MINUTES

of the Special Meeting of the Board of Studies of the Department of Botany held on
Wednesday, 09th September, 2015 at 10:30 a.m. in the Conference Hall of the department.

The following members were present:

1. Prof. Arif Nazir
2. Prof. Mohammad Anis
3. Prof. M.Y.K. Ansari
4. Prof. Nafees A. Khan
5. Prof. Irshad Mahmood
6. Prof. Mansoor A. Siddiqui
7. Prof. M. Badruzzaman Siddiqui
8. Prof. Abrar Ahmad Khan
9. Prof. Hisamuddin
10. Prof. Tabreiz Ahmad Khan
11. Prof. Mohammad Masroor Akhtar Khan
12. Prof. Samiullah Khan
13. Prof. Zaki Anwar Siddiqui
14. Prof. Shamsul Hayat
15. Prof. Fareed A. Khan
16. Prof. Altaf Ahmad
17. Dr. Athar Ali Khan
18. Dr. Qazi Fariduddin
19. Dr. Anwar Shahzad
20. Dr. (Mrs.) Shahla Faizan
21. Dr. Asim Masood
22. Dr. Tariq Aftab
23. Prof. Moinuddin
24. Prof. Sheila Shahab
25. Prof. Akhtar Inam
26. Prof. Razia Khatoon Zaidi
27. Dr. Ghazala Parveen
28. Dr. Kiran Lata Chauhan
29. Dr. Fauzia Naushin
30. Prof. Firoz Mohammad (In the Chair)
The items of the agenda were taken up:

Item No. 1

The board considered and recommended the admission of the following candidates to Ph.D. (Botany) Course - 2015-2016 along with the research topic and supervisor, with Ph.D. Course Programmes (Paper II) of the candidates being given as Annexure 1 (a - r).

Name of candidates recommended for admission to Ph. D. (Botany) Course

1. Lukman Ahamad
2. Manzoor Raiees Khan
3. Chanchal Chaudhary
4. Moh Tariq
5. Amir Khan
6. Zebus Sehar
7. Khan Bilal Mukhtar Ahmed
8. Husna Siddiqui
9. Abbu Zaid
10. Fareen Sami
11. Faroza Nazir
12. Anjuman Hussain
13. Waseem Mushtaq
14. Gufran Ahmad
15. Adnan Khan
16. Shafia Siddiqui
17. Saqib Ul Kalam
18. Urooj Fatima
19. Ghazala Ambrin
Candidates’ academic qualifications alongwith research topic and research supervisor

<table>
<thead>
<tr>
<th>S. No.</th>
<th>NAME OF THE CANDIDATE</th>
<th>ACADEMIC QUALIFICATIONS (% Marks)</th>
<th>Marks obtained in Entrance Test (%)</th>
<th>TOPIC</th>
<th>SUPERVISOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Lukman Ahamad</td>
<td>60.00 AMU 68.50 AMU</td>
<td>44.25</td>
<td>Studies on the interaction of <em>Meloidogyne incognita</em> and <em>Fusarium solani</em> on <em>Daucus carota</em></td>
<td>Prof. Zaki A. Siddiqui</td>
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<td>2.</td>
<td>Manzoor Raiees Khan</td>
<td>53.50 KUK 68.22 UKU</td>
<td>37.25</td>
<td>Studies on the cohabitation of <em>Meloidogyne incognita</em> and <em>Xanthomonas axonopodis pv. malvacearum</em> on <em>Abelmoschus esculentus</em></td>
<td>Prof. Zaki A. Siddiqui</td>
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<td>3.</td>
<td>Chanchal Chaudhary</td>
<td>65.48 AUA 70.08 AMU</td>
<td>37.00</td>
<td>Histopathological studies on the roots of a medicinal plant infected with <em>Meloidogyne incognita</em></td>
<td>Prof. Hisamuddin</td>
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<td>4.</td>
<td>Moh Tariq</td>
<td>62.66 AMU 68.79 AMU</td>
<td>34.25</td>
<td>Studies on the management of <em>Meloidogyne incognita</em> infesting <em>Abelmoschus esculentus</em> L. and <em>Solanum melongena</em> L. through some bioagents and botanicals</td>
<td>Prof. Mansoor A. Siddiqui</td>
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<td>5.</td>
<td>Amir Khan</td>
<td>60.66 AMU 68.79 AMU</td>
<td>32.75</td>
<td>Studies on the potential of some bioinoculants and botanicals against <em>meloidogyne incognita</em> parasitizing <em>Cicer arietinum</em> L. and <em>Vigna radiata</em> L.</td>
<td>Prof. Mansoor A. Siddiqui</td>
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<td>6.</td>
<td>Zebus Sehar</td>
<td>65.53 AMU 74.70 AMU</td>
<td>52.75</td>
<td>The potential of plant hormones and glucose in reversal of salinity induced changes in wheat</td>
<td>Prof. Nafees A. Khan</td>
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<td>7.</td>
<td>Khan Bilal Mukhtar Ahmed</td>
<td>71.53 AMU 73.58 AMU</td>
<td>52.00</td>
<td>Physiological attributes and essential oil production of ‘patchouli’(<em>Pogostemon cablin</em> (blanco) benth.) as influenced by radiation-processed sodium alginate and chitosan and their fractions</td>
<td>Prof. M.M.A. Khan</td>
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<td>8.</td>
<td>Husna Siddiqui</td>
<td>68.00 MUM 72.58 AMU</td>
<td>51.50</td>
<td>Effect of brassinosteroids and glucose under the stress of cadmium on the performance of <em>Brassica juncea</em></td>
<td>Prof. Shamsul Hayat</td>
</tr>
<tr>
<td>S.No.</td>
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<td>CGPA</td>
<td>University</td>
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<td>Saqib Ul Kalam</td>
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<td>Ghazala Ambrin</td>
<td>66.13</td>
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Item No. 2

The Board considered and approved implementation of subsidiary / minor / supporting subjects / generic elective subject at UG level discussed in the consultative meeting of Chairman of Department of Studies, Faculty of Life Sciences under Choice Based Credit System (CBCS).

The Board also considered and discussed at length the credit Framework for skill Development (CFSD) at PG level under CBCS. A thorough discussion was made on separating or merging of two independent courses (each of 2 credits) namely Plant Physiology and Plant Metabolism.

Chairman approved the following CFSD, wherein the two above courses were treated as two independent courses. The approved CFSD is given below.

**Credit Framework for skill Development at PG level**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Titles of Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.Sc. I Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Viruses, Bacteria, Fungi and Nematodes</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Plant Pathology</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Algae and Bryophytes</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>Pteridophytes and Gymnosperms</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>Taxonomy of Angiosperms</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Lab – I (1&amp;2)</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Lab – II (3&amp;4)</td>
<td>2</td>
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<tr>
<td>8.</td>
<td>Lab – III (5)</td>
<td>2</td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
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M.Sc. II Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Titles of Course</th>
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<tbody>
<tr>
<td>9.</td>
<td>Reproduction in Flowering Plants</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>Cell and Molecular Biology</td>
<td>4</td>
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<tr>
<td>11.</td>
<td>Plant Development</td>
<td>4</td>
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<tr>
<td>12.</td>
<td>Plant Physiology</td>
<td>2</td>
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<tr>
<td>13.</td>
<td>Genetics and Cytogenetics</td>
<td>4</td>
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<tr>
<td>14.</td>
<td>Lab – IV (9&amp;10)</td>
<td>2</td>
</tr>
<tr>
<td>15.</td>
<td>Lab – V (11&amp;12)</td>
<td>2</td>
</tr>
<tr>
<td>16.</td>
<td>Lab – VI (13)</td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
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</table>
### M.Sc. III Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>17. Genetic Engineering and Tissue Culture</td>
<td>4</td>
</tr>
<tr>
<td>18. Plant Metabolism</td>
<td>2</td>
</tr>
<tr>
<td>19. Plant Resource Utilization and Conservation</td>
<td>4</td>
</tr>
<tr>
<td>20. Ecology</td>
<td>4</td>
</tr>
<tr>
<td>21. CBC (to be earned from other department)</td>
<td>4</td>
</tr>
<tr>
<td>22. Lab – VII (17)</td>
<td>2</td>
</tr>
<tr>
<td>23. Lab – VIII (18&amp;20)</td>
<td>2</td>
</tr>
<tr>
<td>24. Lab – IX (19)</td>
<td>2</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
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</table>

### M.Sc. IV Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>25. Specialization Paper I</td>
<td>4</td>
</tr>
<tr>
<td>26. Specialization Paper II</td>
<td>4</td>
</tr>
<tr>
<td>27. Seminar</td>
<td>2</td>
</tr>
<tr>
<td>28. Communication Skills</td>
<td>2</td>
</tr>
<tr>
<td>29. Dissertation</td>
<td>4</td>
</tr>
<tr>
<td>30. Viva Voce</td>
<td>2</td>
</tr>
<tr>
<td>31. Lab – X (25&amp;26)</td>
<td>4</td>
</tr>
<tr>
<td>32. Field Work</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

**Grand Total** 96

**NB:** Any one course among that of 4 credits of M.Sc. III Semester or course framed for CBC may be offered to students of other department.

Some members of BOS disagreed on treating the two different courses (2 credits each) separately. They insisted on merging of the two different courses into one course of 4 credits. In this context, a dissent signed by thirteen members of BOS out of 30 present was submitted (Annexure 2).

However, a majority of BOS members agreed with the treatment of the two different courses (2 credits each) as separate entity as fifteen members submitted a Rejoinder in favour (Annexure 3). Thus majority decision prevailed.

The approved PG courses are as Annexure 4.

The approved Credit Framework for Skill Development at UG level is as Annexure 5.
Item No. 3

Application of the teaching staff of Women’s College regarding research space in the department was considered. A room (Room No.61) was allocated for the said purpose.

Item No. 4

Application of Dr. G.V. Subrahmanyam regarding development of a World Class School of Environmental Sciences by him at AMU was considered. The matter was discussed with the Incharge of Environmental Botany Specialization. He suggested that his application may be forwarded to the Faculty of Environmental Sciences.

Item No. 5

The Board considered the matter regarding publication of research papers in journals for credit. It was approved that only ISI Journals related to the field of research may be considered for the purpose.

Item No. 6 The Board considered and recommended Minor Changes (Specifications) in the title of Ph.D. Programme of the following students:

Minor Changes (Specifications)

(i). Ms. Dania Ahmad (D.O.R: 06.05.2014, En. No.GD-4087) - Ph.D.

New Topic
Studies on the interaction and management of disease complex of *Meloidogyne incognita* and *Fusarium solani* on Lentil.

Old Topic
Studies on the interaction and management of disease complex of *Meloidogyne incognita*, *Fusarium solani* and *Rhizoctonia solani* on Lentil.


New Topic
Phytochemical and Molecular Studies on Anthocyanin Production in *in vitro* cultures of *Salix Tetrasperma* Roxb.

Old Topic
Morphogenetic studies on some potential endangered medicinal plants using *in vitro* techniques.
Department of Botany
BOS Special Meeting
held on 09.09.2015

Major Change

(i). Ms. Ashyana Kouser (D.O.R: 14.01.2015, En. No.AA-4315) - Ph.D.

   New Topic
   Studies of the effect of salinity and heavy metals on performance of certain medicinal plants.

   Old Topic
   Ecology and conservation status of Buxus wallichiana Baill. (Buxaceae) in Jammu region.

(Firoz Mohammad)
Professor & Chairman

Copy to:
1. All members of Board of Studies
2. Dean, Faculty of Life Sciences
3. Dy. Registrar (Councils).

(Firoz Mohammad)
Professor & Chairman

(Department of Botany)
BOS Special Meeting
held on 09.09.2015
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Lukman Ahamad (En No.GD-4547)
Name of Supervisor & Internal Examiner: Prof. Zaki A. Siddiqui

Topic of Research: Studies on the interaction of Meloidogyne incognita and Fusarium solani on Daucus carota

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I
Okra, its cultivation, production and nutrient value, major diseases of okra, Concept of plant disease, Host parasite relationship in nematode infection, Effect of abiotic factors in nematode multiplication, Interactions of plant parasitic nematodes with fungi, nematode-nematode interactions.

Unit-II
Disease resistance mechanism in plants, performed substances and structures, induced structures and biochemical defense; Effect of infection on physiology of plants (photosynthesis, translocation, respiration, membrane permeability, transcription and translation).

Unit-III
Morphology and anatomy of nematodes, Structural detail of oesophagi, excretory, nervous and reproductive systems. Life cycle of Meloidogyne, Root-rot of okra caused by Fusarium solani, symptoms, impact of disease and its management.

Unit-IV
Integrated pest management, Regulatory and physical measure of disease management, Management of diseases by culture practice, cropping sequences, organic amendments, Biocontrol of fungal and nematode disease; Use of nanoparticles in plant disease management.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Manzoor Raiees Khan (En No.GH-1827)
Name of Supervisor & Internal Examiner: Prof. Zaki A. Siddiqui

Topic of Research: Studies on the cohabitation of Meloidogyne incognita and Xanthomonas axonopodis pv. malvacearum on Abelmoschus esculentus

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I Okra, its cultivation, production and nutrient value, major diseases of okra, Concept of plant disease, Host parasite relationship in nematode infection, Interactions of plant parasitic nematodes with bacteria, nematode-nematode interactions.

Unit-II Effect of infection on physiology of plants (photosynthesis, translocation, respiration, membrane permeability, transcription and translation), Disease resistance mechanism in plants, performed substances and structures, induced structures and biochemical defense.

Unit-III Morphology and anatomy of nematodes, Structural detail of oesophagi, excretory, nervous and reproductive systems. Life cycle of Meloidogyne, bacterial blight of okra caused by Xanthomonas axonopodis pv. malvacearum, symptoms, impact of disease, and its management.

Unit-IV Broad principles of plant disease management, Integrated pest management, Regulatory and physical measure of disease management, Management of diseases by culture practices, cropping sequences, organic amendments, Biocontrol of nematode diseases, Use of nanoparticles in plant disease management.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Chanchal Chaudhary (En No.GH-7535)
Name of Supervisor & Internal Examiner: Prof. Hisamuddin

Topic of Research: Histopathological studies on the roots of a medicinal plant infected with *Meloidogyne incognita*

Maximum marks: 100
   Theory: 60
   Sessional/Practical: 40

Unit-I  Effects of Pathogens on Physiological Phenomena of plants:
   1. Effect on Photosynthesis,
   2. Effect on Translocation of Water,
   3. Effect on Translocation of Solutes,
   4. Effect on Respiration of Host,
   5. Effect on Transcription in Host,
   6. Effect on Translation in Host.

Unit-II  Diseases Caused by Fungi: Symptoms, Causal Organisms, Disease cycle and Control of the Following Diseases:
   1. Downy Mildew of Cucurbits
   2. Powdery Mildew of Cucurbits
   3. Black Stem Rust of Wheat
   4. Early Blight of Potato
   5. Club Root of Cabbage

Unit-III  Bacteria and Viruses: Structure, Reproduction, Classification of Plant Pathogenic Bacteria; Symptoms Caused by Viral Infections in Plants; Transmission of Viruses.

Unit-IV  Control of Plant Diseases:
   1. Regulatory methods
   2. Cultural methods
   3. Physical methods
   4. Chemical methods
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Moh Tariq (En No.GE-7567)
Name of Supervisor & Internal Examiner: Prof. Mansoor A. Siddiqui

Topic of Research: Studies on the management of *Meloidogyne incognita* infesting *Abelmoschus esculentus* L. and *Solanum melongena* L. through some bioagents and botanicals

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I Importance of nematodes as pests. Soil environmental factors affecting nematodes. Biology of root-knot nematode.

Unit-II Concept of plant disease. Causal organism, symptoms and control of the following diseases:

1. Ear cockle disease of wheat
2. Root-knot disease of brinjal and okra
3. Golden cyst nematode disease of potato

Unit-III Sampling and extraction of root-knot nematode. Collection and maintenance of inoculum for experimental work. Perineal pattern technique for the identification of *Meloidogyne* spp. Identification of four most common species of the genus *Meloidogyne*.

Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Amir Khan (En No.GE-4961)
Name of Supervisor & Internal Examiner: Prof. Mansoor A. Siddiqui

**Topic of Research:** Studies on the potential of some bioinoculants and botanicals against *Meloidogyne incognita* parasitizing *Cicer arietinum* L. and *Vigna radiata* L.

**Maximum marks: 100**
Theory: 60
Sessional/Practical: 40

**Unit-I**
Outline classification of nematodes. Importance of root-knot nematodes as pests. Pathogenicity of Plant parasitic nematodes.

**Unit-II**
Identification of nematodes particularly inhabit in Aligarh soil. Isolation techniques of Plant parasitic nematodes through Cobb’s sieving and decanting method modified by Baermann funnel and Centrifugation floatation method.

**Unit-III**
Concept of Plant disease. Causal organism, symptoms and control of the following diseases:
1. Tundu disease of wheat
2. Cereal root knot disease
3. *Cajanus* Cyst nematode disease

**Unit-IV**
Host parasitic relationship in nematode infection. Interaction of nematodes with nematodes, nematode with fungi, nematode with bacteria and nematode with viruses. Mode of action of nematicides and organic soil amendments.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Zebus Sehar (En No. GE5779)
Name of Supervisor & Internal Examiner: Prof. Nafees A. Khan

Topic of Research: The potential of plant hormones and glucose in reversal of salinity induced changes in wheat

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I Role of phytohormones in abiotic stress tolerance, action of ethylene, salicylic acid, jasmonates and nitric oxide under abiotic stress,

Unit-II Cross talk between phytohormones action, ethylene perception and its regulation, cellular and molecular modes of ethylene action, signal transduction of ethylene and its role in abiotic stress tolerance

Unit-III Salt stress: Causes of salt stress, mechanism of salt stress alleviation; Cross-talk between nitric oxide and sulfur in salt stress alleviation.

Unit-IV Essential and beneficial nutrients, criteria for essentiality, role of primary nutrient elements (nitrogen, phosphorus, potassium, sulfur) in plant growth and development, techniques for nutritional studies.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Khan Bilal Mukhtar Ahmad (En No. GD-4784)
Name of Supervisor & Internal Examiner: Prof. M. Masroor A. Khan

Topic of Research: Physiological attributes and essential oil production of ‘Patchouli’ (Pogostemon cablin (Blanco) Benth.) as influenced by radiation-processed sodium alginate and chitosan and their fractions

Maximum marks: 100
Theory: 60
Sessional/Practical: 40


Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: **Husna Siddiqui (En No.GH-7551)**  
Name of Supervisor & Internal Examiner: **Prof. Shamsul Hayat**

**Topic of Research:**  
Effect of brassinosteroids and glucose under the stress of cadmium on the performance of *Brassica juncea*  

**Maximum marks:** 100  
**Theory:** 60  
**Sessional/Practical:** 40

**Unit-I**  
(a) Brassinosteroids: Occurrence and chemical structures in plants.  
(b) Physiological effects related to brassinosteroids application in plants.

**Unit-II**  
(a) Abiotic Stress, Types of Abiotic Stress in plants. Physiological implications due to abiotic stress.  
(b) Soil cadmium enrichment: Allocation and plant physiological manifestations.

**Unit-III**  
(a) Definition, Biological significance of carbohydrate, Classification of carbohydrates, Structure of Monosaccharides, Properties of monosaccharides.  
(b) Physiological role of glucose in plants under normal and stress condition.

**Unit-IV**  
Mustard (*Brassica juncea*): Botany, Distribution, Uses, Cultivation, varieties, chemical composition.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Abbu Zaid (En No. GH-7403)
Name of Supervisor & Internal Examiner: Prof. Firoz Mohammad

Topic of Research: Study of the effect of plant growth regulators on Mentha piperita L. grown with cadmium

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I
General account of secondary metabolites; essential oils: Definition, historical account, classification and structure, general properties.

Unit-II
Peppermint (Mentha piperita L.): Botany, distribution, cultivation, varieties, chemical composition and diseases.

Unit-III
Heavy metal stress with special reference to cadmium.

Unit-IV
Plant growth regulators: Structure, function and mechanism of action of common plant growth regulators.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Fareen Sami
Name of Supervisor & Internal Examiner: Prof. Shamsul Hayat

Topic of Research: Study of dose dependent response of nitric oxide and glucose under the stress of salinity on the performance of Brassica juncea

Maximum marks: 100
  Theory: 60
  Sessional/Practical: 40

Unit-I (a) Abiotic Stress, Types of Abiotic Stress in plants, Physiological implications due to abiotic stress.

(b) Causes of salinity and plant manifestations to salt stress.

Unit-II (a) Nitric Oxide: Chemistry, Biosynthesis and Physiological Role.

(b) Nitric Oxide and Abiotic Stress in Higher Plants.

Unit-III (a) Definition, Biological significance of carbohydrate, Classification of carbohydrates, Structure of Monosaccharides, Properties of monosaccharides.

(b) Physiological role of glucose in plants under normal and stress condition.

Unit-IV Mustard (Brassica juncea): Botany, Distribution, Uses, Cultivation, varieties, chemical composition.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Faroza Nazir (En No.GH-1808)
Name of Supervisor & Internal Examiner: Dr. Qazi Fariduddin

Topic of Research: Hydrogen peroxide mediated responses of *Lycopersicon esculentum* Mill. under heavy metal in the presence of brassinosteroid

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I  (a) **Mineral nutrition**: Plant essential mineral nutrients and their classification, techniques used in nutritional studies, mineral function, deficiencies and their role in plant metabolism.

(b) **Mustard**: taxonomic status, morphology, cultivation and economic importance.

Unit-II **Photosynthesis**: Photoinhibition and D1 repair cycle; electron transport chain (Z-scheme); Calvin cycle (*C*₃ cycle); *C*₄ cycle; CAM.

Unit-III  (a) **Water relations of plants**: Basic water relations, structure of stomata and mechanics of stomatal movement, stomatal responses and guard cell signal transduction.

(b) **Temperature stress**: High temperature and low temperature stresses in plants

Unit-IV  (a) **Physiology of heavy metal stress**: Introduction, strategies of plants to overcome heavy metals stresses; Osmotic adjustment and its role in heavy metal tolerance, scavenging mechanisms to detoxify reactive species.

(b) **Brassinosteroids**: Brassinosteroid structure and occurrence, Biosynthetic and signalling pathway, role in growth and development, use of BR’s in agriculture.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: **Anjuman Hussain**  
Name of Supervisor & Internal Examiner: **Dr. Qazi Fariduddin**

**Topic of Research:** Role of polyamines in *Brassica juncea* under heavy metal stress in the presence of brassinosteroids

---

**Maximum marks: 100**  
Theory: 60  
Sessional/Practical: 40

---

**Unit-I**  
**Photosynthesis:** Photoinhibition and D1 repair cycle; electron transport chain (Z-scheme) and recent mechanism of ATP synthesis by photophosphorylation. Calvin cycle (C$_3$ cycle); C$_4$ cycle; CAM.

**Unit-II**  
**Mineral nutrition:** Plant essential mineral nutrients and their classification, techniques used in nutritional studies, mineral function, deficiencies and their role in plant metabolism.

**Unit-III**  
(a) **Responses and adaptations to abiotic stress:** Developmental and physiological mechanisms that protect plants against environmental extremes.

(b) **Polyamines:** Role of polyamines in abiotic stress tolerance in plants

**Unit-IV**  
(a) **Brassinosteroids:** Brassinosteroid structure and occurrence, biosynthetic and signalling pathway, role in growth and development, use of BR's in agriculture.

(b) Role of brassinosteroids in various abiotic stresses in plants
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: **Saqib Ul Kalam (En No.GE-7689)**
Name of Supervisor & Internal Examiner: **Dr. Fauzia Naushin**

**Topic of Research:** Occurrence of some heavy metals in selected cucurbits cultivated in some major cities of UP along Ganga river basin

**Maximum marks:** 100
**Theory:** 60
**Sessional/Practical:** 40

**Unit-I** Ecosystem structure and function, productivity concept, energy flow, food chain food web, trophic structure and ecological pyramids.

**Unit-II** Population ecology, ecological amplitude and law of tolerance, population characteristics, survivorship curves, population growth, age distribution, fluctuations in population:

**Unit-III** Soil profile and classification, soil composition, soil pollution by Heavy Metals - sources, effects and control.

**Unit-IV** Mycorrhiza, types of mycorrhiza, endomycorrhiza, classification of endomycorrhiza, roles of mycorrhiza in plant growth and uptake of heavy metals.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Gufran Ahmad (En No.GE-5400)
Name of Supervisor & Internal Examiner: Prof. Abrar A. Khan

Topic of Research: Studies on interaction of air pollutants and root-knot nematode on pumpkin (Cucurbita moschata Duch.)

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I  **Plant Disease:** Concept, classification and diagnosis of plant disease, general idea of animate and inanimate disease in plants. Types of plant parasitic nematodes, symptoms produced by plant parasitic nematodes.

Unit-II  **Air Pollution:** Sources, formation, reaction of sulphur dioxide (SO\(_2\)), ozone (O\(_3\)), oxides of nitrogen (NO\(_x\)) and acid rain, and their effects on plants.

Unit-III  **Soil Pollution:** Biodegradation of chemicals, pesticides and their ill effects, heavy metal pollution, phytoremediation, solid waste management.

Unit-IV  **Particulate Matters:** Particulate air pollutants and their types. Sources and characteristics of fly ash, brick kiln dust and cement dust, and their effects on plants and pathogens.
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: **Urooj Fatima**  
Name of Supervisor & Internal Examiner: **Prof. Altaf Ahmad**

**Topic of Research:** Real-time monitoring of flux of nitrate and sulphate in living cells by in-house designed FRET-based genetically encoded nanosensors

**Maximum marks:** 100  
**Theory:** 60  
**Sessional/Practical:** 40

**Unit-I**  
Nanosensors- types and application; Fluorescent proteins- Discovery, types and applications; Periplasmic binding proteins, Fluorescent Resonance Energy Transfer phenomenon.

**Unit-II**  
2D-gel electrophoresis, Isoelectric focusing gels, Expression of recombinant proteins using bacteria and plant vectors, DNA sequencing methods, Methods for analysis of gene expression at RNA level and protein level.

**Unit-III**  
**Recombinant DNA technology:** Gene cloning, Restriction endonuclease, Cloning vectors, DNA ligase, DNA modifying enzymes: Polynucleotide Kinase, DNA polymerase, Reverse transcriptase, Alkaline phosphatase, Terminal transferase, S1-nulease, Transformation of bacterial cells plasmid with and analysis of recombinants, generation of genomic library and cDNA library.

**Unit-IV**  
**Genetic Engineering of plants:** General strategy; *Agrobacterium tumifaciens* as natural genetic engineer; Plant transformation with plasmid derived vector systems; Physical methods of transferring genes to plants - microprojectile bombardment, electroporation; Use of reporter genes in transformed plant cells; Transgenic plants for insect, fungal, bacterial disease resistance, Golden rice.

Annexure 1 (p)
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Ghazala Ambrin
Name of Supervisor & Internal Examiner: Prof. Altaf Ahmad

Topic of Research: Development of Sequence Characterized Amplified Region (SCAR) markers for the DNA-based authentication of some medicinal plants

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I  Molecular markers and crop improvement: Morphological, biochemical and molecular markers, non-PCR based marker (RFLP, Procedure, construction of RFLP and uses), PCR based markers (RAPD and AFLP), structural and functional genomics in relation to crop improvement, DNA fingerprinting, marker assisted selection.

Unit-II  2D-gel electrophoresis, Isoelectric focusing gels, Expression of recombinant proteins using bacteria and plant vectors, DNA sequencing methods, Methods for analysis of gene expression at RNA level and protein level.

Unit-III  Recombinant DNA technology: Gene cloning, Restriction endonuclease, Cloning vectors, DNA ligase, DNA modifying enzymes: Polynucleotide Kinase, DNA polymerase, Reverse transcriptase, Alkaline phosphatase, Terminal transferase, S1-nulease, Transformation of bacterial cells plasmid with and analysis of recombinants, generation of genomic library and cDNA library.

Unit-IV  Genetic Engineering of plants: General strategy; Agrobacterium tumifaciens as natural genetic engineer; Plant transformation with plasmid derived vector systems; Physical methods of transferring genes to plants - microprojectile bombardment, electroporation; Use of reporter genes in transformed plant cells; Transgenic plants for insect, fungal, bacterial disease resistance, Golden rice.

Annexure 1 (q)
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Shafia Siddiqui
Name of Supervisor & Internal Examiner: Dr. Shahla Faizan

Topic of Research: The alleviation of cadmium stress by the synergistic interaction of symbiotic microbes in medicinal plant

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I Medicinal plants
a) Area covered by medicinal plants in India
b) Botanical description and medicinal importance of—
   • Coriandrum sativum
   • Linum usitatissimum
   • Mentha arvensis
   • Cymbopogon citrates
   • Cuminum cyminum

Unit-II Heavy metal stress
a) Heavy metals and their sources
b) Visible symptoms of toxicity of heavy metals
c) Behaviour of heavy metals in soil
d) Heavy metal-induced oxidative stress and reactive oxygen species (ROS)

Unit-III Stress responses of plants to Cadmium
a) The heavy metal- Cadmium
b) Oxidative stress
c) Plant responses to Cadmium stress
d) Indicator and accumulator species

Unit-IV Role of growth-promoting rhizobacteria (PGPR) and AM fungi.

a) Introduction of AM fungi and rhizobacteria
b) Interaction of AM fungi and rhizobacteria with biotic and abiotic stress
c) Preparation of AM fungi inoculum
d) Role of AM fungi and rhizobacteria in the alleviation of heavy metal stress
Ph.D. Syllabus of Course-II (Internal)

Name of the Candidate: Waseem Mushtaq
Name of Supervisor & Internal Examiner: Prof. M. Badruzzaman Siddiqui

Topic of Research: Allelopathic impact of *Nicotiana plumbaginifolia* Viv. on some weed and pulse crops

Maximum marks: 100
Theory: 60
Sessional/Practical: 40

Unit-I  (Historical background of Allelopathic/ weed science)

Historical background of allelopathy, weed characteristics adaptive strategies and role in agro ecosystems, weed control techniques, potential of allelopathy for weed management. (Aquatic, terrestrial and parasitic).

Unit-II  (Allelopathic weeds and crops)


Unit-III  (Extraction of water soluble salt; sampling, processing and storage of Plant)

Method of extraction of soluble salts (i) Determination of carbonate and bicarbonate (ii) Determination of chloride (iii) Sulphate (iv) Calcium (v) Sodium and Potassium Estimation of Phosphorus, Potassium, Sulphur, Boron, Molybdenum, Estimation of trace elements- Zn, Mn, Cu and Fe.

Unit-IV  (Advanced Analytical Techniques and Instrumentation)

Chromatography, Ion Chromatography, Gas Chromatography, Gel Chromatography, Principal and significance of High Pressure Liquid Chromatography (HPLC).
NOTE OF DISSENT

Dated: Sept 11, 2015

To,
The Chairman
Board of Studies
Department of Botany
A.M.U., Aligarh

A special meeting of Board of Studies (BOS) of the Department of Botany was held on 9-9-2015 at 10:30 AM in the Conference Hall of the department.

Item No. 2 of the agenda of the said meeting was related to implementation of re-structured syllabi of the UG and PG Courses from the academic session 2015-2016. In this connection a committee, comprising eight professors of the Department of Botany, was constituted by the Chairman, wherein the convener was Prof. M.Y.K. Ansari. At the instance of the Convener, a meeting of the said Committee was held on 22-8-2015 at 1:00 PM in his chamber, in which the following decisions were taken:

That as per CBCS guidelines the total number of courses currently being taught and also their credits should be 96 and the committee in compliance to the above directive merged the courses with similar themes into one paper.

Hence, the following were merged:

1) Molecular biology of Plants (Course II), Genetics and cytogenetics (Course V) of I semester and Genetics and cytogenetics (Course VI) of II semester of M.Sc.
2) Pteridophytes and Gymnosperms (Course IV and Course VII)
3) Ecology—I and Ecology—II (Course XIII and Course XIV)
4) Plant resource utilization and Plant resource conservation (Course XV and Course XVI)
5) Biotechnology—I and Biotechnology—II (Course XVII and Course XVIII)

Following similar principle, courses entitled Plant Physiology (course IX) and Plant Metabolism (course X) were also merged into one course as ‘Plant Physiology and Metabolism’.

After thorough deliberations, the above decisions were taken by majority of the members in keeping the guidelines of CBCS. When this matter was placed before the above mentioned BOS, some members of the Physiology Section of the Department objected to the merger of ‘Plant Physiology and Metabolism’. Since the merger policy was general in nature, the majority of the members of BOS felt that the uniform policy of the merger should be adopted and hence the above two courses of the Plant Physiology should be clubbed into one as has been done with reference to the above courses.
The majority of the Members of the BOS, whose signatures are appended below, have agreed for this merger (i.e. Plant Physiology and Metabolism) while a few particularly belonging to the section of Plant Physiology Section, without assigning any cogent reason, have expressed their reservations. Hence, keeping in view of the democratic norms and practice, the majority decision of the BOS be prevail. So that anomalies be corrected.

The above, together with signatures appended below, is for record and necessary action.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name</th>
<th>Signature</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Prof. M.E. Siddiqui</td>
<td></td>
<td>Environmental Botany</td>
</tr>
<tr>
<td>2.</td>
<td>Prof. Samiullah Khan</td>
<td></td>
<td>Genetics &amp; Plant Breeding</td>
</tr>
<tr>
<td>3.</td>
<td>Prof. Azam Mahboob</td>
<td></td>
<td>Plant Pathology</td>
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<tr>
<td>4.</td>
<td>Prof. Aburaz A. Khan</td>
<td></td>
<td>Environmental Botany</td>
</tr>
<tr>
<td>5.</td>
<td>Prof. Masood A. Siddiqui</td>
<td></td>
<td>Plant Pathology</td>
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<td>6.</td>
<td>Prof. Tabrez A. Khan</td>
<td></td>
<td>Plant Pathology</td>
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<td>7.</td>
<td>Dr. Anwar Shahid</td>
<td></td>
<td>Plant Biotechnology</td>
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<tr>
<td>8.</td>
<td>Prof. Karachi Siddiqui</td>
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<td>Plant Pathology</td>
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<tr>
<td>9.</td>
<td>Prof. M.Y. R. Arain</td>
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<td>Genetics</td>
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<td>10.</td>
<td>Prof. Shekib Shahab</td>
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<td>Plant Pathology</td>
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<tr>
<td>11.</td>
<td>Prof. Rahim K. Jundi</td>
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<tr>
<td>12.</td>
<td>Dr. Ghulam Pervaiz</td>
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<tr>
<td>13.</td>
<td>M. Arif</td>
<td></td>
<td>Plant Pathology</td>
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</table>
REJOINDER OF THE DISSENT SUBMITTED BY SOME MEMBERS OF BOS

The statement in the second para of the dissent is misleading as the convener convened a consultative meeting of eight members for restructuring of PG syllabi on 14.08.2015 and circulated the minutes of the meeting on 19.08.2015 (Minutes enclosed, Annexure 1). Nobody showed his disagreement. Without having any disagreement and without notifying cancellation of the minutes of the above meeting, the convener convened another meeting on 22.08.2015. Three members did not deviate from the decision of the first meeting (copy of disagreement of three members enclosed, Annexure 2).

In all, this office received two different minutes, and thus, it was obligatory on the part of the Chairman to prepare the frame work by including almost all the suggestions of both the meetings.

Courses entitled Plant Physiology and Plant Metabolism each carrying 2 credits could not be merged on the basis of the following facts:

The two courses in question are entirely different and deal with different aspects, viz. Plant Physiology covering Plant processes, while Plant Metabolism, bio-chemical reactions. That is why there are separate books for these subjects (List of separate books enclosed, Annexure 3).

The two courses are very useful for students appearing for CSIR-UGC JRF/NET. Every year, there are many questions from these two courses.

The related section of the department comprises 06 Professors (among them 2 are D. Ses.), 01 Associate Professor and 02 Assistant Professors, who are quite competent enough as they have been able to produce internationally recognized more than 100 PhDs, 1000 research papers and 50 books and to fetch more than 2 crores rupees from different funding agencies. It was their consensus in framing these two courses. Moreover, these courses will not affect the teaching of the other disciplines.

The merging of these two courses as one will reduce the quantum of the teaching material and will negatively affect students' benefit. Moreover, two credit courses were required to balance the credits of II and III Semesters, like that of I Semester. Making 2 credit courses is not against the UGC rules.

Out of 30 members present in the meeting (copy enclosed, Annexure- 4), only 13 have signed on the dissent note and 17 members are still in agreement with the proposal submitted in BOS.

The dissent submitted by teachers has no substance except to interrupt the academic functioning of the department.

(Firoz Mohammad)
Professor & Chairman

N.B.: Signatures of Fifteen (15) BOS Members overleaf.
Annexure 3 (b)

1. (Siddique Mohammed)
2. (Prof. Mafeen A. Khan)
3. ALI DR. (ALTAF HAMEED)
4. Abubakir
   (Altaf Ali Khan)
5. (Farooq A. Khan)
6. (Tawfik Attah)
7. (Arif Masood)
8. Aslam
   (Prof. Shamsud Haque)
9. (M. Masroor A. Khan)
10. (Aziz Fariduddin)
11. (Ar. Fanizan Noorshin)
12. Ihsan (Dr. Hisamuddin)
13. Ahsan Ud Din (PROF. MOINUDDIN)
14. Dr. Akhtar Inam
15. ARIF NAZIR

ARIF NAZIR
Office of the Chairman  
Department of Botany  
A.M.U., Aligarh  

Dated: August 19, 2015

Minutes

of

the consultative meeting for discussing matters related to revision of course structure of M.Sc. (Botany) and adoption of CBCS at under-graduate and post-graduate courses was held on 14.08.2015 at 11:00 a.m. in the chamber of the chairman.

The following were present in the meeting:

1. Prof. Mohammad Anis  
2. Prof. M.Y.K. Ansari  
3. Prof. Nafees A. Khan  
4. Prof. Irshad Mahmood  
5. Prof. M.B. Siddiqui  
6. Prof. Hisamuddin  
7. Prof. Samiullah Khan  
8. Prof. Altaf Ahmad

It was resolved that:

1. The teaching of restructured courses in various semesters will be effective from 2015-2016 as per attached courses of post-graduate classes.

2. There will no change in courses of undergraduate classes.

(Prof. M.Y.K. Ansari)  
Convener
### M.Sc. I Semester

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>I - C 1</td>
<td>Diversity of Microbes (Virus, Bacteria, Fungi &amp; Nematodes)</td>
<td>4</td>
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<tr>
<td>I - C 2</td>
<td>Diversity of Plant Pathogens</td>
<td>2</td>
</tr>
<tr>
<td>I - C 3</td>
<td>Diversity of Algae &amp; Bryophytes</td>
<td>1</td>
</tr>
<tr>
<td>I - C 4</td>
<td>Diversity of Pteridophytes &amp; Gymnosperms</td>
<td>4</td>
</tr>
<tr>
<td>I - C 5</td>
<td>Taxonomy of Angiosperms</td>
<td>4</td>
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<tr>
<td>I - C 6</td>
<td>Lab – I (1+2)</td>
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<td>I - C 7</td>
<td>Lab – II (3+4)</td>
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<td>I - C 8</td>
<td>Lab – III (5)</td>
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### M.Sc. II Semester

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<tr>
<td>II - C 1</td>
<td>Reproduction in Flowering Plants</td>
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<td>II - C 2</td>
<td>Anatomy of Flowering Plants</td>
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<td>II - C 3</td>
<td>Cell Biology of Plants</td>
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<td>II - C 4</td>
<td>Plant Physiology</td>
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<td>II - C 5</td>
<td>Plant Metabolism</td>
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<td>II - C 6</td>
<td>Lab – IV (1+3)</td>
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<td>II - C 7</td>
<td>Lab – V (2)</td>
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<td>II - C 8</td>
<td>Lab – VI (4+5)</td>
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### M.Sc. III Semester

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<tr>
<td>III - C 1</td>
<td>Genetics</td>
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<td>III - C 2</td>
<td>Genetic Engineering of Plants &amp; Microbes</td>
<td>4</td>
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<tr>
<td>III - C 3</td>
<td>Economic Botany</td>
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<td>Ecology</td>
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<td>III - C 5</td>
<td>CBC</td>
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<td>III - C 6</td>
<td>Lab – VII (1+2)</td>
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<td>III - C 7</td>
<td>Lab – VIII (4)</td>
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### M.Sc. IV Semester

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<td>IV - C 1</td>
<td>Specialization Paper I</td>
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<td>IV - C 2</td>
<td>Specialization Paper II</td>
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<td>IV - C 3</td>
<td>Seminar</td>
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<td>IV - C 4</td>
<td>Communication Skills</td>
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<td>IV - C 5</td>
<td>Dissertation</td>
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<td>IV - C 6</td>
<td>Viva Voce</td>
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<td>IV - C 7</td>
<td>Lab – X (1+2)</td>
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<tr>
<td>IV - C 8</td>
<td>Field Work</td>
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</table>
Department of Botany  
Aligarh Muslim University  
Aligarh 202002  
Dated: August 24, 2015-08-24  

The Chairman  
Department of Botany  
AMU Aligarh  

We submit the following points in respect of course structure of M.Sc. Botany  

1. The course structure framed, decided and communicated by the Convener on August 19, 2015 is valid and acceptable.  
2. We do not agree to any further change taken up in the meeting of August 22, 2015.  

[Signatures]  

Prof. Naseer A. Khan  

[Seal]  

Haaq  

[Seal]  

[Seal]  

24-8-15
Introductory Plant Physiology

Authors: Noggle and Fritz
Publisher: Prentice-Hal

- The organization of plants
- Cellular constituents and their biosynthesis
- Photophysiology
- Photosynthesis
- Photorespiration
- Mineral nutrition
- Assimilation of inorganic nutrients
- Transport phenomena in plants: general considerations
- Transport processes in plant cells and tissues
- Water as a plant constituent; The plant in relation to water;
- Plant growth substances: structure and physiological effects; Plant growth substances: biosynthesis, analysis, transport, and mechanism of action;
- The physiology of seeds
- Vegetative plant growth; Reproductive growth

Plant Physiology

Author: Jiří Sebánek
Publisher: Elsevier

The book summarizes present scientific knowledge in plant physiology with regards to plant production. The first chapters discuss metabolism i.e. photosynthesis, respiration, mineral and heterotrophic nutrition, and water regime of plants. What follows is a discussion of the physiology of plant growth, development and movements, and finally resistance of plants against unfavourable abiotic and biotic effects. The book shows how to increase the yield of crops by manipulating photosynthesis and also studies the possible flow of photosynthetic products to the commercially valuable parts of the biomass. Rational plant production, however, cannot do without knowledge of plant nutrition and water regime as a theoretical basis for fertilization and irrigation. The reader will find this knowledge detailed as well as information about the ecological and physiological principles of the resistance of plants against drought, frost, heat, diseases and other unfavourable effects.
Title: A text book of Plant Physiology
Author: George James Peirce
Publisher: H. Holt and company, 1903

Introduction to Plant Physiology

William G. Hopkins and Norman P.A. Huner
Publisher: John Wiley and Sons Ltd
Plant Metabolism

David T. Dennis
Publisher: Longman, 1997 631 pages
The text is divided into ten sections, each dealing with a particular aspect of plant metabolism. Section I deals with the fundamentals of the control of metabolism. This includes new chapters on protein synthesis and the molecular biology of plant development.
Section II contains new chapters on the cell wall, structure, communication and defense.
Sections III to IX cover all other major processes and pathways of plant metabolism and have been revised and updated to incorporate recent changes and advances in the field. The final section of the book contains new chapters on the manipulation of carbon allocation in plants and on the biochemical basis for plant improvement.

Plant Metabolism and Biotechnology

Hiroshi Ashihara, Alan Crozier, Atsushi Komamine
Publisher: John Wiley & Sons, Ltd
Published Online: 28 MAR 2011 08:35PM EST

*Plant Metabolism and Biotechnology* describes the biosynthetic pathways of plant metabolites, their function in plants, and some applications for biotechnology. Topics covered include:

- biosynthesis and metabolism of starch and sugars
- lipid biosynthesis
- symbiotic nitrogen fixation
- sulfur metabolism
- nucleotide metabolism
- purine alkaloid metabolism
- nicotine biosynthesis
- terpenoid biosynthesis
- benzylisoquinoline alkaloid biosynthesis
- monoterpenoid indole alkaloid biosynthesis
- flavonoid biosynthesis
- pigment biosynthesis: anthocyanins, betacyanins and carotenoids
- metabolomics in biotechnology

*Plant Metabolism and Biotechnology* is an essential guide to this important field for researchers and students of biochemistry, plant biology, metabolic engineering, biotechnology, food science, agriculture, and medicine.
Plant Metabolism
D. B. Layzell
Published: Prentice Hall College Div (1997-05)

The text is divided into ten sections, each dealing with a particular aspect of plant metabolism. Section I deals with the fundamentals of the control of metabolism. This includes new chapters on protein synthesis and the molecular biology of plant development. Section II contains new chapters on the cell wall, structure, communication and defence. Sections III to IX cover all other major processes and pathways of plant metabolism and have been revised and updated to incorporate recent changes and advances in the field. The final section of the book contains new chapters on the manipulation of carbon allocation in plants and on the biochemical basis for plant improvement.

Plant Biochemistry
By P. M. Dey and J. B. Harborne
Publisher: Academic Press

This book provides students and researchers in plant sciences with a concise general account of plant biochemistry. The edited format allows recognized experts in plant biochemistry to contribute chapters on their special topics. Up-to-date surveys are divided into four sections: the cell, primary metabolism, special metabolism, and the plant and the environment. There is a strong emphasis on plant metabolism as well as enzymological, methodological, molecular, biological, functional, and regulatory aspects of plant biochemistry. Illustrations of metabolic pathways are used extensively, and further reading lists are also included.

Key Features:
The coverage of the subject is divided into four sections:

- The plant cell-describing both molecular components and function
- Primary metabolism-including the pathways of carbohydrate, lipid, nitrogen, nucleic acid and protein metabolism as well as gene regulation
- Special metabolism-chapters on phenolics, isoprenoids and secondary nitrogen compounds
- The plant and the environment-discussions of pathology, ecology and biotechnology at the molecular level.
### M.Sc. Botany Syllabi

*(Effective from the academic session 2015-2016)*

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Titles of Course</th>
<th>Sessional</th>
<th>Mid-Sem Exam</th>
<th>End–Sem Exam</th>
<th>Total Marks</th>
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<tr>
<td><strong>SEMESTER – I</strong></td>
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<td>1.</td>
<td>Viruses, Bacteria, Fungi and Nematodes</td>
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<td>Algae and Bryophytes</td>
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**NB:** Any one course among that of 4 credits of M.Sc. III semester or course framed for CBS may be offered to students of other department.
Course 1 VIRUSES, BACTERIA, FUNGI AND NEMATODES

UNIT – I
• Classification of plant viruses, characteristics and ultrastructure of viruses; isolation, purification and characterization of viruses

• Chemical nature, replication, transmission of viruses, economic importance, symptomatology of plant viruses

UNIT – II
• Phytoplasma: General characteristics and role in causing plant diseases

• Archaebacteria and Eubacteria: General account, ultrastructure, nutrition and reproduction, biology and economic importance, Cyanobacteria-salient features and biological importance, plasmids and their characteristics.

UNIT – III

• Heterothallism, Heterokaryosis and para-sexuality; a concise account of fungi in industry, medicine and food; fungal diseases in plants and humans, mycorrhizae as biocontrol agents

UNIT – IV
General characters of plant parasitic nematodes: Distribution, morphology, life history, feeding habit, symptoms of plant nematode infection, root-knot disease of bringal, diagnostic features of Tylenchoidea, Heteroderoidea, Criconematoidea, Aphelenchoidea, Dorylaimoidea and Trichodoroidea.

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 1st Year (I Semester)

Course 2 | PLANT PATHOLOGY

UNIT – I


UNIT – II

Plant diseases: symptoms causal organism and management of following diseases-Stripe disease of barley, White rust of crucifer, Ear- cockle disease of wheat, Citrus canker, Yellow vein mosaic of okra.

UNIT – III

General principles of plant disease management: Avoidance of pathogen, Exclusion of inoculum, Eradication of pathogen, Protective measures of crop plants and Therapeutic measures.

UNIT – IV

Isolation of fungi from leaf, root, stem and seeds. Maintenance of fungal culture. Isolation of nematodes from soil by Cobb’s decanting and sieving method followed by Baermann’s funnel technique. Isolation of nematodes from the roots. Culture media preparation (Czapek-Dox Agar, Nutrient Agar media and PDA).

LABORATORY: Exercises corresponding to the theory courses.
ALGAE AND BRYOPHYTES

UNIT – I

Algae: Distribution, structure, classification and its basis (Grahm and Wilcox), reproduction and life cycles of Cyanobacteria, Glaucophyta, Euglenophyta, Cryptophyta, Haptophyta, Dinophyta, Ochrophyta, Rhodophyta and Chlorophyta

UNIT – II

Technological applications of algae: Algae as research tools, biomonitor, a gelling agents, antiviral and anticancerous compounds; algae in production of food additives and hydrocarbons and space research; human uses of sea weeds

UNIT – III

Bryophyta: Distribution, structure, outline classification (Proskauer, 1957); Reproduction and life history of Hepaticopsida (Marchantiales), Anthocerotopsida (Anthocerotales) and Bryopsida (Funariales); simple land plant nature

UNIT – IV

Economic importance of bryophytes: Uses of peat, medicinal uses, source of food, soil conservation, bog succession and rock builders; ecological importance of bryophytes as air and water pollution, bioindicators

LABORATORY: Exercises corresponding to the theory courses.
UNIT – I
General characteristic features and classification (Smith 1955 and Bierhorst) of Pteridophytes. Morphology, anatomy and reproduction of Psilophyta (Psilotum), Lycophyta (Selaginella), Sphenophyta (Equisetum), Pteropsida (Osmunda, and Marsilea). Telomic theory, Classification and evolution of steles. Heterospory and origin of seed habit.

UNIT – II
General account of fossil vascular cryptogams: Rhynopsida (Rhynia gwyme-vaughani, Rhynia major and Horneophyton lignieri), Lycopodiopsida- Asteroxylon mackiei. Economic importance of Pteridophytes as food, medicine, fiber, handicraft, construction material, horticultural plants, weed and biofertilizer.

UNIT – III
- General diagnostic features of gymnosperms with special reference to drop mechanism, vessel-less and fruitless seed plants. General account of anatomical variations in gymnospermic leaves (Abies, cedrus, Picea, Cycas and Taxus).
- General characters, global geographical distribution and external features of modern living members of Cycadales, Coniferales and Ginkogales.

UNIT – IV
- Outline classification of gymnosperms as proposed by Sporne (1965) and Sandra Holms (1986); Distribution of living gymnosperms in India; Economic importance of gymnosperms.
- General account of fossils of Medulosaceae (Medullosa), Glossopteridaceae (Glossopteris) and Cycadeoideaceae (Cycadeoidea).

LABORATORY: Exercises corresponding to the theory courses.
M.Sc. 1st Year (I Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 5 TAXONOMY OF ANGIOSPERMS

UNIT – I

- **The species concept:** Taxonomic hierarchy, species, genus, family and other categories; taxonomic keys; salient features of the Recent International Code of Botanical Nomenclature

- **Taxonomic tools:** Field and herbarium techniques, floras, serological techniques.

UNIT – II

**Systems of angiosperm classification:** History, basis, outline and relative merits and demerits of (i) Benthum and Hooker, (ii) Takhtajan, (iii) Bassey, (iv) Hutchinson and (v) Cronquist

UNIT – III

- **Flowering plant families of local importance:** Annonaceae, Portulacaceae, Fumariaceae, Papaveraceae, Malvaceae, Zygophyllaceae, Moringaceae, Lythraceae, Oleaceae, Convolvulaceae, Solanaceae, Asclepiadaceae, Apocynaceae, Scrophulariaceae, Bignoniaceae, Polygonaceae, Casuarinaceae, Commelinaceae, Arecaceae, Cyperaceae and Poaceae

- **Concepts of phytogeography:** Phytogeographic zones of world and India; Endemism (definition, types and endemism in Indian flora); Disjunction and vicariance biogeography. Parallelism and convergence

UNIT – IV

**Origin of Intrapopulation variations and speciation:** Dynamic nature of populations in relation to environment. Evolution (cladogenesis, anagenesis), Natural selection (stabilizing, directional and disruptive). Ecotypes and ecads. Hardy-Weinberg Equilibrium. Isolating mechanisms. Models of speciation. Some examples of known speciation events in plants.

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 1st Year (II Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 9 REPRODUCTION IN FLOWERING PLANTS

UNIT – I

- **Male gametophyte** - Microsporogenesis, role of tapetum, Pollen development, pollen germination, pollen tube growth and guidance, pollen allergy, pollen embryos

- **Female gametophyte** - Ovule development, megasporogenesis, organization of the embryo sac, types of female gametophyte.

UNIT – II

Pollination - pollination mechanisms and vectors; structure of the pistil; pollen-stigma interactions; double fertilization; *in vitro* fertilization

UNIT – III

Endosperm development, Embryogenesis, Polyembryony, Apomixis

UNIT – IV

- Latent life (dormancy) - types of dormancy and importance, overcoming seed dormancy

- Reproduction - vegetative options and sexual reproduction, floral biology

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 1st Year (II Semester)

Max. Marks: 100
Sessional: 10
Mid-Sem Exam.: 30
End-Sem Exam.: 60

Course 10 CELL AND MOLECULAR BIOLOGY

UNIT – I
- Structure and function of Plastids, Endoplasmic reticulum, Mitochondria, Golgi apparatus, Lysosomes, Peroxisomes, and Glyoxysomes, Ribosomes
- **Cell membrane**: Structure, lipid bilayer and membrane protein models, Function of cell membrane
- Genome of Chloroplast and mitochondria

UNIT – II
- **Cell cycle and apoptosis**: Control mechanism, role of cyclins and cyclin depended kinases, cytokinesis and cell plate formation, mechanism of programmed cell death
- **Techniques in cell biology**: Immunotechniques- SDS-PAGE and protein analysis; single and double (Ouchterlony) immunodiffusion; quantitative, qualitative, cross-over and two-dimension immune-electrophoresis; radioimmunoassay (RIA); ELISA; dot immunobinding assay; isoelectric focusing gels; in situ hybridization- FISH and GISH; confocal microscopy.

UNIT – III
- DNA, RNA as genetic materials, Physical and chemical structure of DNA; Mechanism of DNA replications, various enzymes involved and their role in maintaining fidelity of replication
- Structure and function of different types of RNAs, transcription units, RNA polymerases
- **Transcription (Prokaryotes and Eukaryotypes)**: Initiation complex formation and initiation factors, regulation; Elongation and elongation factors; Termination of transcription

UNIT – IV
- **Mechanism of translation**: tRNA and its Aminoacylation, aminoacyl tRNA synthetase, Translational proof reading, Post translational modification of proteins, Genetic code, Regulation of gene expression in prokaryotes (e.g. lactose and tryptophan operons) and in eukaryotes

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 1st Year (II Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 11  PLANT DEVELOPMENT

UNIT – I
Cell wall - nature, formation, growth of cell wall, microscopic and submicroscopic structure and functions

UNIT – II
- Shoot development - organization of the shoot apical meristem (SAM) and vascular tissue differentiation, plastochron, origin of leaves and branches
- Root development - organization of the root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, origin of lateral roots and root hairs in dicots and monocots

UNIT – III
Vascular cambium – origin, structure and function; formation of secondary body, formation of secondary phloem and xylem in relation to environmental factors

UNIT – IV
- Secretary ducts and laticifers – resin ducts of primary body and secondary body, gum ducts, kinoveins.
- Leaf growth and differentiation, phyllotaxy, structure and differentiation of epidermis (with special reference to stomata and trichomes), mesophyll

LABORATORY: Exercises corresponding to the theory courses
Course 12  PLANT PHYSIOLOGY

UNIT – I

- **Energy flow:** Principles of thermodynamics, free energy and energetic coupling, enthalpy and entropy, structure and functions of ATP

- **Enzymology:** Classification and general properties of enzymes, allosteric mechanism, regulatory and active sites, isozymes, effect of enzymes on substrate concentration and regulators on Km and its significance

UNIT – II

**Membrane transport and translocation of water and solutes:** Mechanism of water absorption and its conduction through xylem, aquaporin and its role. Root-microbe interactions in facilitating nutrient uptake, passive and active solutes transport, Pump carriers and ion channels, P-type and V-type ATPases, ABC transporters, Essential and beneficial elements and their roles

UNIT – III

- **Sensory photobiology:** Photochemical and biochemical properties of phytochromes, flavins, phototropins and cryptochromes, Photophysiology of light induced responces, cellular localization, molecular mechanism of action of photomorphogenic receptors, signalling and gene expression

- **Flowering process:** Photoperiodism, circadian rhythm and their significance, floral induction and development, genetic and molecular analysis

UNIT – IV

**Plant growth regulators and elicitors:** Biosynthesis, physiological effects, mechanism of perception, signal transduction and gene expression of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid

LABORATORY: Exercises corresponding to the theory courses
UNIT – I

Nucleus - structure, nuclear pores, nucleosome organization; RNA processing and editing, mRNA transport; Genetic recombination - molecular mechanism of recombination, site specific recombination

UNIT – II

Plasmids: Classification, replication and transfer in plasmids; transposable genetic elements; transposable elements in bacteria- insertion sequences or IS elements; transposable elements in eukaryotes- yeast Ty elements, Ac-Ds elements in maize, Spm-dSpm elements in maize; mutations induced by transposons.

UNIT – III

Mutations: Spontaneous and induced mutation, physical and chemical mutagens; molecular basis of gene mutation; oligonucleotide site directed mutagenesis. DNA damage and repair mechanism, inherited human diseases and defects in DNA repair

UNIT – IV

- Alien gene transfer through chromosome manipulations: Transfer of whole genome (examples from Triticum, Arachis and Brassica); transfer of individual chromosomes and chromosome segments

- Gene mapping with molecular marker, somatic cell genetics, mapping genes by interrupted mating

LABORATORY: Exercises corresponding to the theory courses
GENETIC ENGINEERING AND TISSUE CULTURE

UNIT – I

Genetic engineering – Gene cloning strategies, Restriction endonuclease, DNA ligase, DNA modifying enzymes, transformation of bacteria and analysis of recombinant, generation of genomic DNA library and cDNA library, polymerase chain reaction

UNIT – II

Tissue culture: Concept of cell culture, development of tissue culture, shoot, root tip and embryo culture; problems in plant tissue culture - contamination, phenolics and recalcitrants; factors responsible for in vitro & ex-vitro hardening; role of growth regulators

UNIT – III

Aseptic techniques: Autoclaving, Filter sterilization, Surface sterilization of explants, Selection of suitable media, Preparation of stock solution, Direct and indirect organogenesis, Suspension culture, Synthetic seeds and its application, Haploid plant production, endosperm culture

UNIT – IV

Protoplast isolation and somatic hybridization: Protoplast isolation, protoplast development; protoplast fusion, spontaneous and induced fusion, mechanism of fusion; identification and selection of hybrid cells; cybridization; application of somatic hybrids and cybrids

Plant transformation with Agrobacterium tumefaciens, Physical method of gene transfer; Transgenic plants for insect and fungal resistance

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 2nd Year (III Semester)

Max. Marks : 50
Sessional : 05
Mid-Sem Exam. : 15
End-Sem Exam. : 30

Course 18 PLANT METABOLISM

UNIT – I

**Photochemistry and photosynthesis:** Light harvesting complexes of higher plants, photooxidation of water, mechanism of electron and proton transport, carbon assimilation Calvin cycle, photorespiration and its significance, C4 cycle, CAM pathway, biosynthesis of sucrose

UNIT – II

**Respiration:** Overview of plant respiration, glycolysis, fermentation, tricarboxylic acid cycle, electron transport and ATP synthesis, pentose phosphate pathway, respiratory quotient.

UNIT – III

**Lipid metabolism:** General account (beneficial and harmful) of lipids with special reference to storage (triacyl glycerol and waxes) and structural (glycerophospholipids, sphingolipids and sterols) lipids, fatty acids and triacylglycerol- their structure, synthesis and degradation-alpha oxidation, beta oxidation and glyoxylate cycle

UNIT – IV

**Sulphur and Nitrogen metabolism:** Sulphur uptake, transport and assimilation; biological nitrogen fixation (symbiotic and asymbiotic), nodule formation, nitrate uptake and reduction, ammonia assimilation

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 2nd Year (III Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 19 PLANT RESOURCE UTILIZATION AND CONSERVATION

UNIT – I

- World centres of primary diversity of domesticated plants, plant introductions, secondary centres
- Medicinal and aromatic plants – Opium poppy (*Papaver somniferum*), Rauwolfia (*Rauvolfia serpentina*), Mint (*Mentha* spp.) and Nux-vomica (*Strychnos nux-vomica*)

UNIT – II

- Vegetable oil yielding crops : Distribution, botany, cultivation and uses of groundnut (*Arachis hypogaea*) and soybean (*Glycine max*)

- Fire and timber wood : Diagnostic features of wood and uses of Babul (*Acacia nilotica*), Mango (*Mangifera indica*), Sissoo (*Dalbergia sissoo*), Teak (*Tectona grandis*), Sal (*Shorea robusta*), Chir (*Pinus roxburghii*), Deodar (*Cedrus deodara*) and Kail (*Pinus wallichiana*)

UNIT – III

Strategies for plant conservation (*ex situ* conservation) - principles and practices, botanical gardens, general account of the activities of Botanical Survey of India (BSI), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), and the Department of Biotechnology (DBT), NBPGR (National Bureau of Plant genetic Resources) for plant conservation

UNIT – IV

- Plant biodiversity and its status in India
- Green revolution - benefits and adverse consequences
- Field genebanks, seed banks, *in vitro* repositories, cryobanks

LABORATORY: Exercises corresponding to the theory courses
Course 20 ECOLOGY

UNIT – I

- **Climate, soil and vegetation patterns of the world:** Life zones and major vegetation and soil types of the world.
- **Vegetation organization:** Concepts of community and continuum, analysis of communities (analytical and synthetic characters), indices of diversity (Simpson’s index and Shannon’s index), interspecific association, ordination, concept of ecological niche and habitat
- Introduction to vegetation sampling methods - quadrat method, line ransect and plot less method

UNIT – II

**Ecosystem organization:** Structure and functions, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies)

UNIT – III

**Biological diversity:** Concept and levels, role of biodiversity in ecosystem functions and stability, island biogeography, extinction, IUCN categories of threat, distribution and global patterns of terrestrial biodiversity, hot spots, inventory

UNIT – IV

- **Ecosystem stability:** Concept (resistance and resilience), ecological perturbation (natural and anthropogenic) and their impact on plants and ecosystem, ecology of plant invasion.
- **Ecological management:** Concept, sustainable development, sustainability indicators and ecosystem restoration.

LABORATORY: Exercises corresponding to the theory courses
M.Sc. 2nd Year (III Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Choice Based Course – General Botany

Unit I: Introduction to fungi, diseases caused by fungi (Powdery mildew of cururbits, white rust of crucifers, wilt of pigeon pea, leaf curl of papaya), Type study of bacteria, viruses and nematodes with one example in each.

Unit II: Elementary idea of mineral nutritions and their roles. Deficiency symptoms, significance of photosynthesis and respiration.

Unit III: (a) Environment, brief idea of air, water and sound pollutions, particulate matter. Gene diversity, species diversity, community diversity, National parks and sanctuaries.

(b) Identification, classification and nomenclature of plants. Bentham and Hooker’s system of classification, herbarium techniques.

Unit IV: (a) Concept of tissue culture, types of cultures, hybrids, cybrids, gene transfer methods.

(b) Laws of Mendel, chromosomes, DNA structure, Mitosis and meiosis and their significance, vegetative and sexual reproductions.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 25  PLANT PATHOLOGY -- Elective paper I


Unit II  (a) Roles of enzymes, growth regulators and toxins in pathogenesis.

(b) Effect of infection on physiology of plants (photosynthesis, translocation, respiration, membrane permeability, transcription and translation).

Unit III  (a) Disease resistance mechanism in plants, preformed substances and structures, induced structures and biochemical defense.

(b) Genetics of pathogen and physiological specialization with special reference to Puccinia graminis tritici. Gene for gene concept, breeding for resistant varieties.

Unit IV  (a) Morphology and anatomy of nematodes: Structural details of oesophagi, excretory, nervous and reproductive systems. Life history of root-knot nematode.

(b) Outline classification of plant parasitic nematodes. Identification of Anguina, Hoplolaimus, Helicotylenchus, Rotylenchulus, Tylenchulus, Meloidogyne, Heterodera and Xiphinema.

LABORATORY: Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 26  PLANT PATHOLOGY -- Elective paper II

Unit I  
(a) Concept of plant disease, Host parasites relationship in nematode infection. Effect of abiotic factors in nematode multiplication.

(b) Interaction of plant parasitic nematodes with fungi, bacteria and viruses. Nematode-Nematode interactions.

Unit II  
**Fungal Plant Diseases:** Symptoms, causal organism and management of stem gall of coriander, powdery mildew of cucurbits, apple scab, ergot of rye, loose smut of wheat, brown rust of wheat, red-rot of sugarcane and Tikka disease of groundnut.

Unit III  
**Plant Diseases:** Symptoms, casual organism(s) and management of bacterial blight of rice, potato scab, citrus-canker, tundu disease of wheat, brinjal mosaic, potato leaf roll, cauliflower mosaic, potato spindle tuber viroid, *Rotylenchulus* on pulses, *Meloidogyne* on vegetables and *Globodera* on potato.

Unit IV  
(a) Broad principles of plant disease management: Disease forecasting, Integrated pest management (IPM), Regulatory and physical measures of disease management, Management of diseases by cultural practices, cropping sequences, organic amendments.

(b) Bio-control of fungal and nematode diseases. Chemical measures of diseases management, fungicides and nematicides.

**LABORATORY:** Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 25 ADVANCED PLANT PHYSIOLOGY - Elective paper I

Unit I  **Mineral nutrients:** Essential and beneficial nutrients, soil colloids (clay and humus) and their role in nutrient availability, loss of ions by leaching and fixation, optimal and critical levels of primary (macro and micro) mineral elements.

Unit II  **Manures and Fertilizers:** Nutrients as constituents of metabolites and enzyme regulators, organic (farm-yard manure, green manure, sewage and sludge) and inorganic fertilizers (nitrogenous, phosphatic and potassic) and methods of their application, biofertilizers, mycorrhiza and their role in plant nutrition.

Unit III  (a) **Vitamins and signal transduction:** Structure and role of vitamins in plant metabolism; Calmodulin cascade; G-receptors; G-proteins; phospholipid signalling; role of cyclic nucleotides; diversity in protein kinases and phosphatises and sucrose sensing mechanism.

Unit IV  **Growth regulators in horticulture and allied sciences:** Hormones as regulators of water balance, reproductive development. Photosynthesis and photosynthate partitioning; seed germination, development and their filling; potato tuberization, use of natural and synthetic growth regulators in fruit set, chemical thinning and weeding, vegetative propagation, parthenocarpy, fruit ripening, malting and latex flow.

LABORATORY: Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 26 ADVANCED PLANT PHYSIOLOGY - Elective paper II

Unit I  Secondary metabolites: Introduction, occurrence, biosynthesis and significance of alkaloids (Amino acid and purine derivatives), phenols (simple phenols, phenol carboxylic acid, phenyl propanes, flavon derivatives), terpenoids (Hemi terpenes, mono terpenes, sesqui terpenes) and cutin, suberin and waxes.

Unit II  Regulatory metabolism of photosynthesis and respiration: Oxygenic photosynthesis and photochemical reaction centres, C₃, C₄ and CAM Pathways, glycolysis, TCA cycle and pentose phosphate pathway.

Unit III  Regulatory metabolism of nitrogen: Nitrogen in the biosphere and in plants, enzymology of nitrogen fixation (Nitrate reductase activity and nitrite reductase activity), use of transgenic plants in the study of regulatory assimilation and improvement of biomass production.

Unit IV  Stress physiology: Introduction, stressful environments, water scarcity & lodging. Stress management to water and related stress, chilling injury, high temperature, salt, and heavy metal stress, heat shock proteins, effect of UV radiation on plants.

LABORATORY: Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 25 CYTOGENETICS - Elective paper I

Unit I  **Numerical changes in chromosomes**: Aneuploidy: monosomy, nullisomy, trisomy, tetrasomy. Monoploidy and Haploidy, origin, production, morphology, cytology, uses of haploids.

Unit II  **Polyploidy**: Autopolyploids, origin and production of autopolyploids, induced autopolyploids, effects of chromosome doubling, uses of induced polyploids, allopolyploids, synthesized allopolyploids, evolution of major crop plants, segmental allopolyploids.

Unit III  **Structural changes in chromosomes**: Deficiencies; duplications, translocations; cytology of translocation heterozygote, balanced lethals and gametic complexes, inversions and its types, cytology of inversions, genetic consequences of inversion, DNA damage and repair.

Unit IV  (a)  **Molecular cytogenetics**: Nuclear DNA contents, C-value paradox, cct curve and its significance. Restriction mapping: concept and techniques, multigene families and their evolution, physical mapping of genes on chromosomes.

(b)  **Analysis of variance**: Simple measures of variability-range, mean, standard deviation, standard error and coefficient of variation (CV). Analysis and components of variance, phenotypic coefficient of variance (CVp), genotypic coefficient of variance (CVg) heritability (h²) and genetic advance (GS), correlation coefficient (r) analysis, t-test.

LABORATORY: Exercises corresponding to the theory courses.
Course 26  CYTOGENETICS - Elective paper II

Unit I  Gene structure and Expression: Genetic fine structure, Cis-trans test, fine structure analysis of eukaryotes, introns and their significance, regulation of gene expression in prokaryotes and eukaryotes.

Unit II  Karyotype: evolution, molecular basis of chromosome pairing, molecular organization of centromere and telomere; ribosomal RNA (rRNA) genes, banding pattern.

Unit III  Mechanism of sex determination: Chromosomal basis of sex determination, balance concept in Drosophila, quantitative balance theory, single genic mechanism, environment and hormonal control of sex, sex determination in plants. Sex reversal.

Unit IV  Sex linked traits: Sex linkage in Drosophila, Sex linked lethals in Drosophila, Sex linkage in human being, colour blindness, haemophilia, sex linkage in poultry. Sex Influenced traits in sheep and human beings. Sex-limited traits in poultry, man and cattle, multiple alleles.

LABORATORY: Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Course 25 ENVIRONMENTAL BOTANY - Elective paper I

Unit I Air Pollution:
(a) Source and effects of primary air pollutants: Sulphur dioxide (SO$_2$), Nitrogen oxides (NO$_2$, NO) and Fluorides.

(b) Sources, formation and effects of secondary air pollutants: Acid rain, Ozone (O$_3$) and Peroxyacetylenitrate (PAN).

Unit II Soil Pollution:
(a) Kinds and sources of soil pollutants (Biodegradable, slow degradable and non-degradable pollutants). Pesticides; kinds of pesticides, ill effects of pesticides.

(b) Heavy metal pollution, sources of heavy metals. Behaviour of heavy metals in soil. Impact of heavy metals on agriculture. Solid waste management.

Unit III Water Pollution:
(a) Sources of water pollution, Mercury pollution, Lead pollution, fluoride pollution, Ganga Action Plan, Water standard and water quality management in India.

(b) Role of waste water in agriculture, eutrophication, oil slick and biomagnification.

Unit IV Forest and Forest Management:
(a) Present status of forest wealth of the world, ecological significance of forest, Deforestation, major causes of deforestation, consequences of deforestation.

(b) Forest management and conservation. Present Programmes for the development of forestry and wildlife.

LABORATORY: Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

**Course 26 ENVIRONMENTAL BOTANY - Elective paper II**

**Unit I**

(a) **Particulate Matters:**
Sources and effect of particulate matters (flyash, brick kilm dust and cement dust) Suspended particulate matters (SPM).

(b) **Stress and Plant Life:**
Dynamic concept of stress, Mechanism of tissue temperature tolerance (mechanisms that regulate enzyme and membrane functions). Salt stress: effects of high salt concentration on plants, Regulation of salt content (salt elimination, salt exclusion and salt succulence).

**Unit II**

**Pollution and Animate pathogens:**

(a) Concept of pathogen and disease in plants.
(b) Biotic and abiotic pathogens.
(c) Biotic and abiotic diseases and their symptoms in plants.
(d) Concept and types of interaction (synergistic, antagonistic, additive and neutral).
(e) Impact of pollutants on phylloplane, rhizoplane and rhizosphere microbes.

**Unit III**

**Allelopathy / Weed Science:**

(a) Historical back ground of allelopathy, weed characteristics adaptive strategies and role in agroecosystems, weed control techniques, potential of allelopathy for weed management (aquatic, terrestrial and parasitic).

(b) Allelochemicals – significance uses, understanding the mechanism of crop/weed interference in agroecosystem.

**Unit IV**

**Pollution control:**

(a) Mechanical devices to control gaseous and particulate matters with reference to bag filters, carbon absorber electrostatic precipitators, cyclone collectors and spray collectors.

(b) Legislative measures and international agencies, environmental impact assessment (EIA) Phytoremediation.

**LABORATORY:** Exercises corresponding to the theory courses.
M.Sc. 2nd Year (IV Semester)

Max. Marks : 100
Sessional : 10
Mid-Sem Exam. : 30
End-Sem Exam. : 60

Course 25 PLANT BIOTECHNOLOGY- Elective paper I

Unit I Techniques in Plant Biotechnology: 2D-gel electrophoresis, Isoelectric focusing gels, Expression of recombinant proteins using bacteria and plant vectors, Generation of genomic and cDNA libraries, DNA sequencing methods, Methods for analysis of gene expression at RNA level and protein level, Isolation of specific nucleic acid sequences, Protein sequencing methods, detection of post translation modification of proteins.

Unit II Preserving plant diversity through cryopreservation and germplasm storage: Increasing genetic diversity through somaclonal variation, factors influencing SCV, isolation and molecular basis of SCV, achievements, advantage and limitations. Slow growth and excised root culture methods of germplasm preservation and cryopreservation.

Unit III Plant growth regulators and adjuvents: Role in in vitro morphogenesis, of – auxin, gibberellins, ethylene, abscisic acid, salicylic acid, ethylene, abscisic acid, jasminic acid, brassinosteroids, aspargin, glutamine, CCM, malic acid, yeast extract, casein hydrolysate.

Unit IV In vitro mutagenesis: Site directed mutagenesis (unidirectional deletion, gap setting mutagenesis, linker scanning mutagenesis). Advantages of site directed mutagenesis. Oligonucleotide directed mutagenesis (Chemical mutagenesis, PCR mediated in vitro mutagenesis). Insertional mutagenesis, transposon mediated insertion mutagenesis, T-DNA mediated insertion mutagenesis.

LABORATORY: Exercises corresponding to the theory courses.
Course 26  PLANT BIOTECHNOLOGY- Elective paper II

Unit I  Molecular markers and crop improvement: Morphological, biochemical and molecular markers, non-PCR based marker (RFLP, Procedure, construction of RFLP and uses), PCR based markers (RAPD, DAF, AP-PCR, AFLP, SSR). molecular maps, structural and functional genomics in relation to crop improvement, DNA fingerprinting, marker assisted selection.

Unit II  Genetic Engineering of Plants: Objectives, strategies and approaches; transformation methods: Agrobacterium mediated, biolistic approach, microinjection, electroporation and liposome mediated, selection of transforments and their molecular characterization.

Application: Production of herbicide resistant plants; engineering Plants for abiotic stress, senescence- tolerance and male sterility, environmental, social and legal implications. Production of genetically modified (GM) plants.

Unit III  Biotechnology of Medicinal and Aromatic Plants: Importance of medicinal plants as a source of secondary metabolites, biopesticides and growth regulators etc. Maximization of secondary metabolites production by adding elicitors, through biotransformation and genetic transformation using hairy root cultures (Agrobacterium rhizogenes); prospects for discovering new and bioreactive compounds from plants.

Unit IV  Genetic Manipulation and Its Application: Recombinant DNA technology, basics involved in r-DNA technology, application of restriction endonucleases, DNA ligases and other enzymes used in cloning, principles and process of polymerase chain reaction, transgenic biology, biopiracy and Intellectual property rights.

LABORATORY: Exercises corresponding to the theory courses.
## DEPARTMENT OF BOTANY
### A.M.U., ALIGARH

### Model Curriculum – A (With Lab Courses)  B.Sc. (Hons.) Botany Main

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