam.: 80 Marks

Pass Marks: 40% Each

Internal Assessment Exam.: 20 Marks

Credit: 3:1:0=4

**Unit I**

**Air and Water microbiology**

Aeromicrobiology; Microorganisms in indoor and outdoor environment, nature of bioaerosols, their fate and transport. Air sampling techniques; Allergies and allergens

Microbiology of potable water; Role of microorganisms for biomonitoring of various quality-parameters related to water

**Unit II**

**Environmental Microbiology** : Role of microorganisms in sewage treatment, Bioremediation, Biodegradation of Xenobiotics, Bioaugmentation, Bioleaching, Biofilms, Biofilters, Bioscrubbers. Microbes and climatic change

**Unit III**

**Microbes and Human Diseases**: Tuberculosis, staphylococcal food poisoning, cholera, acquired immunodeficiency syndrome and candidiasis; Emerging and resurgent infectious diseases

**Unit IV**

**Chemotherapy**: General principles; classification of antibiotics; mode of actions, antibacterial and antifungal antibiotics; Mechanism of multidrug resistance in bacteria.

Interferons; Induction and regulation of production; Mechanism of action

**Recommended Books**

Praksh S. Bisen	Microbes - Concepts and Applications, Wiley Blackwell
Judith A. Owen	Kuby Immunology 7th Ed., WH Freeman & Co.