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20/1/18



# DEPARTMENT OF BOTANY

## Ch. Charan Singh University,

MEERUT - 250 004 (INDIA)



0121 - 2762021-24

Ext - 2111

Fax. No.: (0121) 2760577

Ref. No. BOT/PB-572

Dated... 14/3/18...

प्रगति, आगे गोपनीय विभाग  
चौक चरण सिंह विश्वविद्यालय  
मेरठ

महोदय,

वर्तमान विज्ञान विभाग में सम-समय में चतुर्थ श्रेणी  
द्वितीय सेमेस्टर में Open Elective course के पाठ्यक्रम को छात्र  
विवरण निम्न प्रकार है

- |                               |   |
|-------------------------------|---|
| 1. M.Sc I <sup>st</sup> sem   | - Disaster Management - CD - 6610 Revised syllabu |
| 2. M.Sc II <sup>nd</sup> sem  | - Microbial Biotechnology - CH - 4503 — do —      |
| 3. M.Sc III <sup>rd</sup> sem | - Environmental Biotechnology - CH - 4504         |
|                               | Stress Physiology of Plant - CH - 4505            |
|                               | Applied Plant Physiology - CH - 4506              |
- } Old syllabus

अपरोक्ष पाठ्यक्रम की दृष्टिकोण से प्रस्तुत ।

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2- Secy. Dept — 18.7.018

3- जमात वेबसाइट —

Unit - I

10 Hours

1. Value addition in industrially important microorganisms using recombinant DNA technology; Basic techniques involved; Essential enzyme used in recombinant DNA technology; Cloning vectors; Cloning strategies.
2. Fermentation technology; microbial growth, application of fermentation; batch, fed batch and their continuous cultures of microbes.
3. Fermentation Economics.

Unit - II

10 Hours

4. Proteomics- basic concepts and importance, Metagenomics: DNA isolation from diverse sources.
5. Different expression systems – Cloning in bacteria other than *E. coli*; cloning in *Saccharomyces cerevisiae*; cloning in GRAS microorganisms; Gene regulation- RNA interference: antisense RNA technology.
6. Separation of Biomolecules; electrophoresis; Characterization using- SDS-PAGE and Agarose gel electrophoresis.

Unit - III

10 Hours

7. Microbiology and up gradation of alcoholic beverages.
8. Commercial production of organic acids like acetic, lactic, citric and gluconic acids.
9. Commercial production of important amino acids, insulin, recombinant vaccines and vitamins by microorganisms.
10. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.
11. IPR issues

Unit - IV

10 Hours

12. Immobilization of microbial enzymes and whole cells and their applications in industries.
13. Use microbes in food, feed and dairy; Bioprocess engineering; Down stream processing, various steps for large-scale protein purification.
14. Industrial sources of microbial enzymes; Cellulases, Pectinases, Amylases, Lipases, and Proteases, their production and applications.

Unit - V

10 Hours

15. Synthetic biology: A novel approach for Microbiology.
16. Mutagenesis and directed evolution of microbes.

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BOTC.E.T.-II MICROBIAL AND ENVIRONMENTAL BIOTECHNOLOGY  
Course XVI B: *C11-4506* Environmental Biotechnology 4 credits/50 Hours

Unit - I 10 Hours

1. Pollution and Pollutants: Cost of pollution, Kinds of Pollution and Pollutants- Air, Water, and Soil Pollution, Their effects on Plants and Ecosystems;
2. Role of Plants in Pollution Management.

Unit - II 10 Hours

3. Climate Change: Greenhouse Gases ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ , CFCs: sources and roles), Ozone layer and Ozone hole, Consequences of Climate change (acid rain, global warming, sea level rise, UV radiation).

Unit - III 10 Hours

4. Ecosystem Stability: Concept (resistance and resilience), Ecological Perturbations (natural and anthropogenic) and Their Impacts on Plants and Ecosystems, Ecology of Plant Invasion, Environmental Impact Assessment (EIA), Ecosystem Restoration.
5. Environment and energy, Energy resources - Renewable and Non-renewable. Natural resources, Loss of Diversity, causes and consequences, Environmental Auditing, Conservation of Biodiversity.

Unit - IV 10 Hours

6. Ecological Management: Concepts, Sustainable Development, Remote sensing and GIS as Tools for Resources Management.

Unit - V 10 Hours

7. Phytoremediation: Prevention and Control, Methods of reducing Environmental impacts of Chemicals, Weedicides, Pesticides and Fertilizers. Biotechnological advances in pollution control through GEMs.

BOTC.E.T.-III APPLIED AND STRESS PHYSIOLOGY

Course AIII C: *CH-4505* Stress Physiology of Plants 4 credits/50 Hours

Unit-I 10 Hours

1. Biological stress vs. Physical Stress, Types of stresses and general methods of measurement of stress response (Strain),
2. Stress physiology in crop improvement
3. Response to UV stress: Injury and resistance mechanism

Unit- II 10 Hours

4. Response to low temperature stress: Chilling, freezing, frost injury and mechanism of resistance, Adaptations
5. Response to high temperature stress: Injury and mechanism of resistance, Heat shock proteins, Adaptations

Unit -III 10 Hours

6. Response to nutrient deficiency stress
7. Heavy metal stress, injury and mechanism of resistance, adaptations
8. Salinity stress, Ionic and salt stress injury, mechanism of resistance

Unit-IV 10 Hours

9. Response to water deficit: Desiccation, Dehydration injury; Mechanism of resistance, Adaptations
10. Response to water excess: Flooding, hypoxia, Mechanism of resistance, Adaptations

Unit-V 10 Hours

11. Causative agents for Biotic Stresses
12. Mechanism of Resistance against Fungal, Bacterial and viral pathogens

BOTC.E.T.-III APPLIED AND STRESS PHYSIOLOGY

Course XIV C: <sup>CH-4526</sup> Applied Plant Physiology 4 hrs /week/ 4 credits/50 Hours  
Unit -I 10 Hours

Crop Productivity

1. Role of crop physiology in agriculture,
2. Crop growth and productivity, phenology-crop productivity, growth factors related to biomass - concept of growth rates- canopy photosynthesis (leaf area and net assimilation rates as determining factors).
3. Light interception as a major function of leaf area-index, LAD canopy architecture- Light extinction coefficient relative growth rate. Net assimilation rate. Biomass and yield relations. Assimilate partitioning, yield and yield structure analysis.

Unit-II 10 Hours

Physiology of Crop species

4. Concept of source and sink, factors influencing source and sink size and productivity. Environmental factors determining crop growth. Light, temperature and VPD, effect of photoperiod and thermoperiod on duration of growth stages.
5. Growth and development of crop species. Juvenility, shoot growth, types of shoots, patterns of shoot growth, cambial growth and its regulation. Physiological aspects of pruning and dwarfing.
6. Growth measurements. Water relations of tree species, water uptake and transport. Concepts of transpiration rate and water use efficiency. Sexual and asexual propagation.
7. Rootstock and scion interactions.

Unit-III 10 Hours

Post-Harvest Physiology

8. Senescence and ageing in plants. Ethylene - the senescence hormone, leaf senescence. Monocarpic plant senescence. Biochemistry and molecular biology of flower senescence.
9. Gene expression during senescence.
10. Concept of physiological maturity of seeds - post harvest changes in biochemical constituents in field crops - loss of viability, loss of nutritive value, environmental factors influencing post-harvest deterioration of seeds.

Unit-IV 10 Hours

11. Physiological and biochemical changes during fruit ripening and storage. Senescence and post harvest life of cut flowers.
12. Physical, physiological and chemical control of post - harvest deterioration of fruits, vegetables and cut flowers and its significance during storage and transport.
13. Molecular approach in regulation of fruit ripening. Transgenic technology for improvement of shelf-life.

Unit-V 10 Hours

Chemistry of Plant Produced Chemicals

1. Essential plant nutrients (major, secondary and micro), organic manures (farm yard, compost, sewage sludge, green manure, biogas slurries, etc.), production and

OPEN ELECTIVES (Offered by the department for the students of other courses)

OEF -E DISASTER MANAGEMENT - <sup>of Botany</sup> CC-66/0 4 hrs/ week/ 4 Credits/ 50 hrs

#### UNIT- I

Introduction to Disasters: Concepts, and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks.

#### UNIT- II

Disasters: Classification, natural hazards and Man-made disasters, Causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc.) Global trends in disasters, urban disasters and climatic change.

#### UNIT- III

Approaches to Disaster Risk reduction: Disaster management cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Role of NDMA, NDRF, NIDM, STATE DM in disaster Management.

#### UNIT - IV

Disasters and Development: Impact of Development projects such as dams, embankments, changes in Land-use etc, Climate Change. Relevance of indigenous knowledge and local resources

#### UNIT - V

Disaster Risk Management in India: Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy).

#### Suggested Reading list:

Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press, 2000

Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Sciences Working Paper no. 8, 2008

Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters. Routledge.

Coppola P Damon, 2007. Introduction to International Disaster Management,

Carter, Nick 1991. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.

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Chen, F. 1982. Development and Disasters, Oxford University Press.

Document on World Summit on Sustainable Development 2002.

Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.

Government of India, 2009. National Disaster Management Policy,

Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi

Indian Journal of Social Work 2002. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.

Kapur, Anu & others, 2005: Disasters in India Studies of grim reality, Rawat Publishers, Jaipur

Kapur Anu 2010: Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi.

Parasuraman S, Acharya Niru 2000. Analysing forms of vulnerability in a disaster, The Indian Journal of Social Work, vol 61, issue 4, October

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## CH. CHARAN SINGH UNIVERSITY, MEERUT



Ref.: Committee Cell (BOS-Botany) / 3577

Dated: 09-03-2018

A meeting of the Combined Board of Studies (University Campus & Affiliated Colleges) in the subject of Botany will be held on 13-03-2018 at 11:00 A.M. in the Botany Department, Choudhary Charan Singh University, Meerut. Members are requested to kindly find it convenient to attend the meeting please. Agenda of the meeting will be placed on table.

### Members of Board of Studies in Botany:-

1. ✓ Prof. Y.Vimala, Dean Faculty of Science & Head Deptt. of Botany, C.C.S. University, Meerut (Convener-I).
2. Prof. M.U. Charaya, Deptt. Of Botany, C.C.S. University, Meerut.(Retd.)
3. Sh. S.C. Jain, Deptt. of Botany, D.N. College Meerut (Convener-II)
4. Dr. R.S. Saxena, Deptt. of Botany, Meerut College Meerut.
5. Dr. Madan Singh Kasana, Deptt. of Botany, I.P. College, Bulandshahr.
6. Prof. Shanti Swaroop Sharma, Deptt. of Botany, H.P. University, Shimla.
7. Prof. R.C. Dubey, Gurukul Kangri University, Haridwar.
8. Dr. Rajesh Arora, Director Life Science, D.R.D.O. Delhi.
9. Prof. U.K. Varshney, Deptt. of Botany, H.A.U. Hissar.
10. Prof. R.K. Raghuvanshi, (Retd. Professor) Jaipur.

### (Special Invitee)

1. Prof. S.S. Sharma, Deptt. Of Botany, Sikkim University, Gangtok.
2. Prof. R.S. Sengar, S.V.B.P. University, Modipuram Meerut.
3. Dr. R. K. Singhal, Meerut College Meerut.
4. Dr. Yashveer Singh Tomar, J.V. College, Baraut.

Registrar

### Copy to:-

1. S.V.C. for kind information of the Hon'ble Vice Chancellor.
2. P.A. to Pro. V.C. for kind information of the Pro. V.C.
3. Steno to the Finance Controller for information of the Finance Controller to make arrangement of payment of TA/DA of participant and to expedite the bills of refreshment will be submitted by the concerned.
4. H.O.D. concerned/committee cell to make arrangement of refreshment e.t.c. to the members.



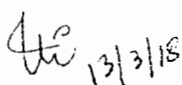
## Proceedings of Board of Studies in Botany dated – 13.03.2018


A meeting of the Board of Studies in Botany was held on 13.03.2018 at 10: 00 a.m. in the Department of Botany for correction and upgradation of B.Sc., M.Sc. (Colleges), M.Sc. (CBCS) and M. Phil. Botany Syllabi. Following members attended the meeting –

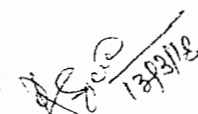
1. Prof. Y. Vimala, (Head Botany, Dean Science), Convener.
2. Dr. M.S. Kasana, I.P. College, Bulandshahr, Member
3. Dr. R.K. Singhal, Meerut College, Meerut, Member
4. Dr. Yashvir Singh, J.V. College, Baraut, Member
5. Prof. R.S. Sengar, Dept. of Biotechnology, SVBP University, Modipuram, Meerut, Member
6. Prof. R.K. Raghuvanshi, Retd. From University of Rajasthan, Jaipur, Member
7. Dr. Rajesh Arora, Scientist F, DRDO Delhi, Member

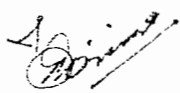
Following corrections and upgradation were made –

1. B.Sc. (Common Minimum Syllabus) – B.Sc. I year paper 1,2 and 3, B.Sc. II year paper 1,2 and 3 and B.Sc. III paper 1,2 and 3 were corrected and modified to avoid repetition; elimination of certain genera and families not available locally and additions of some genera and families was done.
2. M.Sc. (Colleges) – M.Sc. II Semester paper 6 was reorganized and M.Sc. IV Semester paper 13 and 15 was also reorganized.
3. M.Sc. (CBCS) – i) Open Elective disaster management was revised. ii) Core elective paper of Diversity in plants their origin and evolution was renamed as Plant Genetic Resources and Economic Botany and was revised. iii) Core Elective paper on Biodiversity conservation and Plant Resources was corrected. iv) Core Elective Microbial Biotechnology was also revised. v) Core elective on Genomics and Bioinformatics was renamed as Genomics and Plant Improvement with revision.
4. M. Phil. – i) Microbial and Industrial Biotechnology paper was revised ii) Biophysical Chemistry, Molecular Breeding for Abiotic Stress and Quality improvement, Environmental issues and policies, Medicinal and aromatic Plants papers were introduced replacing existing papers on MP-01, 02, 03 and adding MP – 10.
5. CBCS Regulations and grade card were incorporated as part of syllabus and any changes in the regulations will be accepted in spirit here after.

  
(Prof. Y. Vimala)

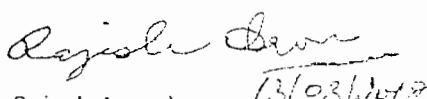
  
(Dr. M.S. Kasana)

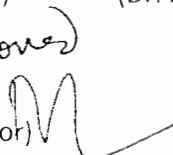
  
(Dr. R.K. Singhal)

  
(Dr. Yashvir Singh)

  
(Prof. R.S. Sengar)

  
(Prof. R.K. Raghuvanshi)

  
(Dr. Rajesh Arora) 13/03/2018

  
Approved  
(Vice-Chancellor)  
14.3.18

**Unified Syllabus of Botany for U.P.State Universities  
(B.Sc. I, II, & III year)**

Effective from July, 2012

Theory Paper's duration is of Three hours and duration of practicals is Four hours

B.Sc. I Year		
Papers	Title of Paper	Max. Marks
Paper I	Diversity of Viruses, Bacteria & Fungi	50
Paper II	Diversity of Algae, Lichens, & Bryophytes	50
Paper III	Diversity of Pteridophytes & Gymnosperms	50
Practical	Practical Syllabus based on theory papers	50
B.Sc. II Year		
Papers	Title of Paper	Max. Marks
Paper I	Diversity of Angiosperms: Systematics, Development & Reproduction	50
Paper II	Cytology, Genetics, Evolution & Ecology	50
Paper III	Plant Physiology and Biochemistry	50
Practical	Practical Syllabus based on theory papers	50
B.Sc. III Year		
Papers	Title of Paper	Max. Marks
Paper I	Plant Resource Utilisation, Palynology, Plant Pathology and Biostatistics	50
Paper II	Molecular Biology & Biotechnology	50
Paper III	Environment Botany	50
Practical	Practical Syllabus based on theory papers	50

At least one Field trip in B.Sc. II is compulsory.

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Unified Syllabus of Botany for U.P.State Universities  
Subject- Botany  
B.Sc. - First Year  
Practical

Time: 4.00 hrs

Max Marks: 50

1- Temporary slide preparation & Identification (Fungi)/Bacteria)	08 Marks
2- Temporary slide preparation & Identification (Pteridophyte/Gymnosperm)	08 Marks
3- Temporary Mount & Identification (Algae/ Bryophyte)	08 Marks
4- Temporary mount of rhizoid, scale, spore; or Gram staining of Bacteria	04 Marks
5- Identify and Comment upon spots (1-6)	12 Marks
6- <i>Viva Voce</i>	05 Marks
8- Practical class record	05 Marks
Total Marks	50

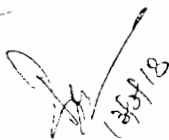
Unified Syllabus of Botany for U.P.State Universities  
Subject- Botany  
B.Sc. -Second Year  
Practical

Time: 4.00 hrs

Max Marks: 50

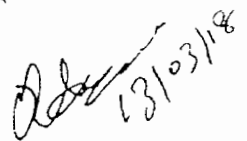
1- Description, Identification and Classification of given Angiospermic Plant	08 Marks
2- To perform and write the observations, results & conclusion (Physiology)	08 Marks
3- Temporary slide preparation & Identification (Anatomy)/ Temporary Mount (Embryology)/ Biochemistry / Genetics Exercise	04 Marks
4- Cytology/Ecology Exercise	08 Marks
5- Identify and Comment upon spots (1-6)	12 Marks
6- <i>Viva Voce</i>	05 Marks
7- Practical class record/ chart/ model/ herbarium	05 Marks
Total Marks	50



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Unified Syllabus of Botany for U.P.State Universities  
Subject- Botany  
B.Sc. - Third Year  
Practical

Time: 4.00 hrs

Max Marks: 50

1- Biotechnology exercise (Tissue culture based)/ Plant diseases	8 Marks
2-Environmental Pollution analysis/ Biostatistics exercise	8 Marks
3-Temporary Mount/ Diagram (Pollen grains)	5 Marks
4 Structure of Different Molecules/soil types	4 Marks
5 Identify and Comment upon spots (1-5)	10 Marks
6- <i>Viva-Voce</i>	5 Marks
7- Practical class record	5 Marks
8- Collection of Model, Chart, Project etc.	5 Marks
Total Marks	50

*Dr. Anam*  
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*Dr. J. K. Singh*  
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*Dr. A. K. Singh*  
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The course details are as follows

B.Sc. I Year

Paper I. Diversity of Viruses, Bacteria, & Fungi

M.M. 50

### Unit-I

History, nature and classification of Viruses, Bacteria and Fungi

History of virology and bacteriology; prokaryotic and eukaryotic cell structure (bacteria, mycoplasma and yeast); structure, classification and nature of viruses; structure (gram positive and gram negative) and classification (based on cell structure, of bacteria, classification (Ainsworth), thallus organization and reproduction in fungi, economic importance of fungi

### Unit-II

**Viruses:** Genome organisation, replication of plant viruses (tobacco mosaic virus), bacteriophages and viroids; techniques in plant viruses - purification, serology and electron microscopy; Economic importance of viruses

### Unit-III

**Bacteria:** Bacterial genome and plasmids; bacterial reproduction, techniques of sterilisation and staining, economic importance.

### Unit-IV

**Fungi:** The outline life cycles of the following.

**Mastigomycotina:** *Albugo*, *Pythium*; **Ascomycotina:** *Saccharomyces*, *Aspergillus*; *Ascobolus*;

**Basidiomycotina:** *Ustilago*, *Puccinia*, *Puccinia*, *Agaricus*; **Deuteromycotina:** *Fusarium*, *Cercospora*.

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B.Sc. II year

Paper - I Diversity of Angiosperms - Systematics, Development & Reproduction - M.M. 50

### Unit - I

Systematics

Principles of classification, Binomial nomenclature; comparative study of different classification systems, viz. Linnaeus, Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist.

Herbarium techniques and important Botanic Gardens.

### Unit - II

Taxonomic study of following families and their economic importance:

Dicots; Ranunculaceae, Malvaceae, Brassicaceae, Cucurbitaceae, Rosaceae, Leguminosaceae, Myrtaceae, Rutaceae, Apiaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Asteraceae, Rubiaceae, Verbenaceae, Euphorbiaceae, and Amaranthaceae.

Monocots: Cyperaceae, Poaceae, Arecaceae, Liliaceae.

### Unit - III

External morphology of vegetative and floral parts; modifications – phyllodes, cladodes, and phylloclades.

Meristems-kinds study of tissue system - epidermal, ground, and vascular.

Anatomy of roots, stems, and leaves. Cambium - its function and anomalies in roots and stems; root-shoot transition.

### Unit - IV

Structure and development of male and female gametophytes – microsporogenesis, microgametogenesis, megasporogenesis, and megagametogenesis, embryo sac types. Double fertilization development of embryo, endosperm development and its morphological nature, apomixis and polyembryony.

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Paper II: Cytology, Genetics, Evolution & Ecology

M.M. 50

Unit - I

Cell structure, cell organelles, nucleus, chromosome structure - nucleosome and solenoid model, salivary gland, lampbrush and B chromosomes

Cell division - mitosis, meiosis; their significance, chromosomal aberrations, cell cycle.

Unit - II

Genetics, laws of inheritance; gene interaction, linkage and crossing over; cytoplasmic inheritance; sex determination

Unit - III

Mutation- spontaneous, induced mutations, molecular mechanism and evolutionary significance; polyploidy origin, kinds and role in evolution. Evidences and theories of evolution.

Unit - IV

Ecology, relation with other disciplines. Plant types: Hydrophytes - *Hydrilla*, *Elodea*, *Nymphaea*, *Typha*.

Xerophytes - *Nerium*, *Casuarina*, *Asparagus*, *Calotropis*, *Parkinsonia*. Plant succession - xeroseres, hydroseres. Ecosystems - concept, basic types, components, & functioning. Food chain, food web, energy flow and productivity.

Paper III Plant Physiology and Biochemistry

M.M. 50

Unit - I

Plant and water relationship, colligative properties of water. Water uptake, conduction, transpiration, mechanism and its regulation by environmental variables

Mineral nutrition : Macro, and micronutrients, their role, deficiency and toxicity symptoms, plant culture practices, mechanism of ion uptake and translocation

Unit - II

Photosynthesis and Chemosynthesis - photosynthetic pigments, O<sub>2</sub> evolution, photophosphorylation, CO<sub>2</sub> fixation - C-3, C-4 and CAM plants

Respiration : aerobic and anaerobic respiration, respiratory pathways, glycolysis, krebs cycle, electron

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## Unit -IV

Study of morphology, anatomy, development and reproductive parts in

**Coniferales - *Pinus*; Gnetales - *Ephedra***

Affinities and relationship of Gymnosperms, evolutionary significance.

Flora of India. Palaeobotany: general account, types of fossils, methods of fossilization and geological time scale.

### Books Recommended:

1. Ganguly and Kar. College Botany Vol. II. Calcutta.
2. Khan, M. 1983. Fundamentals of Phycology. Bishen Singh Mahendra Pal Singh, Dehradun.
3. Parihar, N.S. The Biology and Morphology of Bryophytes, Central Book Depot, Allahabad.
4. Puri, P. 1980. Bryophytes. Atma Ram & Sons, Delhi.
5. Sharma, O.P. A Text Book of Bryophyta.
6. Singh, V., Pandey, P.C. and Jain, D.K. A text book of botany Vashishta, B.R. Text Book of Algae, New Delhi.
7. Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
8. Pandey, S.N. A Text book of Pteridophyta.
9. Sharma, O.P. An Introduction to Gymnosperms, Pragati Prakashan, Meerut.
10. Vashishta, P.C. A Text book of Pteridophyta. New Delhi.
11. Vashishta, P.C. Text Book of Gymnosperm.

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Unit-I

General characters. Range of thallus organization, classification, ultrastructure of eukaryotic algal cell and cyanobacterial cell, economic importance of algae. Lichens, classification, thallus organization, reproduction, physiology and role in environmental pollution. Ecological and economic importance of lichens.

Unit-II

The characteristics and life cycles of the following:-

**Cyanophyta**, *Oscillatoria*; **Chlorophyta** *Volvox*, *Hydrodictyon*, *Oedogonium*.

*Chara*; **Bacillariophyta** *Navicula*; **Xanthophyta** *Vaucheria*; **Phaeophyta**; *Ectocarpus*, *Sargassum*.

**Rhodophyta** *Polysiphonia*

Unit - III

Bryophytes, general characters, classification, reproduction and affinities. Gametophytic and sporophytic organization only of **Hepaticopsida** : *Riccia*, *Marchantia*.

Unit - IV

Gametophytic and sporophytic organization only of:

**Anthocerotopsida**: *Anthoceros*; **Bryopsida**: *Pogonatum*;

Unit - I

**Pteridophytes**: General features, classification, stelar system and its evolution. Heterospory and seed habit. Comparative study of morphology, anatomy, development, vegetative and reproductive systems of following:

**Lycopsida** - *Lycopodium*, *Selaginella*; **Psilopsida** - *Rhynia*

Unit - II

General and comparative account of gametophytic and sporophytic system only in

**Filicopsida** - *Pteridium*, *Equisetum*, *Marsilea*.

Unit - III

**Gymnosperms**: General characters, classification. Comparative study of morphology, anatomy, development of vegetative and reproductive parts in.

**Cycadales**: *Cycas*

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transport, oxidative phosphorylation, pentose phosphate pathway, photorespiration, cyanide resistant respiration. Lipid biosynthesis and its oxidation

### Unit - III

Nitrogen metabolism : atmospheric nitrogen fixation, nitrogen cycle, nitrogen assimilation, Growth: general aspects of phytohormones, inhibitors-auxins: kinetin, gibberellins, and ethylene: action and their application; photoperiodism and vernalization. Germination, growth movements, abscission and senescence

### Unit - IV

Biomolecules : Classification, properties and biological role of carbohydrates, Protein and lipids. Chemistry of nucleic acids, vitamins.

Discovery and nomenclature. Characteristics of enzymes, concepts of holoenzyme, apoenzyme, coenzyme and cofactors. Regulation of enzyme activity, Mechanism of action.

Bioenergetics: Laws of thermodynamics, concept of Gibb's free energy and high energy compounds.

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B.Sc. III year

Paper I Plant Resource utilization, Palynology, Plant Pathology and Biostatistics M.M. 50 marks

**Unit I**

Concepts of domestication of plants, origin of crop plants. Domestication and introduction of crop plants. Basic concepts of Plant Breeding, hybridization, heterosis. Concepts of sustainable development; cultivation, production and uses of - wheat, rice, legumes, sugarcane

**Unit II**

A general account of plants yielding oils, spices, beverages. An account of major fiber, medicinal, pairo, plants of Uttar Pradesh.

**Unit III**

Etiology of viral, bacterial, fungal and insect-pest diseases: mosaic diseases on tobacco, and cucumber, yellow vein mosaic of bhindi; citrus canker, potato scab, little leaf of brinjal; damping off of seedlings late blight of potato, red rot of sugarcane

Integrated pest disease management

**Unit IV**

An introductory knowledge of palynology, morphology, viability and germination of pollens. Classification of data, mean, median and mode, Standard deviation, standard error, variance, correlation,  $\chi^2$  test and experimental designs

Paper II: Molecular biology and biotechnology

M.M. 50

**Unit - I**

Nucleic acid as genetic material, nucleotides, structure of nucleic acids, properties of genetic code, codons assignments, chain initiation of codons mechanism of protein synthesis and its regulation.

**Unit - II**

Replication of DNA in prokaryotes and eukaryotes, gene expression and regulation. Hormonal control and second messengers  $Ca^{2+}$ , Cyclic AMP, IP<sub>3</sub> etc.

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### Unit- III

Introduction to biotechnology, recombinant DNA technology, biotechnology and health related issues

### Unit- IV

Plant tissue culture, methods of gene transfer, transgenic plants, , microbial and environmental biotechnology.

### Paper III- Environmental botany

MM ~~50~~ 50

#### Unit - I

Mineral resources of planet earth, Conservation of mineral resources. soils; types, properties and various problem soils; water; the source of water, physico-chemical and biological properties of water. Sustainable management of water; energy resources in India; Forests: global forest wealth, importance of forests, deforestation.

#### Unit - II

Environmental pollution : air, water, soil, radioactive, thermal and noise pollutions, their sources, effects and control. (greenhouse effect, ozone depletion and acid rain). CO<sub>2</sub> enrichment and climate change.

#### Unit - III

Biodiversity and Phytogeography : biotic communities and populations, their characteristics and population dynamics. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, endemism.

#### Unit - IV

Conservation of plants resources for agriculture and forestry.

*In situ* conservation sanctuaries, national parks, biosphere reserves, wetlands, mangroves.

*Ex situ* conservation; botanical gardens, field gene banks, seed banks, cryobanks.

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Course VI: Cell and Molecular Biology of Plants 50 Hours

Unit - I 10 Hours

1. The Dynamic cell: Structural organization of plant cell, specialized plant cell
2. Microscopy: Principle, parts and functioning of electron microscopes including stereoscopic binocular, dark field illumination, confocal, phase contrast, fluorescence and polarizing microscopes, camera lucida, SEM, TEM, STEM.
3. Cell envelopes: Ultra-structure, chemical foundation and functions of cell wall, Biological membranes with special emphasis on plasma membrane and tonoplast membrane.

Unit - II 10 Hours

4. Plant Cell inclusions, their structure and function; Mitochondria and Chloroplast.
5. Nucleus & Nucleolus Structure, nuclear pores, nucleosome concept
6. Chromatin Organisation: Chromosome structure and composition, Centromere, Telomere, Euchromatin and Heterochromatin, Karyotypes, Polytene, Lamp brush chromosomes and Sex chromosomes.

Unit - III 10 Hours

7. Ribosomes, Dictyosomes, Lysosomes, ER, Microbodies and Plasmodesmata.
8. Cell cycle & Apoptosis: Biochemical and genetic mechanism-
  - a) Mitosis, spindle formation mechanism, cytokinesis, cell plate formation, Cytoskeleton with emphasis on spindle apparatus, motor movements.
  - b) Meiosis and its significance
  - c) Programmed Cell Death (PCD).

Unit - IV 10 Hours

9. Nucleic Acids: Nature, Structure, types of DNA (A, B, Z-DNA) and RNA, (t-RNA, micro-RNA) difference between DNA & RNA; DNA replication (Origin and fork) and its biosynthesis, extra chromosomal replications, DNA damage and repair, transposons and mechanisms of transposition.
10. Genetic Code. Discovery, Properties and cracking of genetic code.

Unit - V 10 Hours

11. Protein Synthesis: Basics, mechanism of protein synthesis in prokaryotes and eukaryotes, transcription, RNA processing, reverse transcription, translation and regulation of protein synthesis in prokaryotes (Structural, regulatory genes and operon model).
12. Control of gene expression at transcription and translation level: Regulation of gene expression in phages, viruses, prokaryotes and eukaryotes, role of chromatin in regulating gene expression and gene silencing.

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M.Sc. Botany (Affiliated Colleges)

Course XIII: Modern Phytotechniques and Biostatistics 50 Hours

Unit I 10 Hours

Basic Botanical techniques.

1. Different types of stains, their preparation and uses. Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram's stains, Acetocarmine
2. Microtomy: dehydration, clearing and embedding of material, section cutting, dewaxing
3. Collection and preparation of herbarium sheets, preservation and storage of plant materials

Unit II 10 Hours

Biophysical methods

4. Instrumentation, principle and Methods of fractionation- Cell sorting, Chromatography, Electrophoresis, Centrifugation, X- ray diffraction

Unit III 10 Hours

Methods of quantitative analysis-

1. Spectrophotometry, MS, NMR, ESR, ORD/CD spectrometers,
2. Radioisotopic methods: Geiger Muller & Liquid Scintillation Counters.
3. Immunological methods: immunodiffusion, immuno- electrophoresis, crossed immuno- electrophoresis, counter- RIA, ELISA, Immunoblotting

Unit IV 10 Hours

Statistical methods

1. Classification and presentation of data, graphical presentation: frequency polygon and curve, & cumulative frequency curve. Distribution
2. Measures of Central tendency: mean, mode, median and their properties.
3. Measures of dispersion: Mean deviation, standard deviation and coefficient of variation.

Unit V 10 Hours

11. Simple correlation, coefficient and regression,
12. Principle of experimental designs, randomized block and latin square designs and analysis of variance (ANOVA).
13. Tests of significance, t-tests,  $\chi^2$  test for goodness of fit.

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# M.Sc. Botany (Affiliated Colleges)

Course XIV: Biodiversity Conservation and Plant Resources 50 Hours

## Unit - I 10 Hours

1. Biodiversity: Definition, factors responsible for determination of Biodiversity:
2. Global concern over climate change.
3. Levels of Biodiversity: Genetic, Species, Ecological, Evolutionary and Agrobiodiversity
4. Diversity Measures: (Diversity Indices)- Alpha( $\alpha$ ), Beta ( $\beta$ ), Gamma( $\gamma$ ) Diversity.

## Unit - II 10 Hours

5. Biodiversity Conservation Initiatives
  - a) *In situ* Strategy : National parks, Wild life sanctuaries, biosphere reserves and world heritage sites.
  - b) *Ex-situ* Strategy : By seeds, reclamation, Afforestation, tree Plantation, seed banks, gene banks, cryobanks
  - c) General account of activities of BSI, NBPGR for conservation and non-formal conservation efforts
  - d) Restoration or Rehabilitation of Endangered species.

## Unit - III 10 Hours

6. Biodiversity at world level: Biodiversity at global and country level, wild plant wealth.
7. Ecosystem diversity in India: Desert, forest, Grassland ecosystem, wetland, Mangroves.
8. Species Diversity: Endemic species, cultivated plants/ Agro- diversity, Endangered plants.

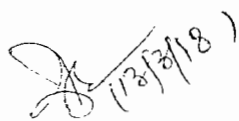
## Unit - IV 10 Hours


9. Loss of Biodiversity:
  - a) Causal factors - Developmental pressure, encroachment, exploitation, human induced and natural floods, earthquake, cyclone, landslides, Disaster management.
  - b) Threat to Ecosystem, species and genetic Diversity.Categories of threats : Endangered, Vulnerable, Rare and Threatened

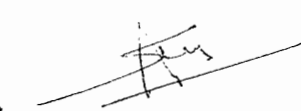
## Unit - V 10 Hours

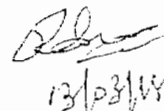
10. Plant resources, Concept, Status and Concern
11. Basic concepts of local plant diversity and its economic importance
12. World centres of primary diversity of domesticated plants
13. Biodiversity protection laws and policies, management of natural resources.

  
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Ch. Charan Singh University, Meerut Campus  
M.Sc. Botany (Choice Based Credit System) Syllabus

Effective from session 2016-17 Revised on 13.3.2018

**Distribution of marks in different courses**

I Semester	Course Title	Credits	Total Marks (Int.+Ext.)
Core Compulsory Theory I/CH-1501	Phytotechniques and Biostatistics	4	40+40
C.C.T II/CH-1502	Microbiology	4	40+40
C.C.T III/CH-1503	Algae and Bryophytes	4	40+40
C.C.T IV/CH-1504	Taxonomy of Angiosperm and Economic Botany	4	40+40
C.C.Practical -I (4 Hours) H-501	Based on Courses I-IV	2+2+2+2	80
Open Elective I: CO-56 -----	Self- Study-1A. Hindi/B. English/C. Urdu/D. Sanskrit	4	100
<b>Total Credits/marks</b>		<b>28</b>	<b>500</b>

II Semester	Course Title	Credits	Total Marks
C.C.T V/CH-2501	Mycology and Plant Pathology	4	40+40
C.C.T VI/CH-2502	Pteridophytes, Gymnosperms and Palaeobotany	4	40+40
C.C.T VII/CH-2503	Molecular Biology and Biotechnology	4	40+40
C.C.T VIII/CH-2504	Cell Biology & Genetics	4	40+40
C.C.P II (4 Hours) H-601	Based on Courses V-VIII	2+2+2+2	80
Open Elective II CO-6610	Disaster Management	4	100
<b>Total Credits/marks</b>		<b>28</b>	<b>500</b>

III Semester	Course Title	Credits	Total Marks
C.C.T IX/CH-3501	Plant Water relations; Growth and Development	4	40+40
C.C.T X/ CH-3502	Phytochemistry and Metabolism	4	40+40
C.C.T XI/ CH-3503	Anatomy and Reproduction in Angiosperms	4	40+40
C.C.T XII/CH-3504	Plant Ecology and Phytogeography	4	40+40
C.C.P III (4 Hours) H-701	Based on theory courses IX-XII	2+2+2+2	80
Open Elective III: CO-7610	Environmental Awareness	4	100



Total Credits/marks

28

500

Specializations	IV Semester	Course Title (Core Elective Courses (Set of two courses each for specialization))	Credits	Total Marks
C.E.T-I Plant Biotechnology	Course XIII /CH-4501	A. Recombinant DNA technology	4	40+40
	Course XIV / CH-4502	A. Plant Tissue Culture	4	40+40
C.ET. II. Microbial and Environmental Biotechnology	Course XV / CH-4503	B. Microbial Biotechnology	4	40+40
	Course XVI / CH-4504	B. Environmental Biotechnology	4	40+40
C.E.T.III. Applied and Stress Physiology	Course XIII / CH-4505	C. Stress Physiology of Plants	4	40+40
	Course XIV / CH-4506	C. Applied Plant Physiology	4	40+40
C.ET.IV Medicinal Botany	Course XV / CH-4507	D. Pharmacognosy	4	40+40
	Course XVI / CH-4508	D. Post -Harvest technology of medicinal plants	4	40+40
C.E.T V Plant Genetic Resources and Conservation	Course XV/ CH-4509	E. Plant Genetic Resources and economic Botany	4	40+40
	Course XVI/ CH-4510	E. Biodiversity conservation and Plant Resources	4	40+40
C.E. VI. Applied Plant Pathology	Course XV/ CH-4511	F. Applied Mycology	4	40+40
	Course XVI/ CH-4512	F. Molecular Plant Pathology	4	40+40
C.E. 7 Computer Science & Bioinformatics	Course XIII/ CH-4513	G. Elementary Computer knowledge and Bioinformatics	4	40+40
	Course XIV/ CH-4514	Genomics for Plant improvement	4	40+40
C.C.P. IV (4 hours)	Practical based on two sets of Core Electives /	Based on theory courses XIII-XIV and two out of XV-XVI	2+2+2+2	80

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Open Elective 4:	Self-Study 4	Intellectual Property Rights/ Project/ Courses provided by other departments	4	100
		Total Credits/marks	28	500
		Grand Total Credits/marks	112	2000

A candidate can select any two sets of elective courses from XIII to XXVIII (as per availability in the institution) to serve as specialization (s). Each core (compulsory and elective) course will have 4 hours theory and 4 hours practical in each week, equaling  $4+2=6$  credits. In each semester there will be one open elective of 4 credits each. A minimum of 108 credits are required to be earned for successful completion of the Master's degree including a minimum of 72 credits of Core Compulsory, 24 credits of Core elective and 12 credits of open elective courses.

All regulations of CBCS courses as provided by the University ordinances and modified from time to time will become effective from the given dates.

A minimum of 30% marks separately in internal and external assessment of each course and an aggregate of 40% marks in all the courses (including practical) is required for passing. In case of failing to obtain 30% marks in internal assessment of any paper, the candidate will not be eligible to appear in external examination of that course.

Internal assessment will be based on :

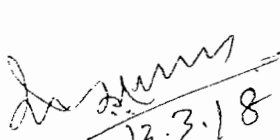
Quizzes -2: (from first Unit) Each for 5 marks

Tests-2: for 10 marks each (based on 2 units each)


Seminar/ Term Paper: 10 marks in each paper

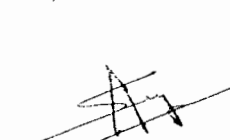
Eligibility for admission to the course: B.Sc (Bio)/B.Sc. (CBZ)/B.Sc. (Life Sc.)/Hons. with minimum 55% marks and Intermediate with second division (45%) or with 50% aggregate marks in B.Sc and Intermediate both. In the subject itself minimum 50% marks are necessary for eligibility.

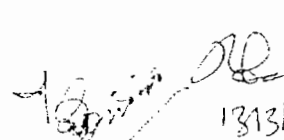
CBCS Regulations and grade card as per University Ordinance will followed with any changes introduced here after.

  
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OPEN ELECTIVES (Offered by the department for the students of other courses)

OET -I: DISASTER MANAGEMENT <sup>of history</sup> C C 6615 4 hrs/ week/ 4 Credits/ 50 hrs

### UNIT- I

Introduction to Disasters: Concepts, and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks.

### UNIT- II

Disasters: Classification, natural hazards and Man-made disasters, Causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc.) Global trends in disasters, urban disasters and climatic change.

### UNIT- III

Approaches to Disaster Risk reduction: Disaster management cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Role of NDMA, NDRF, NIDM, STATE DM in disaster Management.

### UNIT - IV

Disasters and Development: Impact of Development projects such as dams, embankments, changes in Land-use etc, Climate Change. Relevance of indigenous knowledge and local resources

### UNIT- V

Disaster Risk Management in India: Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional Arrangements (Mitigation, Response and Preparedness, DM Act and Policy).

### Suggested Reading list:

- Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press, 2000
- Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Sciences Working Paper no. 8, 2008
- Blaikie, P., Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.
- Appola P Damon, 2007. Introduction to International Disaster Management,
- UNEP, Nick 1991. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.

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Univ. F. 1983. Development and Disasters, Oxford University Press.

Document on World Summit on Sustainable Development 2002.

Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.

Government of India, 2009. National Disaster Management Policy.

Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi

Indian Journal of Social Work 2002. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.

Kapur, Anu & others, 2005: Disasters in India Studies of grim reality, Rawat Publishers, Jaipur

Kapur Anu 2010: Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi.

Parasuraman S, Acharya Niru 2000. Analysing forms of vulnerability in a disaster, The Indian Journal of Social Work, vol 61, issue 4, October

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Plant Genetic Resources and Economic Botany,

Paper I

Diversity in Plants, their origin and evolution

Unit I:

**Food Plants-** Origin, history, botany, cultivation and use of food plants:

**Cereals:** *Triticum, Oryza, Zea, Sorghum, Pennisetum* and minor millets.

**Pulses:** *Cicer, Cajanus, Phaseolus, Vigna, Glycine, Pisum, Lens, Dolichos* etc.

Unit II:

**Fibre & Oil Plants:** Origin, history, botany, cultivation and use of food plants:

**Oilseeds:** *Arachis, Sesamum, Ricinus, Brassica, Helianthus, Cocos, Linum* etc.

**Fibres:** *Gossypium, Bombax, Crotolaria, Corchorus, Agave, and Linum*

Unit III:

**Sugars & Plant of agro-forestry importance:** Origin, distribution, cultivation, production and utilization of

**Sugars:** sugarcane, sugarbeet, sugarplum and sweet sorghum

**Plant of agro-forestry importance:** multipurpose trees / shrubs, *Lucaena, Acacia nilotica, Populus, Sesbania, Azadirachta, Melia*, etc.; non-traditional economic plants: *Simmondsia, Jatropha curcas, Pongamia* etc.

Unit IV:

**Fruits & Vegetables:** Origin, distribution, classification, production and utilization of

**Fruits:** Mango, banana, citrus, guava, grapes and other indigenous fruits; apple, plum, pear, peach, cashewnut and walnut;

**Vegetables:** Tomato, Brinjal, Okra, cucumber, gourds etc.:

Unit V:

**Fumigatories, masticatories & Medicinal and Aromatic Plants:**

**Fumigatories, masticatories:** Tobacco, betel vine, areca nut.

**Medicinal and Aromatic plants:** Sarpagandha, Belladonna, *Cinchona, nux-vomica, Vinca, Mentha* and *Glycyrrhiza, Plantago*. etc

**Narcotics:** Plants: *Cannabis, Datura, Gloriosa*. Products: pyrethrum and opium: Dye-, tannin, gum and resin, yielding plants:

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## Paper II

### Biodiversity Conservation and Plant Resources:

#### Unit I

1. Biodiversity: Definition. Magnitude of Biodiversity, Facts related to biodiversity. 2. Hot spots. Invasive alien Species, Sustainable development. Effect of Climate Change on biodiversity.

#### Unit - II

3. Levels of Biodiversity: Genetic, Species, Ecological, Evolutionary and Agrobiodiversity. 4. Types of Biodiversity: (Diversity Indices)- Alpha( $\alpha$ ), Beta ( $\beta$ ), Gamma( $\gamma$ ) Diversity. 5. Conservation of Biodiversity a) In situ Conservation : National parks, Wild life sanctuaries, biosphere reserves and world heritage sites. b) Ex-situ Conservation: By seeds, reclamation, Afforestation, tree Plantation. seed banks, pollen bank, gene banks, cryobanks c) Restoration or Rehabilitation of Endangered species.

#### Unit - III

6. Biodiversity at global and country level, wild plant wealth. 7. Ecosystem diversity in India: Desert, forest, Grassland ecosystem, wetland, Mangroves. 8. Species Diversity: Endemic species, cultivated plants/Agro-diversity, Endangered plants.

#### Unit - IV

9. Threats to Biodiversity: a) Causal factors of threat – Developmental pressure, encroachment, exploitation, human induced disaster, Management of natural and human resources, political and policy issues. b) Threat to Ecosystem, species and genetic Diversity. Categories of threats: Endangered, Vulnerable, Rare and Threatened 10. Natural disaster: floods, earthquake, cyclone, landslides, Disaster management.

#### Unit - V

11. Plant resources, Concept, Status and Concern. 12. Basic concepts of local plant diversity and its economic importance 13. World centres of primary diversity of domesticated plants.

14. General account of activities of BSI, NBPGR for conservation and non-formal conservation efforts. National and International organization association with PGR: Convention on Biological Diversity (CBD). recent issues related to access and ownership of PGR, IPR, PBRs, farmers rights, sui-generis system etc.

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Microbial Biotechnology

50 Hours

Unit - I

10 Hours

1. Value addition in industrially important microorganisms using recombinant DNA technology: Basic techniques involved; Essential enzyme used in recombinant DNA technology: Cloning vectors; Cloning strategies.
2. Fermentation technology; microbial growth, application of fermentation: batch, fed batch and their continuous cultures of microbes.
3. Fermentation Economics.

Unit - II

10 Hours

4. Proteomics- basic concepts and importance. Metagenomics: DNA isolation from diverse sources.
5. Different expression systems - Cloning in bacteria other than *E. coli*; cloning in *Saccharomyces cerevisiae*; cloning in GRAS microorganisms; Gene regulation- RNA interference: antisense RNA technology.
6. Separation of Biomolecules; electrophoresis; Characterization using- SDS-PAGE and Agarose gel electrophoresis.

Unit - III

10 Hours

7. Microbiology and up gradation of alcoholic beverages.
8. Commercial production of organic acids like acetic, lactic, citric and gluconic acids.
9. Commercial production of important amino acids, insulin, recombinant vaccines and vitamins by microorganisms.
10. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.
11. IPR issues

Unit - IV

10 Hours

12. Immobilization of microbial enzymes and whole cells and their applications in industries.
13. Use microbes in food, feed and dairy; Bioprocess engineering; Down stream processing, various steps for large-scale protein purification.
14. Industrial sources of microbial enzymes; Cellulases, Pectinases, Amylases, Lipases, and Proteases, their production and applications.

Unit - V

10 Hours

15. Synthetic biology: A novel approach for Microbiology.
16. Mutagenesis and directed evolution of microbes.

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CH - 4514

Teaching hours: 50

Genomics for plant improvement  
(M.Sc. - IV sem. CBCS)

**Introductory plant genomics:** Overview of genomic assisted breeding and functional genomics, role in plant/crop improvement, Different molecular marker types: RFLP, RAPD, AFLP, SSRs; STSs; SNP, EST-SSR, EST-SNPs etc, markers from functional portion of genome (etc.), high-throughput genomics. Model plant genomes: *Arabidopsis*, *Brachypodium* and rice, plant genome databases. 10

**High-throughput genotyping:** Different high-throughput genotyping platforms (Radseq, chip based, etc), comparative genomics (collinearity/syteny in maps), genome duplication. 5

**Whole genome sequencing :** Whole genome shotgun sequencing; clone-by-clone or 'hierarchical shotgun' sequencing; different next generation sequencing (NGS) technologies (454, Illumina, ABI SOLiD, single molecule and nanopore sequencing); deep sequencing and re-sequencing of genomes; application of NGS in functional genomics, allele mining for crop improvement. 10

**Forward and reverse genetic tools in genomics:** Positional cloning (genetic mapping, physical maps, EST/transcript maps, functional maps); Insertional mutagenesis (activation tagging); enhancer/promoter trap; whole genome LD mapping, map-based cloning and fine mapping of genes; candidate gene approach, insertion mutagenesis (T-DNA and transport insertion), VIGs, RNAi, TILLING, Eco-TILLING 10

**Genome and base editing technologies:** Genome-editing using programmable nucleases (ZFNs, TALENs) genome editing using CRISPR/CAS, base editing etc. Role in crop plant improvement. 5

**Transgenic plants:** Transgenic trait development, trait integration-backcrossing transgenes, molecular characterization, gene/trait stacking, development, utility and commercialization of transgenic crop (resistance for biotic and abiotic stresses; barnase and barstar for hybrid seed production, engineering for vitamins and nutritional mineral deficiency); molecular farming for production of foreign proteins and edible vaccines; biosafety issues; biosafety regulations. 10

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**1. Global Change**

Global land cover and land use change; Multiple impacts of land use change; Causes, effects and mitigation strategies for global climate change and stratospheric ozone loss.

**2. Environmental Pollution**

Causes and effects of air, water, soil, radioactive pollution; Basic pollution abatement practices and technologies.

**3. Biotic Invasions**

Extent and mechanisms of biological invasions; ecological and economic impacts; Management Strategies.

**4. Loss of Biodiversity**

Threats and pattern of biodiversity loss; Natural and anthropogenic causes; IUCN threat categories, Red data books; conservation and restoration of biodiversity.

**5. Global Water Crisis**

Distribution, withdrawal and consumption pattern; Causes and effects of water crisis; Water conservation approaches.

**6. Global Energy Crisis**

Sources of energy supply; Current potential and future prospects of energy sources; Energy crisis.

**7. Challenges of Urbanization**

Recent trends of urbanization; Environmental impact of urbanization; Concept of green cities.

**8. National Policies on Environment**

National Forest Policy; National Water Policy; National Energy Policy; National Action Plan on Climate Change; National Biodiversity Action Plan.

**Suggested Readings**

1. Mc. Connell, R. (2008) Environmental issues: An introduction to sustainability Person.
2. Wali, M.K., Fatih Evrendilek, M. Siobhan Fannessy (2009) This environmental : Science : Issues and Solutions. CRC Press.
3. Neelin, J. (2011) Climate change and Climate Modelling Cambridge University Press.
4. John Marshall, R. Alan Plumb (2008) Atmosphere, Ocean and Climate dynamics : An introductory text. Elsevier.
5. Phillips, B.D. Thomas, A. Fo
6. thegill, L. Blinn- Pike (2009) Social Vulnerability to disasters. CRC Press
7. Hill, M. (2010) Understanding environmental Pollution Cambridge University Press.

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B. Singh

Teaching hours: 50

## Molecular breeding for abiotic stress and quality improvement

(M.Phil. - ~~Had Sem~~) MP-02  
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**Introduction:** Classification of abiotic stresses, stress inducing factors moisture/drought stress, water logging & submergence, acidity, salinity/alkalinity/sodicity, high/low temperature, wind, etc. Stresses due to soil factors and mineral toxicity, physiological responses. Traditional vs high-throughput/robotic phenotypic screening techniques and data recording; breeding by design, Plant ideotype concept 8

**DNA sequence variation and genetic diversity:** Application of molecular markers for for abiotic stress and Quality; gene tagging; elementary idea of QTL and QTL analysis, brief idea of GWAS (genome wide association studies), gene pyramiding, marker-assisted selection (MAS). 12

**Molecular breeding for abiotic stress (drought, salt and temperature) tolerance:** Genetics of abiotic stress resistance, genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low freezing temperature, Utilizing MAS procedures identifying resistant types in important crops like rice, sorghum, wheat, cotton. Breeding for resistance to stress caused by toxicity, deficiency, and pollutants/contaminants in soil, water and environment. Mechanisms of stress tolerance (role of proline, glycine betaine, dehydration response elements, trehalose) screening for tolerance, sources of tolerance, breeding approaches for improved tolerance to abiotic stress including marker-assisted selection. 16

**Molecular breeding for nutritional quality traits (protein, oil, vitamins and iron):** Molecular breeding for improved protein content and quality in cereals and legumes, sources of quality traits, breeding approaches, achievements; breeding for improved oil content and quality, breeding approaches and achievements; biofortification (including Fe (rice) and Zn, vitamins (golden rice and maize); quality protein maize (QPM). 14

~~B. Singh~~

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## Biophysical Chemistry

- 1. Solution:** Normality, molarity and molality of the solution, ppm and percent solutions, colligative properties of electrolyte solution: the Donnan effect.
- 2. Acid and Bases:** Definition of acid and base, acid-base properties of water, concept of pH and pKa, acid and base titration, diprotic and polyprotic acids, preparing a buffer solution with specific pH, dissociation of amino acid, isoelectric point, titration of protein.
- 3. Bioenergetics**
  - A** Concept of free energy, standard free energy, determination of  $\Delta G$  for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions, Gibbs energy of biological membrane transport.
  - B** Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials & free energy change.
  - ~~C~~ ~~Gibbs energy of biological membrane transport.~~
  - C** ~~D~~ High energy phosphate compounds: introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates along with reasons for high  $\Delta G$ .
  - D** ~~E~~ Free energy of enzymatic equation: activation energy, binding energy, relation between activation energy and free energy.
- 4. Kinetics of biochemical reaction:**

Concept of ES complex, active site, specificity, derivation of Michaelis-Menten equation for uni-substrate reactions. Different plots for the determination of  $K_m$  &  $V_{max}$  and their physiological significances. Importance of  $K_{cat}/K_m$ . Kinetics of zero & first order reactions. Significance and evaluation of energy of activation. Collision & transition state theories. Michaelis - pH functions & their significance. Classification of multi substrate reactions with examples of each class. Derivation of the rate of expression for Ping Pong, random & ordered Bi-Bi mechanisms. Use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanism. Reversible and irreversible inhibition. Competitive, noncompetitive, uncompetitive, linear-mixed type inhibitions and their kinetics, determination of  $K_i$ , denaturation and renaturation kinetics of DNA and protein. Cot curve.
- 5. Regulation of biochemical reaction:**

General mechanisms of enzyme regulation, product inhibition. Reversible and irreversible covalent modifications of enzymes. Feedback inhibition and feed forward stimulation. Allosteric enzymes. qualitative description of "concerted" & "sequential" models for allosteric enzymes. Positive and negative co-operativity. Protein-ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots (derivations and numericals included).

P. B. L. O. A. 13/3/18  
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Syllabus for M. Phil Students Botany

Medicinal and Aromatic Plants

1. **Medicinal Plants:** Origin, Evolution and Cultivation methods of medicinal plants (*Aloe*, *Withania*, *Plantago*, *Centella*, *Andrographis*, *Convolvulus*, *Ocimum* and *Curcuma*).
2. General methods for the extraction of herbal drugs, processing and analytical profile, stability, preservation and evaluation of extracts. Herbal Drug Development and Regulatory Issues.
3. Extraction, isolation, purification and estimation of following phyto-constituents i.e. alkaloids, glycosides, resins, essential oils, terpenoids, fixed oils, carbohydrates, fats, tannins, steroids, pectins, etc. from natural drugs.
4. **Aromatic plants:** Studies on botanical features, Chemical constituents and Cultivation methods of *Mentha*, *Çoriandrum*, *Ocimum*, *Geranium*, *Cymbopogon*, *Citronella*, *Cuminum*, *Syzygium*, *Eucalyptus*, *Cardamomum*.

**Aromatherapy:** Various oils used in Aromatherapy with their Significance.

**Ethnobotany:** Scope, interdisciplinary approaches. Ethnomedicine and Botanicals of *Adhatoda vasica*, *Asparagus racemosus*, *Argemone mexicana*, *Boerhaavia diffusa*, *Hollarhena antidysenterica*, *Tinospora cordifolia*, *Terminalia arjuna*, *Terminalia bellerica*, *Terminalia chebula*, *Pterocarpus marsupium*, *Eclipta prostrata*, *Withania somnifera*, *Rauwolfia serpentine*.

5. **Analytical Techniques:** Application of various chromatographic techniques i.e. Paper chromatography, TLC, HPTLC, HPLC, GLC, LC-MS. GC-MS for the standardization of plant extracts.

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Course (MP- 04): Microbiology and Industrial Biotechnology

1. Microbes and their uses in production of alternative energy sources, e.g. Alcohol and biogas.
2. Biotechnological advances in antibiotic production.
3. Cultivation of mushroom.
4. Use of microbes in Bioremediation, Phytoremediation.
5. Rhizosphere and rhizosphere technology for managing soil- borne plant pathogens; Microbial fuel cells.
6. Methods of microbial strain improvement; biotransformation through microbes.
7. Biotechnological advances in industrial production of beverages, food & feed and commercially important microbial enzymes.
8. Fermentation economics: basic objective for economically viable fermentation process, cost breakdown for well- established fermentation processes, market potential of the product, cost aspects of various stages in the process development including effluent treatment.
9. Rhizobial technology for crop improvement: molecular methods and applications.
10. Metagenomics and proteomics.

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M.Phil. BOTANY

Teaching hours: 50

Course (MP- 04): Microbiology and Industrial Biotechnology

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