

**KANYA MAHA VIDYALAYA, JALANDHAR**  
**(UGC Autonomous College)**  
**P.G. Department of Botany**  
**Proceedings of the Sixth Meeting of Board of Studies**  
**held on 20-04-2021**  
**Meeting by Circulation**

The sixth meeting of the board of studies was held through Zoom App on 20<sup>th</sup> April, 2021 at 11:00am. The minutes of meeting are compiled for your kind approval. Following Members of the Board of Studies were invited to attend the meeting.

**External Expert Members:**

1. Dr. Satwinderjit Kaur, Professor,  
Department of Botanical and Environmental Sciences,  
GNDU, Amritsar.

**(University Nominee)**

2. Dr. Amrik Singh Ahluwalia, Professor,  
Department of Botany,  
Panjab University, Chandigarh.

**(Outside Parent University Nominee)**

3. Dr. C. Nirmala, Professor,  
Department of Botany,  
Panjab University, Chandigarh.

**(Outside Parent University Nominee)**

4. Dr. D.S. Khurana, Dean Agriculture,  
Govind National College  
Narangwal 141203

**(Special Invitee)**

5. Ms. Sarushi **(Alumni)**

**Internal Expert Members:**

Mrs. Sadhna Tandon, Dean of Life Sciences, (Chairperson)

Dr. V.K. Kaul Professor, Department of Agriculture

Mrs. Shikha Vashisht, Assistant Professor, Department of Botany

Mrs. Deepika Vashistha, Assistant Professor, Department of Botany

Dr. Sandeep Kaur, Assistant Professor, Department of Botany

Dr. Sandeep Singh, Assistant Professor, Department of Botany

The Chairperson Mrs. Sadhana Tandon welcomed and introduced the Members of sixth Board of studies. She apprised the members about the programs in department along with teaching and research strengths of the department. Mrs. Shikha Vashist took up the agenda items for deliberation one by one with the permission of committee members.

**Item: Bot 6: 2021-1:** To discuss and approve the proceedings of fifth Board of Studies held on 25.11.20 and action taken report.

**Proceedings:**

House approved the proceedings of fifth Board of Studies and appreciated the implementation of proceedings of previous BOS as discussed in action taken report **(Annexure A)**.

**Item: Bot 6: 2021-2:** To discuss the outcome & syllabus of Botany in **Bachelor of Science (Medical)** (Semester I, II, III, IV, V and VI) under continuous evaluation system for the session 2021-22.

**Proceedings:**

- 2.1 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem I** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure B)**.
- 2.2 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem II** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure C)**.

- 2.3 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem III** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure D)**.
- 2.4 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem IV** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure E)**.
- 2.5 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem V** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure F)**.
- 2.6 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem VI** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure G)**.

**Item: Bot 6: 2021-3:** To discuss the syllabus of Botany in **B.Sc.**

**Biotechnology (SEM I& III)** under continuous evaluation system for the session 2021-22.

**Proceedings:**

3.1 The proposed syllabus and Course outcomes of Botany in **B.Sc.**

**Biotechnology (Sem I )** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **(Annexure H)**.

3.2 The Botany paper from B.Sc. Biotechnology Sem IV was shifted to B.Sc. Biotechnology Sem III. The Course title also changes from Botany C to Botany II. **(Annexure I)**

**Changes in syllabus:**

- Macronutrients and micronutrients and their deficiency symptoms, ascent of sap and transport of organic solutes, biotic (pathogen and insects) topics were added to Unit I.
- Physiological & molecular adaptations in plants with respect to cold – heat - drought and salt stress topics were deleted from Unit I.

- Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways were added to Unit II.
- Heat shock proteins, dehydrins, late embryogenesis abundant proteins, role of different osmolytes in stress tolerance were deleted from Unit II.
- A brief account of the following plant diseases with respect to casual agents, symptoms, epidemiology and their control measures : Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi topics were shifted to Unit III.
- False smut of rice, Bacterial blight of rice, Bunchy top of banana, Downy mildew of bajra topics were deleted from Unit IV.
- Biodiversity: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; Characteristics of a population; population growth curves; population regulation; Major terrestrial biomes; biogeographical zones of India Topics were added to Unit IV.
- False smut of rice, Bacterial blight of rice, Bunchy top of banana, Downy mildew of bajra practicals were deleted from Practical syllabus.
- Three new practicals were added, which are as follows:
  1. Demonstrate the transpiration pull by mercury method.
  2. Demonstration that O<sub>2</sub> is evolved during photosynthesis.
  3. Separation of pigments by paper chromatography/TLC method.

**Item: Bot 6: 2021-4:** To discuss the syllabus of Botany in **B. Sc. Home Science** Semester V under continuous evaluation system for the session 2021-22.

**Proceedings:** The proposed syllabus and Course outcomes of class **B. Sc. Home Science** Semester V was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2020-21. **.(Annexure J).**

**Item: Bot 6: 2021-5:** To discuss the outcome & syllabus of M. Sc Botany in (Semester I, II, III & IV) under continuous evaluation system for the session 2021-22 of the below mentioned:

**Proceedings:**

5.1 The proposed syllabus and Course outcomes of class **M.Sc Botany (Semester I)** was passed by the members of the board in the meeting. Bryology (MBTL-1073) from Sem II **was swapped** with Theoretical Biology (MBTL-2336) from sem I. The new scheme is given below. The syllabus and course outcomes were same as that for the session 2020-21 (**Annexure-K**).

| Sem I (Old Scheme) |                                          |  | Sem I (New Scheme) |                                          |
|--------------------|------------------------------------------|--|--------------------|------------------------------------------|
| Course Code        | Course Title                             |  | Course Code        | Course Title                             |
| MBTL-1071          | Fungi and Plant Pathology                |  | MBTL-1071          | Fungi and Plant Pathology                |
| MBTL-1072          | Phycology                                |  | MBTL-1072          | Phycology                                |
| MBTL-1073          | Plant Physiology                         |  | MBTL-1073          | Bryology                                 |
| MBTL-1074          | Genetics and Evolution                   |  | MBTL-1074          | Plant Physiology                         |
| MBTL-1335          | Theoretical Biology                      |  | MBTL-1075          | Genetics and Evolution                   |
| MBTL-1046          | Computer Applications and Bioinformatics |  | MBTL-1046          | Computer Applications and Bioinformatics |
| MBTP-1077          | Botany Practicals I                      |  | MBTP-1077          | Botany Practicals I                      |
| MBTP-1078          | Botany Practicals II                     |  | MBTP-1078          | Botany Practicals II                     |

5.2 The proposed syllabus and Course outcomes of class **M.Sc Botany (Semester II)** was passed by the members of the board in the meeting. Theoretical Biology (MBTL-2336) from Sem I was swapped with Bryology (MBTL-1073) from Sem II. The new scheme is given below. The syllabus and course outcomes were same as that for the session 2020-21 (**Annexure-L**).

| Old Scheme  |                                         |  | New Scheme  |                                         |
|-------------|-----------------------------------------|--|-------------|-----------------------------------------|
| Course Code | Course Title                            |  | Course Code | Course Title                            |
| MBTL-2071   | Bryology                                |  | MBTL-2071   | Pteridology                             |
| MBTL-2072   | Pteridology                             |  | MBTL-2072   | Diversity and Biology of Gymnosperms    |
| MBTL-2073   | Diversity and Biology of Gymnosperms    |  | MBTL-2073   | General Microbiology                    |
| MBTL-2074   | General Microbiology                    |  | MBTL-2074   | Cell Biology                            |
| MBTL-2075   | Cell Biology                            |  | MBTL-2075   | Ecological Modelling and Forest Ecology |
| MBTL-2076   | Ecological Modelling and Forest Ecology |  | MBTL-2336   | Theoretical Biology                     |
| MBTP-2077   | Botany Practicals I                     |  | MBTP-2077   | Botany Practicals I                     |
| MBTP-2078   | Botany PracticalsII                     |  | MBTP-2078   | Botany PracticalsII                     |
| MBTV-2079   | On Job Training or Assignment           |  | MBTV-2079   | On Job Training or Assignment           |

5.3 The proposed syllabus and Course outcomes of class **M.Sc Botany (Semester III)** was passed by the members of the board in the meeting. **The syllabus for Applied Botany (MBTL- 3075) was revised and changes are listed below.** The syllabus and course outcomes for the rest of the syllabus were same as that for the session 2020-21 (**Annexure-M**).

### **Changes in Syllabus:**

#### **Course Title: Applied Botany (MBTL 3075):**

- Vegetable oils and fats topic moved to Unit III from Unit I.
- Gum and Resins, Rubber moved to Unit IV from Unit II.

- Essential oil yielding plants of India, their use in perfumery moved to Unit III from Unit II.
- Fibre yielding plants moved under title fibres in Unit III.
- Tanning and Dyeing material, rubber and other latex yielding products, gums and resins were shifted Unit IV.
- Topic Sugars was deleted from Unit III as they were already present in Unit I.
- Soils have been deleted from Unit III.

**5.4** It was decided to add 20% internal assessment in all the papers of **M.Sc. (Botany) semester IV** for session 2021-22 under continuous evaluation system. The syllabus for Plant Tissue Culture and Biotechnology (MBTL-4073) is revised and changes are listed below. The syllabus and course outcomes for the rest of the syllabus were same as that for the session 2020-21. (**Annexure N**)

### **Changes in Syllabus**

#### **Course Title: Plant Tissue Culture and Biotechnology (MBTL- 4073):**

- Introduction and Historical Aspects of Tissue culture were added in Unit I.

**Item: Bot 6: 2021-6:** To discuss the syllabus of **B.Sc. (Hons.) Agriculture, Semester V, VI, VI and VIII** under continuous evaluation system for the session 2021-22.

**Proceedings:** The courses for B.Sc.(Hons.) Agriculture programme Semester V-VIII, were finalized in the light of recommendations of 5th Deans Committee, ICAR.

Furthermore, the provisions for online internship as an alternative, in the eventuality of persistence of COVID wave were also finalized unanimously and are appended at **Annexure O**.

**Item: Bot 6: 2021-7:** To discuss and approve list of proposed examiners for above stated courses.

**Proceedings:**

List of Paper setters and evaluators proposed by internal committee members for the above stated courses were approved by BOS members for the session 2021-22.

**(Annexure P)**

**Item: Bot 6: 2021-8:** To discuss teaching methodologies adopted in the Department and inputs required to upgrade the same.

**Proceedings:**

BOS member appreciated the innovative teaching methodologies adopted by department like ICT based educational videos, projects & seminars- leading to critical & creative thinking. In the wake of current COVID 19 Pandemic situation, KMV continued its teaching on Learning Management System where teachers continued their online classes by uploading video lectures, assignments, power point presentations, lessons, notes, tests, quiz etc. So, the effectiveness of teaching could be well maintained and all teachers could finish their syllabi in time. Other highlights of department include student- student mentoring, group discussions, student mentoring by teachers & remedial classes for weak students. The Department is well equipped with smart class rooms, e-content and demonstrations for better understanding of concepts. The department is doing excellent work by organising virtual lab visits, competitions like powerpoint presentation competition, quiz competition and e workshops through online platforms. BOS members really appreciated the faculty for doing such activities.

**Item: Bot 6: 2021-9:** To discuss the outcomes of above stated courses and programmes.

**Proceedings:**

The course outcomes of above stated courses and programmes were discussed and approved by members of Board of studies.

**Item: Bot 6: 2021-10:** To discuss the course scheme and detailed syllabus for above stated programmes.

**Proceedings:**

The course scheme and detailed syllabus for above stated programmes were discussed and approved.

**Item: Bot 6: 2021-11:** To discuss and approve **ordinance for Bachelor of Science (Medical) and M.Sc. Botany** for the session 2021-22.

**Proceedings:**

The ordinances for Bachelor of Science (Medical) and M.Sc. Botany for the session 2021-22 were discussed and approved.

- The meeting ended with vote of thanks by Mrs. Shikha Vashist. She said that all achievements are due to excellent team work and she has full faith in her team for prospective growth of department under Autonomous status.

## **Annexure-A**

### **Kanya Maha Vidyalaya, Jalandhar City (An Autonomous College)**



### **Minutes of 5<sup>th</sup> Meeting of Board of Studies Department of Botany**

**Date: 25.11.2020**

**Time: 2:30 PM**

**Venue: ZOOM**

## **Proceedings of 5th Meeting of Board of Studies held on 25.11.2020**

A meeting of the Board of Studies of Botany was held on 25.11.2020 at 2:30 pm on Zoom platform. Following Members of the Board of Studies attended the meeting:

### **External Expert Members:**

6. Dr. Satwinderjit Kaur, Professor,

Department of Botanical and Environmental Sciences,  
GNDU, Amritsar.

**(University Nominee)**

7. Dr. Amrik Singh Ahluwalia, Professor,

Department of Botany,  
Panjab University, Chandigarh.

**(Outside Parent University Nominee)**

8. Dr. C. Nirmala, Professor,

Department of Botany,  
Panjab University, Chandigarh.

**(Outside Parent University Nominee)**

9. Dr. D.S. Khurana, Dean Agriculture,

Govind National College  
Narangwal 141203

**(Special Invitee)**

5. Mr. Sukhjeet Singh Cheema, M.D.

Pukhraj Organic, Jalandhar

**(Industrial Representative)**

6. Ms Sarushi

**(Alumni)**

### **Internal Expert Members:**

Mrs. Sadhna Tandon, Dean of Life Sciences, (Chairperson)

Dr. V.K.Kaul Professor, Department of Agriculture

Mrs. Shikha Vashisht, Assistant Professor, Department of Botany

Mrs. Deepika Vashistha, Assistant Professor, Department of Botany

Dr. Sandeep Kaur, Assistant Professor, Department of Botany

Dr. Sandeep Singh, Assistant Professor, Department of Botany

Dr. Kuljit Kaur, Assistant Professor, Department of Botany

The Chairperson Mrs. Sadhna Tandon welcomed the Members of Board of Studies. She apprised the members about the programmes in the Department. Mrs. Shikha Vashist took up the agenda items for deliberation one by one with the permission of committee members.

**Item: Bot 5: 2020-1:** To discuss and approve the proceedings of fourth Board of Studies held on 22.05.2020 and action taken report.

**Proceedings:**

House approved the proceedings of fourth Board of Studies and appreciated the implementation of proceedings of previous BOS as discussed in action taken report **(Annexure A)**.

**Item: Bot 5: 2020-2:** To discuss the outcome & syllabus of Botany in **Bachelor of Science (Medical)** (Semester II, IV and VI) under continuous evaluation system for the session 2020-21.

**Proceedings:**

2.7 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem II** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2019-20. **(Annexure B)**.

2.8 The proposed syllabus and Course outcomes of class **B. Sc. (Medical) Sem IV** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2019-20 **(Annexure C)**.

2.9 It was decided to add 20% internal assessment in all the papers of **Bachelor of Science (Medical) semester VI** for session 2020-21 under continuous evaluation system.

All the BOS members approved the proposed syllabus of Bachelor of Science (Medical) semester VI, including internal assessment for session 2020-21 under continuous evaluation system.(Annexure-D)

**Item: Bot 5: 2020-3:**To discuss the outcome & syllabus of Botany in **B.Sc. Biotechnology** (Semester IV)under continuous evaluation system for the session 2020-21.

**Proceedings:**

The proposed syllabusand Course outcomes of Botany in **B.Sc. Biotechnology, (Semesters IV)** was passed by the members of the board in the meeting.The syllabus and course outcomes were same as that for the session 2019-20.(Annexure E).

**Item: Bot 5: 2020-4:**To discuss the outcome & syllabus of M. Sc Botany in (Semester II & IV)under continuous evaluation system for the session 2020-21 of the below mentioned:

**Proceedings:**

4.1The proposed syllabus and Course outcomes of class **M.Sc Botany (Semester II)**was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2019-20 (Annexure-F).

4.2 It was decided to add 20% internal assessment in all the papers of **M.Sc. (Botany) semester IV**for session 2020-21 under continuous evaluation system. All the BOS members approved the proposed syllabus of M.Sc. **(Botany) semester IV**, including internal assessment for session 2020-21 under continuous evaluation system.(Annexure G)

**Item: Bot 5: 2020-5:** To discuss the outcome & syllabus of **B Sc Agriculture (Semester IV& VI)** under continuous evaluation system for the session 2020-21.

**Proceedings:**

5.1 The proposed syllabus and Course outcomes of class **B.Sc. Agriculture (Semester IV)** was passed by the members of the board in the meeting. The syllabus and course outcomes were same as that for the session 2019-20.

5.2 It was decided to add 20% internal assessment in all the papers of **B Sc Agriculture (Semester VI)** under continuous evaluation system for the session 2020-21. All the BOS members approved the proposed syllabus of **B Sc Agriculture (Semester VI)**, including internal assessment for session 2020-21 under continuous evaluation system. (**Annexure H**)

**Item: Bot 5: 2020-6:** To discuss and approve list of proposed examiners for above stated courses.

**Proceedings:**

List of Paper setters and evaluators proposed by internal committee members for the above stated courses were approved by BOS members. (**Annexure I**)

**Item: Bot 5: 2020-7:** To discuss teaching methodologies adopted in the Department and inputs required to upgrade the same.

**Proceedings:**

BOS member appreciated the innovative teaching methodologies adopted by department like ICT based educational videos, projects & seminars- leading to critical & creative thinking. In the wake of current COVID 19 Pandemic situation, KMV continued its teaching on Learning Management System where teachers continued their online classes by uploading video lectures, assignments, power point presentations, lessons, notes, tests quiz etc. So, the effectiveness of teaching could be well maintained and all teachers could finish their syllabi in time. Other highlights of department include student- student mentoring, group discussions, student mentoring by teachers & remedial classes for weak students. The Department is well equipped with smart class rooms, e-content and demonstrations for better understanding of concepts. The department is doing excellent work by organising virtual lab visits, competitions like power point presentation competition,

quiz competition and e workshops through online platforms. BOS members really appreciated the faculty for doing such activities.

**Item: Bot 5: 2020-8:** To discuss the outcomes of above stated courses and programmes.

**Proceedings:**

The course outcomes of above stated courses and programmes were discussed and approved by members of Board of studies.

**Item: Bot 5: 2020-9:** To discuss the course scheme and detailed syllabus for above stated programmes.

**Proceedings:**

The course scheme and detailed syllabus for above stated programmes were discussed and approved.

**Item: Bot 5: 2020-10:** To discuss and approve **ordinance for Bachelor of Science (Medical) and M.Sc. Botany** for the session 2020-21.

**Proceedings:**

The ordinances for Bachelor of Science (Medical) and M.Sc. Botany for the session 2020-21 were discussed and approved.

**Additional Suggestions:**

- The BOS members suggested to change paper of semester I i.e. Theoretical Biology MBTL-1335 with paper of semester II i.e. Bryology, MBTL-2071 in next session.
- The meeting ended with vote of thanks by Mrs. Shikha Vashist. She said that all achievements are due to excellent team work and she has full faith in her team for prospective growth of department under Autonomous status.

**Action Taken Report (ATR)**  
**on**

| Sr.No.                                   | Agenda Item                                                                                                                           | Decision taken in Meeting                                                                                                                                                                                                                                                                                                                                                                                                                                  | Action Taken                                                                                       |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| <b><u>Item No.:<br/>BOS-5-2020-1</u></b> | To approve the proceedings of fourth BOS held on 25.05.2020 and discuss the action taken report.                                      | 1. House approved the proceedings of fourth BOS and appreciated the implementation of proceedings of previous BOS as given in action taken report.                                                                                                                                                                                                                                                                                                         | Suggestions implemented.                                                                           |
| <b><u>Item No.:<br/>BOS-5-2020-2</u></b> | To discuss the syllabus of Botany in B.Sc. Medical, Semesters II, IV & VI under continuous evaluation system for the session 2020-21. | 1. The syllabus of Botany in B.Sc. Medical, Semesters II, IV & VI under continuous evaluation system for the session 2020-21 has been passed.<br><br>2. The syllabus of Botany in B.Sc. Medical Semester VI under continuous evaluation system for the session 2020-21 has been passed<br><br>3. It was decided to add 20% internal assessment in all papers of Bachelor of Science (Medical) Semester VI for session 2020-21 under continuous evaluation. | The approved syllabus is executed.<br><br>Suggestions implemented.<br><br>Suggestions implemented. |
| <b><u>Item No.:</u></b>                  | To discuss the syllabus of Botany in B.Sc.                                                                                            | The syllabus of Botany in B.Sc. Biotechnology                                                                                                                                                                                                                                                                                                                                                                                                              | The approved syllabus is executed                                                                  |

|                                                       |                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                  |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| <b><u>BOS-5-2020-3</u></b>                            | <b>Biotechnology,</b><br>Semester IV under continuous evaluation system for the session 2020-21.                                | Semester IV under continuous evaluation system for the session 2020-21 has been passed.                                                                                                                                                                                                                                                                                                                                          |                                                                                  |
| <b><u>Item No.:</u></b><br><b><u>BOS-5-2020-4</u></b> | To discuss the syllabi of class M.Sc. Botany, Semester II&IV under continuous evaluation system for the session 2020-21.        | <ol style="list-style-type: none"> <li>1. The syllabi of class <b>M.Sc. Botany</b> Semester II under continuous evaluation system for the session 2020-21 has been passed.</li> <li>2. It was decided to add 20% internal assessment in all the papers of <b>M.Sc. Botany</b> Semester IV for session 2020-21 and the syllabus has been passed which includes internal assessment under continuous evaluation system.</li> </ol> | <p>The approved syllabus is executed</p> <p>The same has been incorporated.</p>  |
| <b><u>Item No.:</u></b><br><b><u>BOS-5-2020-5</u></b> | To discuss the syllabus of <b>B.Sc. Agriculture,</b> semester IV&VI under continuous evaluation system for the session 2020-21. | <ol style="list-style-type: none"> <li>1. The syllabus of class B.Sc. Agriculture Semester IV under continuous evaluation system for the session 2020-21 has been passed.</li> <li>2. It was decided to add 20% internal assessment in all the papers of B.Sc. Agriculture Semester IV under continuous evaluation system.</li> </ol>                                                                                            | <p>The approved syllabus is executed.</p> <p>The same has been incorporated.</p> |

|                                                               |                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b><u>Item No.:</u></b><br/><b><u>BOS-5-2020-6</u></b></p> | <p>To discuss the list of proposed examiners for above stated courses.</p>                                  | <p>The list of paper setters and evaluators proposed by internal committee members for the above stated courses has been approved.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>Suggestions implemented.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b><u>Item No.:</u></b><br/><b><u>BOS-5-2020-7</u></b></p> | <p>To discuss teaching methodologies adopted in the Department and inputs required to upgrade the same.</p> | <p>BOS members appreciated the innovative teaching methodologies of department like ICT based educational videos, projects&amp; seminars-leading to critical &amp; creative thinking. During COVID19 Pandemic situation, KMV continued its teaching on Learning Management System where teachers continued their online classes by uploading video lectures, assignments, power point presentations, lessons, notes, test, quiz. The department is well-equipped with smart classrooms, e-content and demonstration for better understanding of concepts. The department is doing excellent work by organizing virtual lab visits, competitions like power point presentation competition, quiz competition and e-workshops through online platforms. Other highlights of department include student-student mentoring, group discussions, student mentoring by teachers and remedial classes for weak students.</p> | <ol style="list-style-type: none"> <li>1. Department of Botany organised a <b>Two Days E-Workshop On The Emerging Trends Of Botanical Studies(20-21 November)</b>. Dr.SarojArora and Dr.RajinderKaur were the resource persons for this workshop. There was a virtual tour to Botanical garden of Guru Nanak Dev University.</li> <li>2. Department organises a webinar on 25<sup>th</sup> January 2021 on the topic <b>Tree Talk in the Wood Wide Web</b>. The speaker for the talk was Dr. Rajiv Angrish. He explained the concept of plant communication.</li> <li>3. A webinar on the topic <b>Plants, Agriculture and Humans: Past, Present and Future</b> was organised on 29<sup>th</sup> January 2021 and speaker for the webinar was Dr. Rajiv Angrish. In his talk he discussed about the evolution of humanns along with</li> </ol> |

|                                                       |                                                                                                              |                                                                                                                  |                                         |
|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|                                                       |                                                                                                              |                                                                                                                  | the domestication of crops and animals. |
| <b><u>Item No.:</u></b><br><b><u>BOS-5-2020-8</u></b> | To discuss the outcome of above stated courses and programmes.                                               | The Programme Outcomes, Programme specific outcomes and course outcomes were approved.                           | Suggestions implemented.                |
| <b><u>Item No.:</u></b><br><b><u>BOS-5-2020-9</u></b> | To discuss the course schemes and detailed syllabi for above stated programmes.                              | The course scheme and detailed syllabi for above stated programmes were approved.                                | Suggestions implemented                 |
| <b><u>Item No.:</u></b> BOS<br><b><u>2020-10</u></b>  | To discuss and approve ordinance for Bachelor of Science (Medical) and M.Sc. Botany for the session 2020-21. | The ordinances for <b>Bachelor of Science (Medical) and M.Sc. Botany</b> for the session 2020-21 were discussed. | Suggestions implemented.                |

**FACULTY OF LIFE SCIENCES**

**SYLLABUS**

**Of**

**Botany For**

**Bachelor of Science (Medical)**

**Semester I-VI**

**(Under Continuous Evaluation System)**

**(12+3 System of Education)**

**Session: 2021-22**



**The Heritage Institution  
KANYA MAHA VIDYALAYA  
JALANDHAR  
(Autonomous)**

**Kanya Maha Vidyalaya, Jalandhar (Autonomous)**  
**SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE**  
**PROGRAMME**

**Bachelor of Science (Medical)**  
**Session 2021-22**  
**Botany**

| <b>Bachelor of Science (Medical)</b> |                               |                    |  |                    |              |                                           |             |          |           |                                    |
|--------------------------------------|-------------------------------|--------------------|--|--------------------|--------------|-------------------------------------------|-------------|----------|-----------|------------------------------------|
| <b>Semester I</b>                    |                               |                    |  |                    |              |                                           |             |          |           |                                    |
| <b>Course Name</b>                   | <b>Program Name</b>           | <b>Course Code</b> |  | <b>Course Type</b> | <b>Total</b> | <b>Marks Paper</b>                        | <b>Ext.</b> |          | <b>CA</b> | <b>Examination time (in Hours)</b> |
|                                      |                               |                    |  |                    |              |                                           | <b>L</b>    | <b>P</b> |           |                                    |
| Botany                               | Bachelor of Science (Medical) | BSMM-1075          |  | I                  | 100          | Diversity of Microbes                     | 30          | -        | 20        | 3                                  |
|                                      |                               |                    |  | II                 |              | Diversity of Cryptogams                   | 30          | -        |           | 3                                  |
|                                      |                               |                    |  | P                  |              | Practical (based on Paper-I and Paper-II) | -           | 20       |           | 3                                  |

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

## SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

### Bachelor of Science (Medical)

Session 2021-22

### BOTANY

| Bachelor of Science (Medical)<br>Semester II |                               |             |    |             |       |                                      |       |    |    |                                |
|----------------------------------------------|-------------------------------|-------------|----|-------------|-------|--------------------------------------|-------|----|----|--------------------------------|
| Course Name                                  | Program Name                  | Course Code |    | Course Type | Total | Course Title                         | Marks |    | CA | Examination time<br>(in Hours) |
|                                              |                               |             |    |             |       |                                      | L     | P  |    |                                |
| Botany                                       | Bachelor of Science (Medical) | BSMM-2075   | I  | E           | 100   | Cell Biology                         | 30    | -  | 20 | 3                              |
|                                              |                               |             | II |             |       | Genetics                             | 30    | -  |    | 3                              |
|                                              |                               |             | P  |             |       | Practical (Based on Papers-I and II) | -     | 20 |    | 3                              |

**Kanya Maha Vidyalaya, Jalandhar (Autonomous)**  
**SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME**

**Bachelor of Science (Medical)**  
**Session 2021-22**  
**Botany**

**Bachelor of Science (Medical)**  
**Semester III**

| <b>Bachelor of Science (Medical)</b><br><b>Semester III</b> |                               |                    |    |                    |              |                                                                |               |          |           |                                    |
|-------------------------------------------------------------|-------------------------------|--------------------|----|--------------------|--------------|----------------------------------------------------------------|---------------|----------|-----------|------------------------------------|
| <b>Course Name</b>                                          | <b>Program Name</b>           | <b>Course Code</b> |    | <b>Course Type</b> | <b>Total</b> | <b>Marks</b>                                                   |               |          | <b>CA</b> | <b>Examination time (in Hours)</b> |
|                                                             |                               |                    |    |                    |              | <b>Paper</b>                                                   | <b>Ext. L</b> | <b>P</b> |           |                                    |
| Botany                                                      | Bachelor of Science (Medical) | BSMM-3075          | I  | E                  | 100          | Structure, Development and Reproduction in Flowering Plants-I  | 30            | -        | 20        | 3                                  |
|                                                             |                               |                    | II |                    |              | Structure, Development and Reproduction in Flowering Plants-II | 30            | -        |           | 3                                  |
|                                                             |                               |                    | P  |                    |              | Practical (Based on Papers-I and II)                           | -             | 20       |           | 3                                  |

**Kanya Maha Vidyalaya, Jalandhar (Autonomous)**  
**SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME**

**Bachelor of Science (Medical)**  
**Session 2021-22**  
**BOTANY**

| Bachelor of Science (Medical)<br>Semester IV |                               |             |    |             |       |                                                    |      |    |    |                                |
|----------------------------------------------|-------------------------------|-------------|----|-------------|-------|----------------------------------------------------|------|----|----|--------------------------------|
| Course Name                                  | Program Name                  | Course Code |    | Course Type | Marks |                                                    |      |    |    | Examination time<br>(in Hours) |
|                                              |                               |             |    |             | Total | Course Title                                       | Ext. |    | CA |                                |
|                                              |                               |             |    |             |       |                                                    | L    | P  |    |                                |
| Botany                                       | Bachelor of Science (Medical) | BSMM-4075   | I  | E           | 100   | Diversity of seed Plants and their systematics -I  | 30   | -  | 20 | 3                              |
|                                              |                               |             | II |             |       | Diversity of seed Plants and their systematics -II | 30   | -  |    | 3                              |
|                                              |                               |             | P  |             |       | Practical (Based on Papers–I and II)               | -    | 20 |    | 3                              |

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

## SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

### Bachelor of Science (Medical) Session 2021-22 Botany

| Bachelor of Science (Medical)<br>Semester V |                               |             |    |             |       |                                           |      |    |    |                              |
|---------------------------------------------|-------------------------------|-------------|----|-------------|-------|-------------------------------------------|------|----|----|------------------------------|
| Course Name                                 | Program Name                  | Course Code |    | Course Type | Total | Marks                                     | Ext. |    | CA | Examinati on time (in Hours) |
|                                             |                               |             |    |             |       | Paper                                     | L    | P  |    |                              |
| Botany                                      | Bachelor of Science (Medical) |             | I  | E           | 100   | Plant physiology                          | 30   | -  | 20 | 3                            |
|                                             |                               |             | II |             |       | Biochemistry &Biotechnology               | 30   | -  |    | 3                            |
|                                             |                               |             | P  |             |       | Practical (based on Paper-I and Paper-II) | -    | 20 |    | 3                            |

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

**Bachelor of Science (Medical)**

**Session 2021-22**

**BOTANY**

**Bachelor of Science (Medical) Semester VI**

| Bachelor of Science (Medical) Semester VI |                               |             |    |             |       |                                           |      |    |    |                             |
|-------------------------------------------|-------------------------------|-------------|----|-------------|-------|-------------------------------------------|------|----|----|-----------------------------|
| Course Name                               | Program Name                  | Course Code |    | Course Type | Marks |                                           |      |    |    | Examination time (in Hours) |
|                                           |                               |             |    |             | Total | Course Title                              | Ext. |    | CA |                             |
| L                                         | P                             |             |    |             |       |                                           |      |    |    |                             |
| Botany                                    | Bachelor of Science (Medical) | BSMM-6075   | I  | E           | 100   | Ecology                                   | 30   | -  | 20 | 3                           |
|                                           |                               |             | II |             |       | Economic Botany                           | 30   | -  |    | 3                           |
|                                           |                               |             | P  |             |       | Practical (based on Paper-I and Paper-II) | -    | 20 |    | 3                           |

**Programme Specific Outcomes – B. Sc. Medical (Zoology, Botany, Chemistry)  
Session (2021-22)**

**Upon successful completion of this course, students will be able to:**

- Understand the nature and basic concepts of cell biology, Biochemistry, Taxonomy and ecology.
- Analyze the relationships among animals, plants and microbes
- Perform procedures as per laboratory standards in the areas of Biochemistry, Bioinformatics, Taxonomy, Economic Zoology and Ecology
- Understand the applications of biological sciences in Apiculture, Aquaculture, Agriculture and Medicine
- Understand the importance of plants, their diversity and its conservation.
- Understand contribution of botany in medicines, food, fibers and other plant products.
- Understand Health and Environmental Protection and to tackle pollution problems.
- Understand the importance of nature.
- Understand Experiments in Botany.
- Understand knowledge of Botany is an essential requirement for the pursuit of many applied sciences like Agriculture, Horticulture, Sericulture, Forestry, Biotechnology and many more.
- Demonstrate knowledge of organic, inorganic and physical chemistry and apply this knowledge to analyse a variety of chemical phenomena and will be able to interpret and analyse quantitative data.
- Understand theoretical concepts of instruments that are commonly used in most chemistry fields as well as interpret and use data generated in instrumental physical and chemical analyses.
- They will also be able to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in industry or a chemistry postgraduate program.

**Bachelor of Science (Medical) Semester-I  
(Session 2021-22)  
BOTANY**

**Course Code: BSMM-1075(I)**

**DIVERSITY OF MICROBES**

**(Theory)**

**Course outcome: -**

After passing this course the student will be able to:

CO1: Understand diversity in microscopic living organisms and their associations with other organisms.

CO2: Understand evolutionary history and time scale of non-vascular plants.

CO3: Develop basic knowledge about the variations in life cycle pattern of different organisms.

CO4: Interpret the structure and functional anatomy of plants belonging to the principal groups of living and fossil land plants.

**Bachelor of Science (Medical) Semester-I**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-1075(I)**

**DIVERSITY OF MICROBES**

**(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**UNIT-I**

Algae: General characters, classification and economic importance, range of thallus organization, important features and life history of Chlorophyceae– *Volvox*, *Oedogonium*, *Coleochaete*; Xanthophyceae– *Vaucheria*; Phaeophyceae– *Ectocarpus*, *Sargassum*; Rhodophyceae– *Polysiphonia*.

**UNIT-II**

General account of viruses and mycoplasma with special reference to SARS and Covid-19. Bacteria–structure, nutrition, reproduction and economic importance; general account of cyanobacteria.

**UNIT-III**

General account, classification and economic importance of fungi. Important features and life history of Mastigomycotina– *Pythium*, *Phytophthora*; Zygomycotina– *Mucor*, Ascomycotina– *Saccharomyces*, *Eurotium*, *Chaetomium*, *Peziza*.

**UNIT-IV**

Basidiomycotina– *Puccinia*, *Agaricus*; Deuteromycotina–*Cercospora*, *Colletotrichum*. General account of Lichens.

**Suggested Readings:**

- Dube, H.C., 2007, A Textbook of Fungi, Bacteria and Viruses (3rd edition), Scientific Publishers, India
- Dube, H.C., 2013, An Introduction to Fungi (4th edition), Scientific Publishers, India.
- James W. Brown. (2015). Principles of Microbial Diversity. ASM press, USA.
- Ogunseitan, O. (2008). Microbial Diversity: Form and function in Prokaryotes. Wiley Publishers, USA.
- Sharma, O.P., 2004, Text Book of Thallophytes. McGraw Hill Publishing Co., India.
- Sharma, P.D., 2004, The Fungi, (2nd Edition) Rastogi Publication, India
- Srivastava, H.N., 2018, Diversity of Microbes and Cryptogams, Vol. I, Pradeep's Publication.

**Bachelor of Science (Medical) (Semester-I)**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-1075(II)**

**DIVERSITY OF CRYPTOGRAMS**

**(Theory)**

**Course Outcomes:**

After passing this course student will be able to:

CO1: Demonstrate knowledge of similarities and differences between vascular and nonvascular plants.

CO2: Build up a sound foundation in the subject of Cryptogamic Botany in general and Bryophytes in particular so that the students may be able to apply the acquired knowledge while interacting into the other fields of Botany.

CO3: Acquaint the students about the classification, morphology, biology and economic importance of various pteridophytic plants.

CO4: recognize different plants and flora that come under cryptogams.

**Bachelor of Science (Medical) Semester-I  
(Session 2021-22)  
BOTANY**

**Course Code: BSMM-1075(II)  
DIVERSITY OF CRYPTOGRAMS  
(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Bryophyta:** Amphibians of plants kingdom displaying alternation of generations; structure, reproduction.

**UNIT-II**

**Classification of Hepaticopsida** (e.g. *Marchantia*); **Anthocerotopsida** (e.g. *Anthoceros*), **Bryopsida** (e.g. *Funaria*).

**UNIT-III**

**Pteridophyta:** The first vascular plant; important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; Structure, reproduction in *Rhynia*

**UNIT-IV**

Structure and reproduction in *Lycopodium*, *Selaginella*, *Equisetum*, *Pteris* and *Marsilea*.

**Suggested Readings:**

- Goffinet B. (2008). Bryophyte Biology. Cambridge University Press, UK.
- Sambamurty, S.S. (2013). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. I K International Publishing House Pvt Ltd., India
- Sharma, O.P. (2014). Bryophyta. McGraw Hill Education Pvt Ltd., India.
- Srivastava, H.N., 2018, Diversity of Microbes and Cryptogams, Vol. I, Pradeep's Publication.
- Vashishta, P.C, Sinha, A.K, Kumar, A., (2010). Botany for Degree Students Pteridophyta (Vascular cryptogams). S.S. Chand Publications

**Bachelor of Science (Medical) Semester-I  
(Session 2021-22)  
BOTANY**

**Course Code: BSMM-1075(P)**

**PRACTICAL – RELATED TO DIVERSITY OF MICROBES&  
DIVERSITY OF CRYPTOGRAMS**

**Course Outcomes:**

After passing this course student will be able to:

CO 1: Ability to evaluate different sources of phylogenetic information (e.g. molecular sequence data, ultrastructure, morphology) for understanding algal, fungal.

CO 2: Knowledge of the evolutionary history and time-scale of non-vascular plants, including the development of the first terrestrial plants from green algae.

CO 3: Knowledge of the history and time-scale of land plant evolution, and evaluation of the principal types of evidence underlying.

CO 4: Basic understanding of algal and fungal diversity (incl. morphology, cell structure and level of organization) to phylum level, and their association as lichens.

**Bachelor of Science (Medical) Semester-I  
(Session 2021-22)  
BOTANY**

**Course Code: BSMM-1075(P)**

**PRACTICAL – RELATED TO DIVERSITY OF MICROBES &  
DIVERSITY OF CRYPTOGRAMS**

**Time: 3 Hrs.**

**Marks: 20**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar

**Suggested Laboratory Exercises**

Teachers may select plants/material available in their locality/institution.

1. Gram staining of bacteria.
2. Observation of disease symptoms in hosts infected by fungi, viruses and mycoplasma. Section cutting of diseased material and identification of the pathogens as per the theory syllabus.
3. Study of the genera included under algae and fungi.
4. Study of morphology, reproductive structures and anatomy of the examples cited in theory under Bryophyta and Pteridophyta.
5. Types of Bacteria to be observed from temporary /permanent slides /electron micrographs.

**Suggested Readings:**

- Lee, R.E. (2018). Phycology, Fifth Edition, Cambridge University Press, USA.
- Agrios, G.N. (2005). Plant Pathology, 5th edition, Academic Press, U.K.

**Bachelor of Science (Medical) Semester-II**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-2075 (I)**  
**CELL BIOLOGY**  
**(Theory)**

**Course outcome: -**

After passing this course the student will be able to:-

CO1: Explain cellular processes and mechanisms that lead to physiological functions as well as examples of pathological state.

CO2: Describe the intricate relationship between various cellular structures and their corresponding functions.

CO3: Describe cytological, biochemical, physiological and genetic aspects of the cell, including cellular processes common to all cells, to all eukaryotic cells as well as processes in certain specialized cells.

CO4: Relate normal cellular structures to their functions.

**Bachelor of Science (Medical) Semester-II**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-2075 (I)**  
**CELL BIOLOGY**  
**(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**UNIT-I**

An Overview: prokaryotic and eukaryotic cells, cell size and shape and *Escherichiacoli*. Structure and Function of Nucleus; Ultrastructure; nuclear membrane; nucleolus.

**UNIT-II**

Extranuclear Genome: Presence and function of mitochondrial and plastid DNA; plasmids. Structure and Function of other Organelles: Golgi bodies, Endoplasmic reticulum, Peroxisomes, Vacuoles.

**UNIT-III**

Chromosome Organization: Morphology; centromere and telomere; chromosome alterations; deletions, duplications, translocations, inversions; variations in chromosome number, aneuploidy, polyploidy; sex chromosomes.

**UNIT-IV**

The Cell Envelopes: Plasma membrane; bilayer lipid structure; functions; the cell wall.

**Suggested Readings:**

1. Gupta, P.K. (2017). A Text–book of Cell and Molecular Biology (5th edition). Rastogi Publications, Meerut, India
2. Johnson, A., Raff, L. and Walter, R. (2008). Molecular Biology of the Cell (5th Edition). Taylor and Francis Group, USA.
3. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments (7th Edition). Wiley Publishers, USA.
4. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd edition). HarperCollinsCollege Publishers, New York, USA.
5. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A. and Ploegh, H. (2016). Molecular Cell Biology (5th edition) , W.H. Freeman & Co., New York, USA.
6. Snustad, D.P. and Simmons, M.J. (2012). Principles of Genetics (8th Edition). John Wiley and Sons Inc., U.S.A.

**Bachelor of Science (Medical) Semester-II**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-2075(II)**  
**GENETICS**  
**(Theory)**

**Course outcome: -**

After passing this course the student will be able to:-

CO1: Comprehensive, detailed understanding of the chemical basis of heredity

CO2: Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.

CO3: Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.

CO4: Understanding the role of genetic mechanisms in evolution. The knowledge required to design, execute, and analyze the results of genetic experimentation in animal and plant model systems.

CO5: The ability to evaluate conclusions that are based on genetic data. Insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets in systems biology settings.

**Bachelor of Science (Medical) Semester-II**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-2075(II)**  
**GENETICS**  
**(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**UNIT-I**

DNA the Genetic Material: DNA structure; replication; DNA–protein interaction; the nucleosome model; genetic code; satellite and repetitive DNA.

**UNIT-II**

Cell Division: Mitosis; meiosis. Genetic Inheritance: Mendelism; laws of segregation and independent assortment; linkage analysis; allelic and non–allelic interactions.

**UNIT-III**

Gene expression: Structure of gene; transfer of genetic information; transcription, translation, protein synthesis, tRNA; ribosomes; regulation of gene expression in prokaryotes and eukaryotes; proteins, 1D, 2D, and 3D structure.

**UNIT-IV**

Genetic Variations: Mutations, spontaneous and induced; transposable genetic elements; DNA, damage and repair.

**Suggested Readings:**

1. Brown, T.A. (2011). Genetics: A Molecular Approach (3rd Edition). BIOS Scientific Publishers, UK.
2. Fletcher, H., Hickey, I. and Winter, P. (2010). Instant Notes on Genetics (3rd edition) Taylor and Francis Group, USA.
3. Gardner, E.J., Simmons, M.J. and Snustad, D.P. (2012). Principles of Genetics (8th Edition). Wiley Sons, USA.
4. Gupta, P.K. (2017). Cell and Molecular Biology (5th edition), Rastogi Publications, Meerut, India.
5. Kleinsmith, L.J. and Kish, V.M. (1995). Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
6. Krebs, B. E., Goldstein, E.S. and Kilpatrick, S.T. (2014). Lewin's Genes XI. Jones and Bartlett Publishers, LLC, UK.
7. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A. and Ploegh, H. (2016). Molecular Cell Biology (5th edition), W.H. Freeman & Co., New York, USA.
8. Singh, B.D. (2018). Molecular Genetics. Kalyani Publishers, India.
9. Snustad, D.P. and Simmons, M.J. (2012). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.

**Bachelor of Science (Medical) Semester-II**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-2075(P)**  
**PRACTICAL – GENETICS AND CELL BIOLOGY**

**Course outcome: -**

After passing this course the student will develop:

**CO1:** A critical awareness of how genetics techniques can be applied to biological problems.

**CO2:** A critical awareness of current thinking in a specialist area of cell biology and genetics.

**CO3:** the ability to evaluate methodologies in the design of experimental procedures.

**CO4:** The ability to critically evaluate experimental data.

**CO5:** The ability to synthesize hypotheses from a wide range of information sources.

**CO6:** The ability to design and implement a wide range of experimental procedures.

**CO7:** to be able to make sound judgments on the significance of incomplete data sets.

**CO8:** Demonstration of independence and originality in solving problems.

**CO9:** The ability to exercise initiative and personal responsibility.

**CO10:** The development of independent learning skills required for continuing professional development.

**Bachelor of Science (Medical) Semester-II**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-2075(P)**  
**PRACTICAL – GENETICS AND CELL BIOLOGY**

**TIME: 3Hours**

**Practical: 20**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Laboratory Exercises**

Teachers may select plants/material available in their locality/institutions.

1. To study cell structure from onion leaf peels; demonstration of staining and mounting methods.
2. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*. Study of cyclosis in *Tradescantia* Staminal Cells.
3. Study of plastids to examine pigment distribution in plants (e.g. *Cassia*, *Lycopersicon* and *Capsicum*).
4. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
5. Study of electron micrographs of viruses, bacteria, cyanobacteria and eukaryotic cells for comparative cellular organization.
6. Microscopy- Theoretical knowledge of Light and Electron microscope.
7. Examination of various stages of mitosis and meiosis using appropriate plant material (e.g. onion root tips, onion flower buds).
8. Preparation of karyotypes from dividing root tip cells and pollen grains.
9. Cytological examination of special types of chromosomes: bar body, lampbrush and polytene chromosomes.
10. Working out the laws of inheritance using seed mixtures.
11. Working out the mode of inheritance of linked genes from test cross and/or F<sub>2</sub> data.

**Suggested Readings: -**

1. Fukui, K. and Nakayama, S. 1996. Plant Chromosomes; Laboratory Methods, CRC Press, Boca Raton, Florida.
2. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology; Structure and Function, Jones AndBarllett Publishers, Boston, Massachusetts.
3. Harns, N. and Oparka, K.J. 1994. Plant Cell Biology, A Practical Approach. IRL Press, at OxfordUniversity Press, Oxford, UK.
4. Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes; Analysis. Manipulation and Engineering, Harwood Academic Publishers, Australia.
5. Plopper, G. (2016). Principles of Cell Biology. Jones and Barnett Learning, Boston, Massachusetts.

**Bachelor of Science (Medical) Semester-III**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-3075(I)**  
**STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS-I**  
**(Theory)**

**Course outcome: -**

After passing this course the student will develop:

CO1: Understanding of basic body plan of a flowering plant, Diversity in plant form branching pattern and canopy architecture trees.

CO2: Understanding of shoot apical meristem and its histological organization. Cambium and its function and formation of secondary xylem.

CO3: Understanding of wood in relation to water and minerals, growth rings and structure of secondary phloem and periderm.

CO4: Understanding of origin, development, arrangement and diversity in size and shape of leaf, internal structure in relation to photosynthesis and water loss, senescence and abscission.

**Bachelor of Science (Medical) Semester-III**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-3075(I)**

**STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS-I**  
**(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit I**

The basic body plan of a flowering plant-modular type of growth. Diversity in plant form in annuals, biennials and perennials; trees-largest and longest-lived, branching pattern; monopodial and sympodial growth; canopy architecture.

**Unit II**

The Shoot System: The shoot apical meristem and its histological organization; meristematic and permanent tissue, formation of internodes. Cambium and its functions; formation of secondary xylem.

**Unit III**

A general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; role of woody skeleton; secondary phloem-structure function relationships; periderm.

**Unit IV**

Leaf: Origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

**Suggested Readings:**

- Beck, C.B. (2010). An Introduction to Plant Structure and Development: Plant anatomy for the Twenty First Century (2nd Edition). Cambridge University Press, UK.
- Cutler, D. F., Botha, T. and Stevenson, D. M. (2007). Plant Anatomy: An Applied Approach. Blackwell Publishing, Oxford, UK.
- Dickison, W.C. (2000). Integrative Plant Anatomy. Academic Press, California, USA.
- Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
- Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
- Rudall, P. J. (2007). Anatomy of Flowering Plants: An Introduction to Structure and Development (3rd Edition). Cambridge University Press, UK.
- Thomas, P. (2000) Trees: Their Natural History, Cambridge University Press, Cambridge.
- Srivastava, H.N. (2018) Diversity of Seed Plants and Their Systematics, Vol. III, Pradeep's Publication.

**Bachelor of Science (Medical) Semester-III  
(Session 2021-22)  
BOTANY**

**Course Code: BSMM-3075(II)**

**STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING PLANTS-II  
(Theory)**

**Course outcome: -**

After passing this course the student will be able to:

CO1: Recognize the major groups of vascular plants and their phylogenetic relationships.

CO2: Know the structure and development of monocot and dicot embryos.

CO3: Understand different means of vegetative reproduction.

CO4: Understand physiology of seed germination.

**Bachelor of Science (Medical) Semester-III**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-3075(II)**

**STRUCTURE, DEVELOPMENT AND REPRODUCTION IN FLOWERING-II**  
**(Theory)**

**Time: 3Hrs**

**Max Marks. 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit I**

The Root System: The root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes.

**Unit II**

Vegetative Reproduction: various methods of vegetative propagation. Detailed study and types of grafting and budding, economic aspects. Flower: A modified shoot; structure, development and varieties of flower; functions

**Unit III**

Structure of anther and pistil; the male and female gametophytes; types of pollination; attractions and reward for pollinators; (sucking and foraging types); pollen-pistil interaction self incompatibility.

**Unit IV**

Double fertilization: formation of seed endosperm and embryo: fruit development and maturation  
Significance of Seed: Suspended animation; ecological adaptation; unit of genetic recombination with reference to reshuffling of genes and replenishment; dispersal strategies.

**Suggested readings:**

- Bhojwani, S.S., Bhatnagar, S.P. and Dantu P.K. (2015). The Embryology of Angiosperms, 6th edition. Vikas Publishing House, Delhi.
- Hartmann, H.T. and Kestler, D.E. (1976). Plant Propagation: Principles and Practices, 3<sup>rd</sup> edition, Prentice Hall of India Pvt. Ltd., New Delhi.
- Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
- Peau, K. (1977). Anatomy of Seed Plants, 3rd edition. John Wiley & Sons, New York.
- Pegeri, K. and Vander Pijl (1979). The Principles of Pollination Biology, Pergamon Press, Oxford.
- Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1999). Biology of Plants, 5th edition. W.H. Freeman and Co., Worth Publishers, New York.
- Srivastava, H.N. (2018) Diversity of Seed Plants and Their Systematics, Vol. III, Pradeep's Publication.

**Bachelor of Science (Medical) Semester-III  
(Session 2021-22)**

**BOTANY**

**Course Code: BSMM-3075 (P)**

**PRACTICAL – STRUCTURE, DEVELOPMENT AND REPRODUCTION IN  
FLOWERING PLANTS (I & II)**

**Course outcome: -**

After passing this course the student will be able to:

CO1: Develop knowledge about the role of herbarium techniques in plant identification.

CO2: Understand different life forms exhibited by flowering plants.

CO3: Understand anatomy of different plant parts using free hand razor technique.

CO4: Examine flower and their mode of pollination.

**Bachelor of Science (Medical) Semester-III  
(Session 2021-22)**

**BOTANY**

**Course Code: BSMM-3075 (P)**

**PRACTICAL – STRUCTURE, DEVELOPMENT AND REPRODUCTION IN  
FLOWERING PLANTS (I & II)**

**TIME: 3 Hours      Practical: 20**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Laboratory Exercises**

1. Study of any commonly occurring dicotyledonous plant (for example *Solanum nigrum* or *Kalanchoe*) to the body plan, organography and modular type of growth.
2. Life forms exhibited by flowering plants (by a visit to a forest or a garden, Study of tree like habit in cycads, bamboo, banana, traveller's tree (*Revenalamadagascariensis*) and *Yucca* and comparison with true trees as exemplified by conifers and dicotyledons.
3. L.S. Shoot tip to study the cytohistological zonation and origin of leaf primordia.
4. Monopodial and sympodial types of branching in stems (especially rhizomes).
5. Anatomy of primary and secondary growth in monocots and dicots using free hand razor technique (*Solanum*, *Boerhavia*, *Helianthus*, *Mirabilis*, *Nyctanthus*, *Draceana*, Maize) hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood, Microscopic study of wood in T.S., T.L.S. and R.L.S.
6. Field study of diversity in leaf shape, size, thickness, surface properties. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf).
7. Anatomy of the root. Primary and secondary structure.
8. Examination of a wide range of flowers available in the locality and methods of their pollination.
9. Structure of anther, microsporogenesis (using slides) and pollen grains (using whole mounts). Pollen viability using in vitro pollen germination.
10. Structure of ovule and embryo sac development using serial sections from permanent slides.
11. Nuclear and cellular endosperm. Embryo development in monocots and dicots (using permanent slides/dissections).
12. Simple experiments to show vegetative propagation (leaf cuttings in *Bryophyllum*, *Sansevieria*, *Begonia*; stem cuttings in rose, *Salix*, money plant, Sugarcane and *Bougainvillea*).
13. Germination of non-dormant and dormant seeds.

**Suggested Readings (for laboratory exercises):**

1. Bhojwani, S.S. and Bhatnagar, P. (2000). The Embryology of Angiosperms (4<sup>th</sup> revised and enlarged edition), Vikas Publishing House, New Delhi.
2. Mauseth, J.D. (1988). Plant Anatomy, The Benjamin/Cumminas Publishing Co., Inc., Mehlo Park, California, USA.
3. Raven, P.H., Evert, R.F. and Eichhorn, S.E. (1992). Biology of Plants (5<sup>th</sup> Edition). Worth Publishers, New York.
4. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development (2<sup>nd</sup> Edition). CambridgeUniversity Press, Cambridge

**Bachelor of Science (Medical) Semester-IV**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-4075(I)**  
**DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS-I**  
**(Theory)**

**Course outcome: -**

After passing this course the student will develop:

CO1: Understanding of characters of seed plants, origin and evolution of seed habit, angiosperms and gymnosperms

CO2: Understanding of general characters of gymnosperms, their classification and evolution including fossil and living gymnosperms.

CO3: Understanding of morphology of vegetative and reproductive parts of *Pinus* and *Cycas*

CO4: Understanding of morphology of vegetative and reproductive parts of *Ephedra* and *Ginkgo*

**Bachelor of Science (Medical) Semester-IV**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-4075(I)**  
**DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS-I**  
**(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

Characteristics of seed plants; Evolution of the seed habit; Distinguishing features of angiosperms and gymnosperms. Angiosperms: Origin and evolution. Some examples of primitive angiosperms.

**Unit-II**

General features of gymnosperms and their classification; evolution and diversity of Gymnosperms including fossil and living gymnosperms; Geological time scale and fossilization.

**Unit-III**

Morphology of vegetative and reproductive parts; Anatomy of root, Stem and leaf; reproduction and life cycle of *Pinus*, *Cycas*.

**Unit-IV**

Morphology of vegetative and reproductive parts; Anatomy of root, Stem and leaf; reproduction of life cycle of *Ephedra* and *Ginkgo*.

**Suggested Readings: -**

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms, New Age International Limited, New Delhi.
2. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
3. Pellant, C. (1994). Fossils, Dragon's World, Great Britain
4. Sporne, K.R. (1965). The Morphology of Gymnosperms, Hutchinson & Co. (Publishers) Ltd., London.
5. Taylor, T. N., Taylor, E. L. and Krings, M. (2008). Paleobotany: The Biology and Evolution of Fossil Plants (2nd Edition). Elsevier Inc. Netherlands.
6. Vashistha, P. C. (2016). Botany for degree students. S.Chand and Company, New Delhi.

**Bachelor of Science (Medical) Semester-IV**  
**(Session 2020-21)**  
**BOTANY**  
**Course Code: BSMM-4075(II)**  
**DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS-II**  
**(Theory)**

**Course outcome: -**

After passing this course the student will develop:

CO1: Plant description, describe the morphological and reproductive stretch of plant and also identify the different families.

CO2: Understanding of Botanical Nomenclature, classification of angiosperms and Salient features of the systems proposed by Bentham and Hooker, Engler and Prantl

CO3: Understanding diversity of flowering plants in families like Ranunculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae.

CO4: Understanding diversity of flowering plants in families like Apocynaceae, sclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

**Bachelor of Science (Medical) Semester-IV**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-4075(II)**  
**DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS-II**  
**(Theory)**

**Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

Angiosperm taxonomy; Brief history, Aims and fundamental components (alpha-taxonomy, Omega-taxonomy, Holotaxonomy); Identification, keys. Taxonomic literature. Botanical nomenclature: Taxonomic ranks; Type concept; Principle of priority.

**Unit-II**

Botanical nomenclature: Taxonomic ranks; Type concept; Principle of priority. Major contribution of cytology, Phytochemistry and taxometrics to taxonomy. Classification of angiosperms; Salient features of the systems proposed by Bentham and Hooker, Engler and Prantl

**Unit-III**

Diversity of flowering plants as illustrated by members of the families Ranunculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae.

**Unit-IV**

Diversity of flowering plants as illustrated by members of the families Apocynaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.

**Suggested Readings: -**

1. Bendre, A. (2007). Practical Botany, Rastogi Publications, Meerut.
2. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd, London.
3. Gifford, E.M. and Foster, A.S. (1988). Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
4. Jeffrey, C. (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
5. Jones, S.B., Jr. and Luchsinger, A.E. (1986). Plant Systematics (2nd edition). McGraw- Hill Book Co., New York.
6. Radford, A.E. (1986). Fundamental of Plant Systematics, Harper and Row, New York

**Bachelor of Science (Medical) Semester-IV**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-4075(P)**  
**DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS (I&II)**  
**(PRACTICAL)**

**Course outcome: -**

After passing this course the student will able to:

CO1: Identify different plants from different families through their vegetative and reproductive characters.

CO2: Understanding different types of placentation system.

**Bachelor of Science (Medical) Semester-IV**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-4075(P)**  
**PRACTICAL – DIVERSITY OF SEED PLANTS AND THEIR SYSTEMATICS**  
**(I &II)**

**TIME: 3Hours**

**Practical: 20**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Laboratory Exercises**

1. Angiosperms The following species are suitable for study.
2. This list is only indicative. Teachers may select plants available in their locality. Teachers may select plants/material available in their locality/institution.
1. Ranunculaceae: *Ranunculus*, *Delphinium*
2. Brassicaceae: *Brassica*, *Alyssum*, *Iberis*, *Coronopus*.
3. Malvaceae: *Hibiscus*, *Abutilon*.
4. Rutaceae: *Murraya*, *Citrus*.
5. Fabaceae: Faboideae: *Lathyrus*, *Cajanus*, *Melilotus*, *Trigonella*, Caesalpinioideae: *Cassia*, *Caesalpinia*, Mimosoideae: *Prosopis*, *Mimosa*, *Acacia*.
6. Apiaceae: *Coriandrum*, *Foeniculum*, *Anethum*.
7. Acanthaceae: *Adhatoda*, *Peristrophe*.
8. Apocynaceae: *Vinca*, *Thevetia*, *Nerium*.
9. Asclepiadaceae: *Calotropis*.
10. Solanaceae: *Solanum*, *Withania*, *Datura*.
11. Euphorbiaceae: *Euphorbia*, *Phyllanthus*.
12. Lamiaceae: *Ocimum*, *Salvia*.
13. Chenopodiaceae: *Chenopodium*, *Beta*.
14. Liliaceae: *Asphodelus*, *Asparagus*.
15. Poaceae: *Avena*, *Triticum*, *Hordeum*, *Poa*, *Sorghum*.

The Students should be made familiar with the use of identification keys including use of computers in taxonomy. The teachers should prevent students from collecting plants from the wild and submitting them for the practical examination. Instead, the student should be asked to prepare field reports.

**Gymnosperms**

**Cycas** (i) Habit, armour of leaf bases on the stem (if specimen is not available show photography), very young leaf (circinate vernation) and old foliage leaves, scale leaf, bulbils, male cone (specimen); Microsporophyll, megasporophyll mature seed. (ii) Study through permanent slides—normal root (T.S.), stem (T.S.) (if sections are not available show photographs), ovule (L.S.). (iii) Study through hand sections or dissections—coralloid root (T.S.), rachis (T.S.), leaflet (V.S.), microsporophyll (V.S.) pollen grains (W.M.).

**Pinus** (i) Habit, long and dwarf shoot showing cataphylls and scale leaves, T.S. wood showing growth rings, male cone, 1st year, 2nd year and 3rd year female cones, winged seeds. (ii) Study

through permanent slides-root (T.S.), female cone (L.S.) ovule (L.S.), embryo (W.M.) showing polycotyledonous condition. (iii) Study through hand sections or dissections-young stem (T.S.), old stem (wood) (T.L.S. and R.L.S.), needle (T.S. male cone (L.S.), male cone (T.S.), Pollen grains (W.M.).

**Ephedra**(i) Habit and structure of whole and female cones. (ii) Permanent slides-female cone (L.S.). (iii) Hand sections/dissections-node (L.S.), internode (T.S.), macerated stem to see vessel structure; epidermal peel mount of vegetative parts to study stomata, male cone (T.S. and L.S.), pollen grains.

**Ginkgo** (i) Habit and structure of whole plant. (ii) Permanent slides-male and female reproductive parts. (iii) pollen grains

### **Suggested Readings:**

1. Angiosperm Phylogeny Group (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG
2. Botanical Journal of the Linnaean Society 141: 399-436. 2. Cronquist, A. (1981). An Integrated System of Classification of Flowering Plants. ColumbiaUniversity Press, New York.
3. Simpson, M.C. (2006). Plant Systematics. Elsevier, Amsterdam

**Bachelor of Science (Medical) Semester-V  
(Session 2021-22)**

**BOTANY**

**Course Code: BSMM-5075**

**Course Title: Plant Physiology  
(Theory)**

**Course outcome: -**

After passing this course the student will be able to:

CO1. Understand the plants and plant cells in relation to water.

CO2. Understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C3 and C4 pathways.

CO3. Understand the respiration in higher plants with particular emphasis on aerobic and anaerobic respiration.

CO4. Learn about the movement of sap and absorption of water in plant body

**Bachelor of Science (Medical) Semester-V**  
**(Session 2021-22)**

**BOTANY**

**Course Code: BSMM-5075 (I)**

**Course Title: Plant Physiology**

**(Theory)**

**Examination Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Plant-Water Relation:** Importance of water to plant life, physical properties of water, (imbibition) diffusion and osmosis, absorption, transport of water and transpiration, physiology of stomata.

**Unit-II**

**Mineral Nutrition:** Essential macro-and micro-elements and their role, mineral uptake, deficiency and toxicity symptoms (hydroponics).

**Transport of Organic Substances:** Mechanism of phloem transport, source-sink relationship, factors affecting translocation.

**Unit-III**

**Photosynthesis:** Significance, historical aspects, photosynthetic pigments, action and absorption spectra and enhancement effects, concept of two photosystems, z-scheme, photophosphorylation, Calvin cycle, C4 pathway, CAM plants, photorespiration.

**Unit-IV**

**Growth and Development:** Definitions, phases of growth and development, kinetics of growth, seed dormancy, seed germination and factors of their regulation, plant movements, the concept of photoperiodism, physiology of flowering, florigen concept, biological clocks, physiology of senescence, fruit ripening.

**Plant growth regulators** - auxins, gibberellins, cytokinins, abscissic acid and ethylene, history of their discovery, biosynthesis and mechanism of action, general account of salicylic acid, jasmonates and brassinosteroids, photomorphogenesis, phytochromes and cryptochromes, their discovery, physiological role and mechanism of action.

**Suggested Readings:-**

1. Bhatia, K.N. (2019). Plant Physiology I and II. Trueman Book Company. New Delhi
2. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology (4th Edition). John Wiley and Sons. U.S.A.
3. Jain, V.K. (2017). Fundamentals of Plant Physiology. S. Chand Publishing. New Delhi.
4. Mandavia, C., Patel, S. V., Mandavia, M. K., Golakiya, B. A. and Chovatia, V. P. (2009). Glimpses in Plant Physiology. International Book Distributing Co., Lucknow, India.
5. Mohr, H. and Schopfer, P. (1995). Plant Physiology. Springer-Verlag, Berlin, Germany.
6. Pandey, S.N. and Sinha, B. K. (2005). Plant Physiology. Vikas Publishing. New Delhi.
7. Salisbury, F.B. and Ross, C.W. 2006. Plant Physiology (4th Edition). Wadsworth Publishing Co., California, USA.
8. Srivastava, H. N. (2019). Plant Physiology, Biochemistry and Biotechnology. Pradeep Publications, Jalandhar.
9. Taiz, L. and Zeiger, E. (2010). Plant Physiology (5th Edition). Sinauer Associates Inc. USA.

**Bachelor of Science (Medical) Semester-V  
(Session 2021-22)**

**BOTANY**

**Course Code: BSMM-5075 (II)**

**Course Title: Biochemistry & Biotechnology**

**(Theory)**

**Course outcome: -**

After passing this course the student will be able to:

CO1. Understand the properties of Monosaccharide, Oligosaccharides and Polysaccharides.

CO2. Understand the Properties of saturated and unsaturated fatty acids.

CO3. Understand lipid metabolism and its significance in plants.

CO4. Understand structure and classification and protein biosynthesis in prokaryotes and eukaryotes. They will learn about the nucleic acid metabolism.

CO5. Understand the fundamentals of Recombinant DNA Technology. Know about the Genetic Engineering. Understand the principle and basic protocols for Plant Tissue Culture.

**Bachelor of Science (Medical) Semester-V**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-5075 (II)**  
**Course Title: Biochemistry & Biotechnology**  
**(Theory)**

**Examination Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Basics of Enzymology:** Discovery and nomenclature, characteristics of enzymes, concept of holoenzyme, apoenzyme, coenzymes and cofactors regulation of enzyme activity, mechanism of action.

**Respiration:** ATP-the biological energy currency, aerobic and anaerobic respiration, Krebs's cycle, electron transport mechanism (chemiosmotic theory), redox potential, oxidative phosphorylation, pentose phosphate pathway.

**Unit-II**

**Nitrogen and Lipid Metabolism:** Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation, structure and function of lipids, fatty acid biosynthesis,  $\beta$ -oxidation, saturated and unsaturated fatty acids, storage and mobilization of fatty acids.

**Unit-III**

**Genetic Engineering:** Tools and techniques of recombinant DNA technology, cloning vectors, genomic and cDNA library, transposable elements, techniques of gene mapping.

**Unit-IV**

**Biotechnology:** Functional definition, basic aspects of plant tissue culture, cellular totipotency, differentiation and morphogenesis, biology of Agrobacterium, vectors for gene delivery and marker genes, salient achievements in crop biotechnology.

**Suggested Readings: -**

1. Bhojwani, S.S. (1996). Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
2. Dennis, D.T., Turpin, D.H. Lefebvre, D.D. and Layzell (eds.) (1997). Plant Metabolism (2<sup>nd</sup> Edition). Longman, Essex, England.
3. Galston, A.W. (1994). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Glick, B.R., Pasternak, J.J. (2010). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5. Lea, P.J. and Leegood, R.C. (1999). Plant Biochemistry and Molecular Biology. John Wiley Sons, Chelichester, England.
6. Old, R.W. and Primrose, S.B. (2006). Principles of Gene Manipulation, Blackwell Scientific Publishers, Oxford, UK.
7. Snustad, D.P. and Simmons,M.J. (2010). Principles of Genetics (5th Edition). John Wiley and Sons Inc., U.S.A.
8. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques  
And Applications. John Wiley & Sons Inc. U.S.A.
9. Vasil, I.K. and Thorpe, T.A. (2012). Plant Cell and Tissue Culture. Kluwer Academic  
Publishers, The Netherlands

**Bachelor of Science (Medical) Semester-V**  
**(Session 2021-22)**  
**BOTANY**  
**Course Code: BSMM-5075(P)**  
**PRACTICAL – Plant physiology, Biochemistry & Biotechnology**  
**(I & II)**

**Course outcome: -**

After passing this course the student will be able:

- CO 1: determine the osmotic potential of cell sap by plasmolytic method.
- CO2: determine the Diffusion Pressure Deficit (DPD) of plant cells.
- CO3: determine the effect of time period on the rate of imbibition in different types of seeds.
- CO4: determine the relation between absorption and transpiration.

**Bachelor of Science (Medical) Semester-V  
(Session 2021-22)**

**BOTANY**

**Course Code: BSMM-5075(P)**

**PRACTICAL – Plant physiology, Biochemistry & Biotechnology  
(I & II)**

**TIME: 3Hours**

**Practical: 20**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Laboratory Exercises**

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effects of temperature on permeability of plasma membrane.
3. To prepare the standard curve of protein and determine the protein content in unknown samples.
4. To study the enzyme activity of catalase and peroxidase as influenced by pH and temperature.
5. Separation of chloroplast pigments by solvent method.
6. Determining the osmotic potential of vacuolar sap by plasmolytic method.
7. Determining the water potential of any tuber.
8. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.
9. Bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant material.
10. Demonstration of the technique of micropropagation by using different explants, e.g. axillary buds, shoot meristems.
11. Demonstration of the technique of another pollen culture.
12. Demonstrate the ascent of sap using a dye.
13. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.
14. Demonstrate the transpiration pull by mercury method.
15. Demonstration of osmosis by potato osmoscope.
16. Comparison of loss of water from two surfaces of leaf by  $\text{CoCl}_2$  method/four leaf method.
17. Demonstration of imbibition by plaster of Paris method.
18. Demonstration that  $\text{O}_2$  is evolved during photosynthesis.
19. Separation of pigments by paper chromatography/TLC method.
20. Demonstration of phototropism movements.
21. Demonstration the measurements of growth by arc auxanometer.
22. Requirements for setting up the tissue culture laboratory.
23. Preparation of nutrient medium.
24. Sterilization of glassware and plant material.
25. Preparation of explant for aseptic manipulation.

### **Suggested Readings (For Laboratory Exercises)**

1. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
3. Dixon, R.A. (Ed.) 1994. Plant Cell Culture: A Practical Approach, IRL Press, Oxford.
4. Kochhar, S. L. and Gujral, S. K. (2016). Comprehensive Practical Plant Physiology. Macmillan Publishers India Ltd., Delhi.
5. Moore, T.C. 2012. Research Experiences in Plant Physiology: A Laboratory manual. Springer-Verlag, Berlin.
6. Plummer, D.T. (2001). An Introduction to Practical Biochemistry (3rd Edition). Tata McGraw-Hill Publishing Co. Ltd. New Delhi.
7. Roberts, J. and Tuckar, G.A. (Eds.) 2000. Plant Hormone Protocols. Human Press, New Jersey, USA.
8. Scott, R.P.W. 1995. Techniques and Practices of Chromatography. Marcel Dekker, Inc., New York.
9. Smith, R.H. 2000. Plant Tissue Culture: Techniques and Experiments. Academic Press, New York.

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-6075 (I)**

**Ecology**

**(Theory)**

**Course outcome: -**

After passing this course the student will develop:

CO1.Demonstrate practical fieldwork skills.

CO2.Demonstrate an understanding of key ecological interactions and processes:

CO3.Explain scales and patterns in ecology and biodiversity

CO4.Appreciate the relationships between ecology and society

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-6075(I)**

**Ecology**

**(Theory)**

**Examination Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Plants and Environment:** Atmosphere (gaseous compositions), water (properties of watercycle), light (global radiation, photosynthetically active radiation), temperature, soil (development, soil profiles, physico-chemical properties), and biota.

Morphological, anatomical and physiological responses of plants to water (hydrophytes and xerophytes), temperature (thermoperiodicity and vernalization), light (photoperiodism, heliophytes and sciophytes) and salinity.

**Unit-II**

**Community Ecology:** Community characteristics, absolute and relative frequency, density and dominance, basal area and importance value index (IVI), Whittaker's classification of biodiversity, indices of alpha, beta and gamma diversity, life forms, biological spectrum, ecological succession.

**Unit-III**

**Population Ecology:** Growth curves, ecotypes, ecads.

**Ecosystem:** Structure, abiotic and biotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles of carbon, nitrogen and phosphorus.

**Unit-IV**

**Biogeographical Regions of India**

**Vegetation types of India:** Forests and grasslands

**Landscape Ecology:** Definition & concept, effect of patch size and shape on biodiversity, dynamics of land use.

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**

**Suggested Readings**

1. De, Debapriya and De, Debasish (2014). Fundamentals of Environment and Ecology. S. Chand Publishing, New Delhi
2. Kumar, H.D. (2018). Modern Concepts of Ecology 8<sup>th</sup> edition. Vikas Publishing House, New Delhi.
3. Mackenzie, A., Ball, A. and Virdee, S. (2001). Instant Notes in Ecology. Taylor & Francis, London, United Kingdom
4. Odum, E.P. and Barrett, G.W. (2012). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd., New Delhi.
5. Saini, A. (2019). Plant Ecology. Trueman Book Company. New Delhi.
6. Sharma, P.D. (2017). Environmental Biology and Toxicology. 3<sup>rd</sup> edition. Rastogi Publications, Meerut.
7. Srivastava, H. N. (2020). Botany Vol VI, Ecology and Utilization of Plants. Pradeep publications, Jalandhar.

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-6075(II)**

**Economic Botany**

**(Theory)**

**Course outcome: -**

After passing this course the students will be able to:

CO1: - Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems.

CO2: -Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership.

CO3: -Develop a basic knowledge of taxonomic diversity and important families of usefulplants.

CO4: -Increase the awareness and appreciation of plants& plant products encountered in everyday life.

CO5: -Appreciate the diversity of plants and the plant products in human use.

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-6075(II)**

**Economic Botany**

**(Theory)**

**Examination Time: 3Hrs**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (I-IV). Questions of Sections I-IV should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Food Plants:** *Oryza sativa* (Rice), *Triticum aestivum* (Wheat), *Zeamays* (Maize), *Solanumtuberosum* (Potato), *Saccharum officinarum* (Sugarcane).

**Fibres:** *Gossypium hirsutum* (Cotton) and *Chorchorus capsularis* (Jute).

**Vegetable Oils:** *Arachis hypogea* (Groundnut), *Brassica campestris* (Mustard) and *Cocos nucifera* (Coconut).

**Unit-II**

**Spices:** General account of *Piper nigrum* (Black pepper), *Eugenia caryophyllum* (Cloves), *Cinnamomum verum* (Cinnamomum), *Elettaria cardamomum* (cardamom), *Zingiber officinalis* (Ginger), *Curcuma longa* (Turmeric), *Coriandrum sativum* (Coriander), *Foeniculum vulgare* (Fennel) and *Mentha arvensis* (Mint).

**Unit-III**

**Medicinal Plants:** General account of *Terminalia chebula* (Harar), *Terminalia belerica* (Bahera), *Azadirachta indica* (Neem), *Phyllanthus emblica* (Amla), *Aconitum napellus* (Aconite), *Rauwolfiaserpentina* (Sarpagandha), *Atropa belladonna* (Belladonna), *Datura stramonium* (Datura), *Withaniasomnifera* (Ashwagandha) and *Papaver somniferum* (Poppy).

**Unit-IV**

**Beverages:** *Camellia sinensis* (Tea) and *Coffea arabica* (Coffee).

**Rubber:** Morphology of *Hevea brasiliensis* (Rubber), Processing and Uses. General account of sources of firewood, timber and bamboos.

### **Suggested Readings:**

1. Verma, V. (2016). Textbook of Economic Botany, ANE Books, New Delhi.
2. Das, K. (2014). Medicinal plants- Their importance in Pharmaceutical Sciences, Kalyani Publishers, New Delhi.
3. Kocchar, S.L. (2016). Economic Botany of the Tropics, Macmillan India Pvt. Ltd., New Delhi.
4. Prinotel, D. and Hall, C.W. (Eds.) (2001). Food and Natural Resources. Academic Press, London, New York.
5. Reddy, K. et al. (2015). Advances in Medicinal plants, Universities Press, Hyderabad.
6. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
7. Swaminathan, M.S. and Kocchar, S.L. (Eds) (2009). Plants and Society. Macmillan Publications Ltd., London.
8. Council of Scientific & Industrial Research (1986). The Useful Plants of India. Publications and Information Directorate. CSIR, New Delhi.

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-6075(P)**  
**PRACTICAL: - Ecology and Economic botany**  
**(I &II)**

**Course Outcomes:**

On completion of this course, the students will be able to:

- CO1. Determination of abundance and frequency of species by quadrature method.
- CO2. To measure the dissolved oxygen content in polluted and unpolluted water samples.
- CO3. Study of anatomical peculiarities with reference to ecological adaptations.
- CO4. Preparation of different stains, solutions and reagents as per theory paper.
- CO5. To understand the economic importance of plants.
- CO6. To acquire knowledge in the preparation of herbarium techniques. Submission of field report and practical records.

**Bachelor of Science (Medical) Semester-VI**  
**(Session 2021-22)**  
**BOTANY**

**Course Code: BSMM-6075(P)**

**PRACTICAL: - Ecology and Economic botany**  
**(I &II)**

**TIME: 3Hrs Practical: 20**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Laboratory Exercises**

1. To determine minimum number of quadrats required for reliable estimate of biomass in grasslands through species area curves.
2. To study the frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkiaer's Standard Frequency Diagram.
3. To estimate Importance Value Index for grassland species on the basis of relative frequency, relative density and relative dominance in protected and grazed grassland.
4. To measure the vegetation cover of grassland through point frame method.
5. To measure the above ground plant biomass in a grassland.
6. To study the morphological anatomical features of hydrophytes (*Hydrilla*, *Eichhornia*)
7. Xerophytes (*Nerium*, *Calotropis*).
8. To determine diversity indices (richness, Simpson, Shannon-Weaver) in grazed and protected grassland.
9. To estimate bulk density and porosity of grassland and woodland soils.
10. To determine moisture content and water holding capacity of grassland and woodland soil.
11. To study the vegetation structure through profile diagram.
12. To estimate transparency, pH and temperature of different water bodies.
13. To measure dissolved oxygen content in polluted and unpolluted water samples.
14. To estimate salinity of different water samples.
15. To determine the percent leaf area injury of different leaf samples collected around polluted sites.
16. To estimate dust-holding capacity of the leaves of different plant species.
17. **Food Plants:** Study of the morphology, structure and simple microchemical tests of the food storing tissues rice, wheat, maize, potato and sugarcane. Microscopic examination of starch in these plants (excepting sugarcane).
18. **Fibres:** Study of cotton flowers, sectioning of the cotton ovules/developing seeds to trace the origin and development of cotton fibers. Microscopic study of cotton and test for cellulose.
19. Sectioning and staining of jute stem to show the location and development of fibers.
20. Microscopic structure. Tests for lignocelluloses.
21. **Vegetable Oils:** Study of hand sections of groundnut, mustard and coconut and staining of oil droplets by Sudan III and Sudan Black.
22. **Field Visits:** To study sources of firewood (10 plants)/timber yielding trees (10 trees)/bamboos, list to be prepared mentioning special features, collection of plant based articles of common use.

24. **Spices:** Examine black pepper, cloves, cinnamon (hand sections) and opened of cardamom and describe them briefly.
25. Preparations of an illustrated inventory of 10 medicinal plants used in indigenous systems of medicine or allopathy: Write their botanical and common names parts used and diseases/disorders for which they are prescribed.
26. **Beverages:** Section boiled coffee beans and tea leaves to study the characteristic structural features.
27. Visit to *in situ* conservation site/Botanical Garden.

### **Suggested Readings (for laboratory exercises)**

1. Council of Scientific & Industrial Research. (1986). The Useful Plants of India. Publications and Information Directorate. CSIR, New Delhi.
2. Kocchar, S.L. (2016). Economic Botany of the Tropics, Macmillan India Pvt. Ltd., New Delhi.
3. De, Debapriya and De, Debasish (2014). Fundamentals of Environment and Ecology. S. Chand Publishing, New Delhi
4. Kumar, H.D. (2018). Modern Concepts of Ecology 8<sup>th</sup> edition. Vikas Publishing House, New Delhi.
5. Mackenzie, A., Ball, A. and Virdee, S. (2001). Instant Notes in Ecology. Taylor & Francis, London, United Kingdom
6. Princentel, D. and Hall, C.W. (Eds.) (2001). Food and Natural Resources. Academic Press, London, New York.
7. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
8. Swaminathan, M.S. and Kocchar, S.L. (Eds.) (2009). Plants and Society. Macmillan Publications Ltd., London.

**FACULTY OF LIFE SCIENCES**

**SYLLABUS**

**Of**

**Botany For**

**Bachelor of Science (Biotechnology)**

**Semester I &III**

**(Under Continuous Evaluation System)**

**(12+3 System of Education)**

**Session: 2021-22**



**The Heritage Institution**

**KANYA MAHA VIDYALAYA  
JALANDHAR  
(Autonomous)**

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

## SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME

### Bachelor of Science (Biotechnology) (Session 2021-22) Botany-I

| Bachelor of Science (Biotechnology) Semester-I |                                     |             |             |       |      |    |    |                             |
|------------------------------------------------|-------------------------------------|-------------|-------------|-------|------|----|----|-----------------------------|
| Course Name                                    | Program Name                        | Course Code | Course Type | Marks |      |    |    | Examination time (in Hours) |
|                                                |                                     |             |             | Total | Ext. |    | CA |                             |
|                                                |                                     |             |             |       | L    | P  |    |                             |
| Botany-I                                       | Bachelor of Science (Biotechnology) | BBTM-1074   | C           | 60    | 30   | 18 | 12 | 3+3                         |

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

## SCHEME AND CURRICULLUM OF EXAMINATION OF THREEYEAR DEGREE PROGRAMME

### Bachelor of Science (Biotechnology) Semester-III

Session 2021-22

#### BOTANY-II

| Bachelor of Science (Biotechnology) Semester –III |                                     |             |             |       |       |    |    |                             |
|---------------------------------------------------|-------------------------------------|-------------|-------------|-------|-------|----|----|-----------------------------|
| Course Name                                       | Program Name                        | Course Code | Course Type | Total | Marks |    |    | Examination time (in Hours) |
|                                                   |                                     |             |             |       | Ext.  | CA |    |                             |
|                                                   |                                     |             |             |       | L     | P  |    |                             |
| Botany-II                                         | Bachelor of Science (Biotechnology) | BBTM-3074   | C           | 60    | 30    | 18 | 12 | 3+3                         |

**Bachelor of Science (Biotechnology) Semester-I  
(Session: 2021-22)**

**Course Code: BBTM-1074  
Botany-I**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand the diversity of plants.

CO2: Understand the structure of root and stem.

CO3: Understand structure and development of anther, male gametophyte, ovule and female gametophyte.

CO4: Understand different aspects of Pollination, fertilization and sterility.

CO5: Understand terminology related to floral descriptions.

**Bachelor of Science (Biotechnology) Semester-I**  
**(Session: 2021-22)**  
**BBTM-1074**  
**Botany-I**

**Time: 3 Hrs.**

**Max. Marks: 30**

**Instructions for the Paper Setters:**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit -A**

**Diversity in plants:** General characters of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Concepts of species, hierarchical taxa and biological nomenclature.

**Unit -B**

**Anatomy of flowering plants:** Meristems, simple and complex permanent tissues, internal structure of stem, root and leaf, secondary growth in stem and root of *Helianthus*.

**Unit -C**

**Reproduction in flowering plants:** Structure and development of anther and male gametophyte, Structure and development of ovule and female gametophyte; Pollination (self and cross) and fertilization; structure and function of endosperm and embryo (dicot and monocot), polyembryony, self-incompatibility.

**Unit -D**

**Taxonomy of flowering plants:** Artificial (Linnaeus), natural (Bentham & Hooker) and phylogenetic (Engler and Prantl) systems of classification; Terminology pertaining to floral description, General characteristics (including economic importance) of following families of angiosperms; giving examples of few important genera: Solanaceae: *Solanum/Petunia*, Rutaceae: *Citrus, Murraya*, Cruciferae- *Brassica*, Apiaceae (Umbelliferae) – *Coriander*, Asteraceae - *Helianthus*, Leguminosae –*Cassia/Acacia/Sweet pea*, Poaceae (Graminae)- *Triticum*.

## **Bachelor of Science (Biotechnology) Semester-I (Session: 2021-22)**

### **Books Recommended:**

1. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.
2. Peau, K. (1977). Anatomy of Seed Plants, 3<sup>rd</sup> edition. John Wiley & Sons, New York.
3. Pegeri, K. And Vander Pijl (1979). The Principles of Pollination Biology, Pergamon Press, Oxford.
4. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. (1974). Plant Anatomy. Pergamon Press, USA and UK.
7. Hopkins, W.G. and Huner, P.A. (2008). Introduction to Plant Physiology. John Wiley and Sons.
8. Taiz, L. and Zeiger, E. (2006). Plant Physiology, 4<sup>th</sup> edition, Sinauer Associates Inc .MA, USA

**Bachelor of Science (Biotechnology) Semester-I**  
**(Session: 2021-22)**  
**BBTM-1074**  
**Botany-I (Practical)**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand anatomy of root, stem and leaves.

CO2: Understand structure and development of anther, male gametophyte, ovule and female gametophyte.

CO3: Understand the floral identification and descriptions.

**Bachelor of Science (Biotechnology) Semester-I**  
**(Session: 2021-22)**

**Course Code: BBTM-1074**

**Botany-I**  
**(Practical)**

**Time: 3 Hrs.**

**Max. Marks: 18**

Note. The question paper will be set by the examiner based on the syllabus

**Instructions for the paper setter:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya MahaVidyalaya, Jalandhar.

**LIST OF EXPERIMENTS**

**Plant Anatomy:**

Anatomical studies of stem, root and leaf in *Helianthus* and maize plant.

**Embryology:**

Study of the permanent slides pertaining to micro and megasporogenesis and female gametophytes and endosperms.

**Taxonomy:**

- a) Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.
- b) Identification and short morphological economic note on the specimens included in Unit IV of the theory paper.

**Bachelor of Science (Biotechnology) Semester – III**  
**(Session 2021-22)**  
**Course Code: BBTM-3074**  
**Botany-II**  
**(Theory)**

**Course outcome: -**

After passing this course the student will be able to:

CO1: Understand the plants and plant cells in relation to water

CO2: Understand the chemical contents of the plant products

CO3: Know the concept and characteristics of antiseptic, disinfectant and their mode of action.

CO4: Know the prevention and control measures of plant diseases and its effect on economy of crops.

**Bachelor of Science (Biotechnology) Semester – III  
(Session 2021-22)**

**Course Code: BBTM-3074**

**Botany-II  
(Theory)**

**Time: 3Hrs**

**Max. Marks: 60**

**Theory: 30**

**Practical: 18**

**CA: 12**

**Instructions for the Paper Setter**

Eight questions of equal marks (6 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Nutrition, Transport and Stress responses in plants:** Macronutrients and micronutrients and their deficiency symptoms; Water relations, osmosis, transpiration, water potential & its components, ascent of sap and transport of organic solutes. Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

**Unit-II**

**Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO<sub>2</sub> fixation-C3, C4 and CAM pathways.

**Unit-III**

**Plant Pathology & epidemiology:** Definitions, classification, mode of transmission & control measures of plant diseases; host-pathogen interaction, Disease resistance, phytoalexins, PR proteins. A brief account of the following plant diseases with respect to casual agents, symptoms, epidemiology and their control measures: Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi.

**Unit-IV**

**Biodiversity:** Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; Characteristics of a population; population growth curves; population regulation; Major terrestrial biomes; biogeographical zones of India.

**Suggested Readings:**

1. Salisbury, F.B. and C.W. Ross (1992), Plant Physiology, Wadsworth Publication Company
2. Taiz, L. and Zeiger, E. (2002), Plant Physiology. 3rd Edn., Sinauer Associates
3. Srivastava, H.N. (2005) Plant Physiology, Pardeep Publications.
4. Pandey, B.P. (2014) Plant Pathology, S Chand.
5. M.J. Carlile, S.C. Watkinson & G.W. Gooday (2001), The Fungi 2ndEd. Academic Press.
6. G.N. Agrios (2008), Plant Pathology 5thEd., Academic Press.
7. R.S. Mehrotra and Ashok Aggarwal (2003) Plant Pathology Tata McGraw Hill New Delhi.

**Bachelor of Science (Biotechnology) Semester- III**  
**(Session 2021-22)**  
**Course Code: BBTM-3074**  
**Botany-II**  
**(Practical)**

**Course outcome: -**

After passing this course the student will be able to develop:

CO1: Practical skill on plants and plant cells in relation to water

CO2: Know the symptoms and control measures of plant diseases and its effect on economy of crops.

**Bachelor of Science (Biotechnology) Semester- III**  
**(Session 2021-22)**  
**Course Code: BBTM-3074**  
**Botany-II**  
**(Practical)**

**Time: 3Hrs**

**Practical: 18**

**Instructions for the paper setter:** question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar

1. Estimation of relative water content of leaf.
2. Measurement of osmotic potential of different tissues by Chardakov method.
3. Demonstrate the transpiration pull by mercury method.
4. Demonstration that O<sub>2</sub> is evolved during photosynthesis.
5. Separation of pigments by paper chromatography/TLC method
6. Study of Plant pathogens (a) Symptoms of the diseases (b) Morbid anatomy of the plants infected with following diseases. Black stem rust of wheat, Loose smut of wheat, Late and early blight of potato, Red rot of sugarcane, TMV of potato, Yellow vein mosaic of bhindi.

**Suggested Readings:**

1. Salisbury, F.B. and C.W. Ross (1992), Plant Physiology, Wadsworth Publication Company
2. Taiz, L. and Zeiger, E. (2002), Plant Physiology. 3rd Edn., Sinauer Associates
3. Srivastava, H.N. (2005) Plant Physiology, Pardeep Publications.
4. Pandey, B.P. (2014) Plant Pathology, S Chand.
5. M.J. Carlile, S.C. Watkinson & G.W. Gooday (2001), The Fungi 2ndEd. Academic Press.
6. G.N. Agrios (2008), Plant Pathology 5thEd., Academic Press.
7. R.S. Mehrotra and Ashok Aggarwal (2003) Plant Pathology Tata McGraw Hill New Delhi.

**FACULTY OF LIFE SCIENCES**

**SYLLABUS**

**Of**

**Botany For**

**Bachelor of Science (Home Science)**

**Semester V**

**(Under Continuous Evaluation System)**

**(12+3 System of Education)**

**Session: 2021-22**



**The Heritage Institution**

**KANYA MAHA VIDYALAYA  
JALANDHAR  
(Autonomous)**

**Kanya Maha Vidyalaya, Jalandhar (Autonomous)**  
**SCHEME AND CURRICULLUM OF EXAMINATION OF THREE YEAR DEGREE PROGRAMME**

**Bachelor of Science (Home Science) Semester -V**  
**(Session 2021-22)**

**Botany**

| <b>Bachelor of Science (Home Science) Semester -V</b> |                                    |                    |                    |              |               |          |           |                                    |
|-------------------------------------------------------|------------------------------------|--------------------|--------------------|--------------|---------------|----------|-----------|------------------------------------|
| <b>Course Name</b>                                    | <b>Program Name</b>                | <b>Course Code</b> | <b>Course Type</b> | <b>Total</b> | <b>Marks</b>  |          |           | <b>Examination time (in Hours)</b> |
|                                                       |                                    |                    |                    |              | <b>Ext. L</b> | <b>P</b> | <b>CA</b> |                                    |
| Applied botany and home gardening                     | Bachelor of Science (Home Science) | BHSM-5077          | C                  | 100          | 50            | 30       | 20        | 3+3                                |

**Bachelor of Science (Home Science) Semester-V  
(Session 2021-22)**

**Course Code: BHSM-5077**

**APPLIED BOTANY AND HOME GARDENING  
(Theory)**

**Course outcome: -**

After passing this course the student will be able to:

CO:1 Identify different plants.

CO:2 Learn art of home gardening.

CO:3 Understand the art of soil preparation for gardening.

CO:4 Understand different means of plant propagation.

**Bachelor of Science (Home Science) Semester-V  
(Session 2021-22)**

**Course Code: BHSM-5077**

**APPLIED BOTANY AND HOME GARDENING  
(Theory)**

**Time: 3 Hrs.**

**Theory: 50**

**Instructions for the Paper Setters:**

Eight questions of equal marks (10 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

**Unit-I**

**Gardening**

Layout of a Garden

Soil preparation – digging, tillage, drainage, watering and weeding.

Manures and fertilizers

**Unit-II**

**Propagation of plants**

Seed propagation

Vegetative propagation by natural and artificial methods (Bulbs Rhizomes suckers

Runners Tubers Budding and grafting)

**Unit-III**

**Kitchen Garden**

Principle of planning and cultivation of vegetables with reference to potato tomato radish cauliflower brinjal, pea and spinach.

**Unit-IV**

**Lawn and Hedges**

Principle of planning of lawn and hedges

Brief description of care and cultivation of ornamental plants.

Care and cultivation of seasonal flowers

Care and cultivations of common indoor plants.

**General characteristics, morphology and economic importance:** algae, fungi and moulds.

**Suggested Redings:**

- 1) Basic Gardening Gemmell Alam Penguin books publication.
- 2) B. Choudhary: Vegetables (National Book of India, New Delhi 1979)
- 3) Breikell C. 1993, Step by Step Gardening Technique (Royal Horticultural Society's Encyclopedia of Practical Gardening).
- 4) Dutta A.C. Botany for Degree Students (Oxford University Press, New Delhi 1970)
- 5) Gangullee H.C. Dass, K.S. Dass, K.S. Dutta C: College Botany Vol. I (New Central Book Agency Calcutta 1991)
- 6) Gopalaswamianger K.S. 1991 Complete Gardening in India (Messers Nagaraj and Co., Madras).
- 7) H.T. Harman and D Keter: Plant Propagation, Principles and Practices (Prentice Hall of India Pvt. Ltd. New Delhi 1979).
- 8) Hind Book of Agriculture: ICAR, New Delhi 1987.
- 9) J.L. Shreemali Economic Botany (Har Anand Publication, New Delhi 1995)
- 10) O.P. Sharma: Hill's Economic Botany 2006 Tata McGraw-Hill Publishing Co. Ltd.

**Bachelor of Science (Home Science) Semester-V**  
**(Session 2021-22)**  
**Course Code: BHSM-5077(P)**

**APPLIED BOTANY AND HOME GARDENING**  
**(Practical)**

**Course outcome: -**

After passing this course the student will be able to:

CO:1 Identify different tools to be used in soil preparation.

CO:2 Understand the use of different plant parts for plant propagation.

CO:3 Maintain different plants in the garden.

CO:4 Identify ornamental plants.

**Bachelor of Science (Home Science) Semester-V**  
**(Session 2021-22)**  
**Course Code: BHSM-5077(P)**

**APPLIED BOTANY AND HOME GARDENING**  
**(Practical)**

**Time: 3 Hrs.**

**Marks: 30**

**Note: Paper will be set on the spot by the examiner.**

1. Study of garden tools and accessories.
2. Identification of different types of plants i.e. vegetable flowers, ferns and ornamental plants.
3. Preparation of soil digging tillage drainage watering and weeding.
4. To prepare and manuring a seed bed for raising seedlings.
5. To prepare a bed for sowing potatoes and cultivate them.
6. To prepare a plot for raising seedlings.
7. To prepare a pot for repotting.
8. To prepare a plot and cultivate seasonal vegetable (as in theory).
9. Plant propagation.
  - a) From seeds guiding rules for seed sowing.
  - b) Vegetative propagation by cutting and grafting.
  - c) Maintenance of plants
  - d) Use of pesticides and fungicides
  - e) Identification of slides of algae fungi and moulds.

**Project:** Prepare Herbarium file Collection of specimen of ornamental plants flower.

**Annexure (K-N)**  
**FACULTY OF LIFE SCIENCES**

**SYLLABUS**  
**Of**  
**Botany For**  
**Master of Science (Botany)**  
**Semester (I – IV)**  
**(Under Continuous Evaluation System)**

**Session: 2021-22**



**The Heritage Institution**  
**KANYA MAHA VIDYALAYA**  
**JALANDHAR**  
**(Autonomous)**

## Kanya Maha Vidyalaya, Jalandhar (Autonomous)

### SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

#### Master of Science (Botany) Semester-I Session-2021-22

| Course Code | Course Type | Course Title                             | Hours/<br>Week | Marks |      |    |    | Examination<br>time<br>(in Hours) |
|-------------|-------------|------------------------------------------|----------------|-------|------|----|----|-----------------------------------|
|             |             |                                          |                | Total | Ext. |    | CA |                                   |
|             |             |                                          |                |       | L    | P  |    |                                   |
| MBTL-1071   | C           | Fungi and Plant Pathology                | 3              | 50    | 40   | -  | 10 | 3                                 |
| MBTL-1072   | C           | Phycology                                | 3              | 50    | 40   | -  | 10 | 3                                 |
| MBTL-1073   | C           | Bryology                                 | 3              | 50    | 40   | -  | 10 | 3                                 |
| MBTL-1074   | C           | Plant Physiology                         | 3              | 50    | 40   | -  | 10 | 3                                 |
| MBTL-1075   | C           | Genetics and Evolution                   | 3              | 50    | 40   | -  | 10 | 3                                 |
| MBTL-1046   | C           | Computer Applications and Bioinformatics | 3              | 50    | 40   | -  | 10 | 3                                 |
| MBTP-1077   | C           | Botany Practicals I                      | 6              | 75    | -    | 60 | 15 | 3                                 |
| MBTP-1078   | C           | Botany Practicals II                     | 6              | 75    | -    | 60 | 15 | 3                                 |
|             |             | Total                                    |                | 450   |      |    |    |                                   |

# Kanya Maha Vidyalaya, Jalandhar (Autonomous)

## SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

### Master of Science (Botany) Semester-II

#### Session-2021-22

| Course Code | Course Type | Course Title                            | Hours/ week | Marks                          |      |    |    | Examination time (in Hours) |
|-------------|-------------|-----------------------------------------|-------------|--------------------------------|------|----|----|-----------------------------|
|             |             |                                         |             | Total                          | Ext. |    | CA |                             |
|             |             |                                         |             |                                | L    | P  |    |                             |
| MBTL-2071   | C           | Pteridology                             | 3           | 50                             | 40   | -  | 10 | 3                           |
| MBTL-2072   | C           | Diversity and Biology of Gymnosperms    | 3           | 50                             | 40   | -  | 10 | 3                           |
| MBTL-2073   | C           | General Microbiology                    | 3           | 50                             | 40   | -  | 10 | 3                           |
| MBTL-2074   | C           | Cell Biology                            | 3           | 50                             | 40   | -  | 10 | 3                           |
| MBTL-2075   | C           | Ecological Modelling and Forest Ecology | 3           | 50                             | 40   |    | 10 | 3                           |
| MBTL-2336   | C           | Theoretical Biology                     | 3           | 50                             | 40   | -  | 10 | 3                           |
| MBTP-2077   | C           | Botany Practicals I                     | 6           | 75                             | -    | 60 | 15 | 3                           |
| MBTP-2078   | C           | Botany PracticalsII                     | 6           | 75                             | -    | 60 | 15 | 3                           |
| MBTV-2079   | C           | On Job Training or Assignment           |             | Satisfactory/ Not Satisfactory |      |    |    |                             |
|             |             | Total                                   |             | 450                            |      |    |    |                             |

# Kanya Maha Vidyalaya, Jalandhar

## SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

### Master of Science (Botany) Semester-III

Session: 2021-22

| Course Code | Course Type | Course Title            | Hours/ week | Marks      |      |    |    | Examination time (in Hours) |
|-------------|-------------|-------------------------|-------------|------------|------|----|----|-----------------------------|
|             |             |                         |             | Total      | Ext. |    | CA |                             |
|             |             |                         |             |            | L    | P  |    |                             |
| MBTL-3071   | C           | Developmental Botany    | 3           | 50         | 40   | -  | 10 | 3                           |
| MBTL-3072   | C           | Plant Molecular Biology | 3           | 50         | 40   | -  | 10 | 3                           |
| MBTL-3073   | C           | Plant Breeding and IPR  | 3           | 50         | 40   | -  | 10 | 3                           |
| MBTL-3074   | C           | Plant Biochemistry      | 3           | 50         | 40   | -  | 10 | 3                           |
| MBTL-3075   | C           | Applied Botany          | 3           | 50         | 40   | -  | 10 | 3                           |
| MBTL-3076   | C           | Plant Morphogenesis     | 3           | 50         | 40   |    | 10 | 3                           |
| MBTP-3077   | C           | Botany Practicals I     | 6           | 75         | -    | 60 | 15 | 3                           |
| MBTP-3078   | C           | Botany Practicals II    | 6           | 75         | -    | 60 | 15 | 3                           |
|             |             | <b>Total</b>            |             | <b>450</b> |      |    |    |                             |

# Kanya Maha Vidyalaya, Jalandhar

## SCHEME AND CURRICULUM OF EXAMINATIONS OF TWO YEAR DEGREE PROGRAMME

### Master of Science (Botany) Semester -IV

Session: 2021-22

| Course Code      | Course Type | Course Title                               | Hours /week                    | Marks                          |      |    |    | Examination time (in Hours) |
|------------------|-------------|--------------------------------------------|--------------------------------|--------------------------------|------|----|----|-----------------------------|
|                  |             |                                            |                                | Total                          | Ext. |    | CA |                             |
|                  |             |                                            |                                |                                | L    | P  |    |                             |
| MBTL-4071        | C           | Plant Anatomy                              | 3                              | 50                             | 40   | -  | 10 | 3                           |
| MBTL-4072        | C           | Structure and Metabolism of Plant Hormones | 3                              | 50                             | 40   | -  | 10 | 3                           |
| MBTL-4073        | C           | Plant Tissue Culture and Biotechnology     | 3                              | 50                             | 40   | -  | 10 | 3                           |
| MBTL-4074        | C           | Analytical Techniques                      | 3                              | 50                             | 40   | -  | 10 | 3                           |
| MBTL-4075        | C           | Diversity and Biology of Angiosperms       | 3                              | 50                             | 40   | -  | 10 | 3                           |
| MBTL-4076(Opt-A) | C           | Hazardous Chemicals (Optional Paper)       | 3                              | 50                             | 40   |    | 10 | 3                           |
| MBTL-4076(Opt-B) | C           | Immunology (Optional Paper)                | 3                              | 50                             | 40   |    | 10 | 3                           |
| MBTP-4077        | C           | Botany Practicals I                        | 6                              | 75                             | -    | 60 | 15 | 3                           |
| MBTP-4078        | C           | Botany Practicals II                       | 4                              | 75                             | -    | 60 | 15 | 3                           |
| MBTP-4079        | C           | Field Study                                | Satisfactory/ Not Satisfactory |                                |      |    |    |                             |
| MBTP-4070        | C           | Research Techniques                        | 3                              | Satisfactory/ Not Satisfactory |      |    |    |                             |
|                  |             | Total                                      |                                | 450                            |      |    |    |                             |

Student can opt only one paper from the two optional papers (i) MBTL-4076(Opt-A) and (ii) MBTL-4076(Opt-B)

# **Semester - I**

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Program Specific Outcomes**

- PSO1.** Understand the nature and basic concepts of cell biology, biochemistry, taxonomy and ecology.
- PSO2.** Analyze the relationships among animals, plants and microbes.
- PSO3.** Perform procedures as per laboratory standards in the areas of biochemistry, bioinformatics, taxonomy, economic botany and ecology.
- PSO4.** Apply the knowledge of basic science, life Science and fundamental process of plants to study and analyze any plant form.
- PSO5.** Identify the taxonomic position of plants, formulate the research literature, and analyze non reported plants with substantiated conclusions using first principles and methods of nomenclature and classification in Botany.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Fungi and Plant Pathology**  
**MBTL-1071**

**Course outcomes**

**After passing this course the student will be able to**

**CO: 1** Explain sources of diversity in the fungal kingdom

**CO: 2** To understand the major virulence mechanisms that phytopathogens employ to colonize plants.

**CO: 3** Develop an appreciation for the strategies that can be employed to incorporate disease resistance in crop plants.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Fungi and Plant Pathology**  
**MBTL-1071**

Time: 3 hrs

Max. Marks- 50  
Theory - 40  
CA – 10

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

History, classification, study of structure, development, reproduction, life history of the following

• **GYMNOMYCOTA**

- (i) Acrasiomycetes - a general account
- (ii) Protosteliomycetes - a general account
- (iii) Myxomycetes: *Stemonitis*

• **MASTIGOMYCOTA** 1. Haplomastigomycotina

- (i) Chytridiomycetes: *Chytrium*, *Allomyces*; (ii) Hyphochytridiomycetes: *Rhizidiomyces*
- (iii) Plasmodiophomycetes: *Plasmodiophora*

2. Diplomastigomycotina (i) Oomycetes: *Pythium*, *Saprolegnia*, and *Achlya*

- **AMASTIGOMYCOTA** Zygomycotina (i) Zygomycetes: *Entomophthora* and *Pilobolus*
- (ii) Trichomycetes – a general account.

**UNIT-II**

History, classification, study of structure, development, reproduction, life history of the following:

**AMASTIGOMYCOTA** Ascomycotina (Ascomycetes)

- (i) Hemiascomycetidae: *Protomyces*
- (ii) Piectomycetidae: *Talaromyces*
- (iii) Pyrenomycetidae: *Melanospora* and *Nectria*.
- (iv) Discomycetidae: *Morchella*
- (v) Laboulbeniomycetidae: *Laboulbenia*
- (vi) Loculoascomycetidae: *Mycospharella*

**Basidiomycotina** (Basidiomycetes)

- (i) Teliomycetidae: *Ustilago* and *Puccinia*
  - (ii) Holobasidiomycetidae-I (Hymenomycetes): *Polyporus* and *Exobasidium*.
  - (iii) Holobasidiomycetidae-II (Gasteromycetes): *Lycoperdon*.
- (Deuteromycetes) (i) Hyphomycetidae: *Alternaria*, *Cercospora* and *Rhizoctonia*
- (ii) Blastomycetidae: *Sporobolomyces* and *Cryptococcus*.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**

**UNIT-III**

**Symptomatology:** Identification, etiology and control measures of the following plant disease:

**Fungal Diseases:** Potato wart, damping-off diseases, Blight of colocasia, peach leaf curl, apple scab. Wilt of cotton and arhar, Anthracnose disease of chillies, Late blight of potato, Early blight of potato, Stem rust of wheat, Loose smut of wheat, Karnal bunt of wheat, powdery mildew of bajra, White rust of crucifers, Tikka disease of groundnut.

**Bacterial Diseases:** Bacterial leaf blight of rice, ring rot of potato, citrus canker, brown rot of potato, tundu disease of wheat.

**Viral Diseases:** Papaya leaf curl, leaf curl of tomato and bunchy top of banana

**UNIT-IV**

Principles and methods for the prevention and control for plant diseases, toxins and enzymes in plant diseases, defence mechanisms of plants against pathogens, Genetics of plant pathogen interaction. Sex hormones in fungi, Heterothallism, heterokaryosis, parasexual cycle. Mycorrhizae in agriculture and plant growth, Biological control and concept of mycoherbicides.

Important contributions of the following mycologists/microbiologists: E.J. Butler, K.C. Mehta, B.B. Mundkur, Robert Koch, Alexander Flemming, S.A. Waksman, W.M. Stanley and Christian Gram. Important mycological and plant pathological journals and institutes.

**Books Recommended**

1. Agrios, G.N. (2005). Plant Pathology. 5<sup>th</sup> edition, Academic Press, New York.
2. Ainsworth, G. C. (2008). Ainsworth & Bisby's dictionary of the fungi. 10<sup>th</sup> edition, Cabi.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (2007). Introductory Mycology. 4<sup>th</sup> edition, John Wiley and sons, INC, New York.
4. Aneja, K.R. and Mehrotra, R.S. (2015). An Introduction to Mycology. 2<sup>nd</sup> edition, New Age International Private limited, New Delhi.
5. Carlile, M. J., Watkinson, S. C. and Gooday, G. W. (2001). The fungi. Gulf Professional Publishing.
6. Dube, H. C. (2013). An Introduction to Fungi, 4<sup>th</sup> Edition, Scientific Publisher, India
7. Mehrotra, R.S. (2017). Plant Pathology. 3<sup>rd</sup> edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
8. Vashista, B.R. and Sinha, A.K. (2008) Botany for degree students - Fungi. S. Chand and Company Ltd, New Delhi-pp 1-752.
9. Webster, J. and Weber, R. W. S. (2007). Introduction to Fungi. Cambridge University Press, Cambridge, London.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Phycology**  
**MBTL-1072**

**Course Outcomes**

**After passing this course the student will be able to:**

**CO: 1** Identify and classify different species of algae.

**CO: 2** Have an overview of the biology of algae.

**CO: 3** Use the study of algae to provide a basis for understanding the evolutionary pathways to higher plants.

**CO: 4** Understand the role of algae in various environments as primary producers, suppliers of nutrition and resources for humans.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Phycology**  
**MBTL-1072**

Time: 3 hrs

Max. Marks- 50  
Theory - 40  
CA – 10

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Habitat and habit, Comparative account of important system of classification (Fritsch F.E.1937 and Lee R.E.2008). Organization of thallus, structure of algal cell, algal pigments and photosynthetic apparatus. Algal flagella food reserves,

**UNIT-II**

Comparative account of, reproductive diversity, life history patterns, nutrition, origin & evolution of sex in algae Chlorophyta (*Volvox*, *Hydrodictyon*, *Cladophora*, *Fritschella*, *Oedogonium*, *Zygnema*, *Chara*). Xanthophyta (*Vaucheria*).

**UNIT-III**

Phaeophyta (*Ectocarpus*, *Laminaria*, *Dictyota*, *Fucus*), Rhodophyta (*Porphyra*, *Batrachospermum*, *Polysiphonia*).

**UNIT-IV**

Cyanophyta (*Nostoc*, *Oscillatoria*, *Rivularia*, *Stigonema*). Rhythms and bioluminescence in Dinoflagellates, economic importance of algae, bacterial and fungal pathogens of algae, algae as indicators of water pollution and algal blooms.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**

**Books Recommended**

1. Ahluwalia, A.S. (Ed.) (2003). Phycology. Daya Publishing House, New Delhi-110035
2. Anderson, R.A. (2005). Algal Culturing techniques. Physiological society of America. Elsevier Academic Press, USA.
3. Barsanti, L. and Gualtieri, P. (2014) Algae: Anatomy, Biochemistry, and Biotechnology 2<sup>nd</sup> Edition, CRC press
4. Fritsch, F.E. (1979) The structure and reproduction of algae (Vol.I and II). Vikas Publishers House Pvt. Ltd., New Delhi.
5. Kumar. H. D. (2017) Introductory Phycology, 2<sup>nd</sup> edition, East – West Press Pvt. Ltd. New Delhi.
6. Lee, R. E. (2018). Phycology. 5<sup>th</sup> edition, Cambridge University Press.
7. Vashishta, B. R., Singh, V. P. and Sinha, A. K. (2012) Botany for Degree Students – Algae S. Chand Publishing, New Delhi, India

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Bryology**  
**MBTL-1073**

**Course outcomes**

After passing this course the student will be able to:

CO1: Understand the main characteristics of bryophytes.

CO2: Identify and classify different species of bryophytes.

CO3: Describe the distinguishing traits of liverworts, hornworts, and mosses.

CO4: Understand land adaptations in the bryophytes.

CO5: Describe the events in the bryophyte lifecycle.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Bryology**  
**MBTL-1073**

Time: 3 hrs

Max. Marks- 50

Theory - 40

CA – 10

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Habitat and habit and distribution of Bryophytes, origin of bryophytes (including fossil records), primitive vs advanced/derived characters, economic importance

**UNIT-II**

Comparative morphological account of gametophytes and sporophytes and life cycle of Marchantiales (*Riccia*, *Marchantia*, *Targionia*, *Cyathodium*, *Lunularia*); Sphaerocarpaceae (*Sphaerocarpus*); Calobryales, Jungermanniales (*Porella*); Metzgeriales (*Pellia*); Anthocerotales (*Anthoceros*); Sphagnales (*Sphagnum*); Andreaeales (*Andrea*); Bryales (*Funaria*)

**UNIT-III**

Origin of land habit, Evolution of gametophyte and sporogonium in liverworts and mosses (taking examples of above mentioned orders).

**UNIT-IV**

Means of spore dispersal, peristomal teeth in mosses, palynology of Bryophytes, method to conserve Bryophytes at national level. Morphogenetic changes in moss protonema, characteristic endohydric, ectohydric, myxohydric bryophytes

**Master of Science (Botany) Semester-I**  
**Session 2021-22**

**Suggested readings:**

1. Campbell, D.R. (1985). The Evolution of Land Plants (Embryophyta) Reprinted Central Book Depot, Allahabad
2. Goffinet, B. and Shaw, A.J. (2008) Bryophyte Biology, 2<sup>nd</sup> edition, Cambridge University Press, Cambridge, pp. 476
3. Willis, K. and McElwain, J. (2014). The evolution of plants. Oxford University Press.
4. Stewart, W.N. (1983). Palaeobotany and Evolution of Plants. Cambridge University Press, London.
5. Taylor, T.N. (1981). Palaeobotany. An Introduction to Fossil Plant Biology, McGraw Hill Book Company, New York.
6. Vanderpoorten, A. and Goffinet, B. (2009). Introduction to Bryophytes. Cambridge University Press.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Plant Physiology**  
**MBTL-1074**

**Course outcomes**

**After passing this course the student will be able to:**

**CO: 1** Understand the relationship between structure and function as it relates to plant macromolecules, cells, and tissues.

**CO: 2** Understand the interaction between the environment, plant growth and development

**CO: 3** Gain an appreciation of the metabolic and physiological processes unique to plant

**CO: 4** Acquire a comprehension of plant biology from the sub cellular to the organism level.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Plant Physiology**  
**MBTL-1074**

Time: 3 hrs

Max. Marks- 50

Theory - 40

CA – 10

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Properties of water, soil-plant, water relations kinetic theory, chemical and potential gradients, Raolt's Laws, rate of diffusion free energy of water, atmospheric H<sub>2</sub>O, measurement of water potential components.

Energy metabolism (concept of the energy), thermodynamic principles in biology, energy rich bonds, weak interactions, coupled reactions and oxidative phosphorylations, group transfers, biological energy transducers, bioenergetics.

**UNIT-II**

Signal transduction: Overview, receptors and G-proteins, phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signalling mechanisms e.g. two-component sensor-regulator system in bacteria and plants, sucrose-sensing mechanism.

**UNIT-III**

Nitrogen Metabolism: Introduction, Overview of nitrogen in the biosphere and in plants, Overview of nitrogen fixation, Enzymology of nitrogen fixation, symbiotic nitrogen fixation, Ammonia uptake and transport, Overview of nitrate uptake and reduction, Nitrate reduction, Interaction between nitrate assimilation and carbon metabolism.

**UNIT-IV**

Sulphur Metabolism: Overview of sulphate assimilation, Sulphur chemistry and function, Sulphur uptake and transport, the reductive sulphate assimilation pathway, Synthesis and function of glutathione and its derivatives.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**

**Books Recommended**

1. Buchann, B.B., Gruissen, W., and Jones, R.L(2010). Biochemistry and molecular biology of plants. American society of plant physiologists, Maryland, USA
2. Nobel, P.S. (2009). Physiochemical and Environmental Plant Physiology. Academic press, San Diego, U.S. A
3. Pandey, S. N. and Sinha, B. K. (2005). Plant Physiology, 4<sup>th</sup> edition, Vikas Publication House Pvt Ltd
4. Scott, P. (2008). Physiology and Behaviour of Plants. John Wiley and Sons Ltd. England.
5. Stewart, S. and Globig, S. (2011). Plant Physiology. Apple Academic Press Inc., Canada.
6. Taiz, L., and Zeiger, E. (2010). Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts.
7. William, G., Hopkins and Norman P.A. Huner (2008). Plant Physiology. John Wiley & Sons. Inc. USA
8. Salisbury, B., Frank and Ross, W., Cleon (2004). Plants Physiology. Wadsworth, U.S.A

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Genetics and Evolution**  
**MBTL-1075**

**Course Outcomes**

**After passing this course the student will be able to**

**CO:1** Understand chemical basis of heredity.

**CO:2** Understand genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.

**CO:3** Understand the effect of broad societal issues including health and disease, food and natural resources, environmental sustainability etc.

**CO:4** Understand the role of genetic mechanisms in evolution.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Genetics and Evolution**  
**MBTL-1075**

Time: 3 hrs.

Max. Marks- 50  
Theory - 40  
CA – 10

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Fine structure of gene, classical versus molecular concept of gene, the cis-trans complementation for functional allelism; Mendelian Principles: Codominance, incomplete dominance, gene interactions, pleiotropy, penetrance, expressivity, fine structures of gene and “Complex loci” in eukaryotes, over-lapping genes; concept of split gene; pseudogenes, nucleotide sequences.

Genetic Material: - Properties and replication, proof that the genetic information is stored in DNA, the Watson - Crick Model, the double helix, alternate forms of double helix, DNA replication, initiation and primer problem, complex replication apparatus, rolling circle replication of phage  $\phi$  X174.

**UNIT-II**

Homologous chromosomes, polytene and Lampbrush chromosomes; Oncogenes, biochemistry and molecular biology of cancer, genetic disorders, Correlation between mutagenicity and carcinogenicity.

Mutations: Definition, types, detection in bacteria, *Neurospora*, maize and *Drosophila*; molecular basis of mutations; induced mutations (radiation and chemical mutagenesis), DNA repair mechanisms, DNA recombination mechanism.

**UNIT-III**

Transposable Genetic Elements: introduction, transposable elements in bacteria (Is elements, Tn 3 family), transposable elements in eukaryotes “Yeast Ty elements”, maize transposons, *Drosophila* transposons, significance of transposable elements. Somatic Crossing Over: Molecular mechanism of crossing over, gene conversion, ordered and unordered tetrad analysis, somatic cell hybridization.

Regulation of Gene Expression in Prokaryotes: The Operon model, lac, an inducible operon, trp, a repressible operon, positive control of the lac operon by CAP and CAMP, attenuation.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**

**UNIT-IV**

Polyploids: Inheritance pattern in autopolyploids (chromosome and chromatid segregation), diploidization, role of polyploidy in evolution.

Paleontology and Evolutionary History: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.

Organic evolution: Review of theories of evolution. Hardy-Weinberg law, speciation, modes of speciation (gradual and abrupt).

**Books Recommended**

1. Brown, T.A. (2017). Genomes 4, 4<sup>th</sup> edition, Garland Science, United States.
2. Griffiths, A. J., Wessler, S. R., Lewontin, R. C., Gelbart, W. M., Suzuki, D. T., & Miller, J. H. (2005). An introduction to genetic analysis. Macmillan. Freeman and Company, USA.
3. Hawley R.S. and Walker, M. Y. (2003) Advanced Genetic Analysis-Finding meaning in Genome. Blackwell Publishing, USA.
4. Klug W. S., Cummings, M. R., Spencer, C. A. and Palladino M. A. (2015). Concepts of Genetics. 11<sup>th</sup> edition, Pearson Education, London, England.
5. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2018). Lewin's GENES XII. Jones & Bartlett Learning, Burlington, Massachusetts.
6. Simmons, M. J., & Snustad, D. P. (2006). Principles of genetics. John Wiley & Sons.
7. Smith, J.M. (1998). Evolutionary Genetics. 2<sup>nd</sup> edition, Oxford University Press.
8. Watson, J. D. (2004). Molecular biology of the gene. Pearson Education India.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Computer Applications and Bioinformatics**  
**MBTL-1046**

**Course outcomes:**

A student completing this paper shall be able to apply:

CO: 1 Knowledge and awareness of the basic principles and concepts of biology, computer science and bioinformatics.

CO: 2 Existing software effectively to extract information from large databases and to use this information in computer modeling.

CO: 3 Problem-solving skills, including the ability to develop new algorithms and analysis methods.

CO: 4 An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Computer Applications and Bioinformatics**  
**MBTL-1046**

**Time: 3 hrs**

**Max. Marks-50**

**Theory -40**

**C.A- 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (08 marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

**SECTION-A**

Overview of word processing software, creating, saving and opening a new file in MS-Word, various formatting tools, paragraphs and sections, indents and outdents, creating lists and numbering, types of lists, Headings, styles, fonts and font size. Editing, positioning and viewing texts, Finding and replacing text, inserting page breaks, page numbers, book marks, symbols and dates, Inserting header, footer

**SECTION-B**

Worksheet: Introduction to worksheet, worksheet basics, building a worksheet, moving within work sheet, entering data into worksheet, saving & quitting worksheet, opening and moving around in an existing worksheet,

Working with Formulae: cell referencing, use of formulae, auto sum, copying formulae, absolute & relative addressing, working with ranges- creating, editing and selecting ranges,

Previewing & Printing Worksheet: page setting, print titles, adjusting margins, page break, headers and footers. Graphs and Charts: using wizards, various charts type, formatting grid lines & legends, previewing & printing charts.

**SECTION-C**

Introduction to MS Power Point, presentation overview, power point elements, exploring power point Menu, entering information, presentation creation. Opening and saving presentation, slide view, slide sorter view, Notes view, outline view, Printing Slides, formatting and enhancing text formatting.

Introduction to Bioinformatics, History of Bioinformatics, milestones, objectives and applications of Bioinformatics. Introduction to Biological Databases, Types of Databases, Literature Databases: PUBMED, PUBMED Central, European PUBMED Central

**SECTION-D**

Nucleic acid and protein databases: GenBank, EMBL, DDBJ, SWISSPROT, UNIPROT. Database Retrieval and Deposition Systems: SRS, Entrez, Bankit, Seqin, Webin. Biotechnological Databases: EST, SNP. Databases for species identification and classification: GBIF, taxonomy browser at NCBI. Plant Genome Databases: TAIR, Rice Genome Annotation Project, Maize GDB. Structural Databases: PDB, NDB. Carbohydrates and lipid databases: GlycoSuiteDB, LIPIDAT

**Books Recommended:**

- 1.) Baxevas B.F. and Quellette F. (2004). Bioinformatics A Practical Guide to the Analysis of Genes and Proteins. Wiley-Interscience.
- 2.) Bourhe P. E. and Weissig H. (2003). Structural Bioinformatics (Methods of Structural Analysis). Wiley-Liss.
- 3.) Eidhammer I., Jonassen I. and Taylor W. R. (2004). Protein Bioinformatics: An Algorithmic Approach to Sequence and Structure Analysis. Mathematics.
- 4) Mount D. W. (2004). Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press.
- 5) Orengo C.A., Jones D.T. and Thornton J.M. (2003). Bioinformatics: Genes Proteins and Computers. Bios Scientific Pub.
- 6) Peter Norton's (1998). Introduction to computers, Tata McGraw-Hill Publishing Company Limited, New Delhi
- 7) Sinha, P.K. (1998). Computer Fundamentals. BPB Publications, New Delhi.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Botany Practicals I**  
**MBTP-1077**

(Based on MBTL-1071, MBTL-1072, MBTL-1073)

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Characterize different disease symptoms of crop plants.

CO2: Identify pathogenic organisms responsible for plant diseases.

CO3: Perform different experiments on culturing of plant pathogens.

CO4: Understand different plant defence mechanisms against plant diseases.

CO5: Know about the history and time-scale of land plant evolution, and evaluation of the principal types of evidence underlying.

CO6: Understand algal diversity (incl. morphology, cell structure and level of organization) to phylum level, and their association as lichens.

**Master of Science (Botany) Semester-I**  
**Session 2021-22**  
**Botany Practicals I**  
**MBTP-1077**

(Based on MBTL-1071, MBTL-1072, MBTL-1073)

Time: 6 hrs

Max. Marks- 75

Practical - 60

CA – 15

**Instructions for the paper setter:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya MahaVidyalaya, Jalandhar.

**Suggested Practicals**

**Based on MBTL-1071:**

1. Principles & working of instruments in the Mycology & Plant Pathology laboratory.
2. Characterization of disease symptoms and identification of pathogenic organisms (stem rust of wheat, damping off disease, white rust of crucifers, early and late blight of potato, loose smut of wheat, wilt of cotton, tikka disease of groundnut, citrus canker, leaf curl of papaya, yellow vein mosaic of bhindi, red rot of sugarcane, anthracnose of chillies.)
3. To study type genus *Eurotium*, *Mucor*, *Peziza*, *Geastrum*, *Nidularia*, *Lycoperdon*, *Morchella*, *Agaricus*.
4. Comparative biochemical and physiological observations of healthy and infected leaves.
5. Ocular micrometry of spores of pathogenic fungi.
6. Observations on rhizosphere of infected plants.
7. Modelling for disease forecasting.
8. Studies on different defense mechanism adopted by plants against pathogenic attack.
9. Measurement of radial growth of fungi in petriplates.

**Based on MBTL-1072:**

10. Sectioning and permanent mounting of thalli of various species of Cyanophyta, Chlorophyta, Charophyta, Phaeophyta, Rhodophyta.
11. Study of diversity of freshwater and sewage water algae.
12. Preparation of synthetic media and cultivation of algae
13. Interpretation of electron micrograph of some algae.
14. Biochemical analysis of pigments present available in algal species
15. Studies on habit and habitat of various algae
16. Estimation of total carbohydrates from fresh water algae.

**Based on MBTL-1073:**

1. Morphological, reproductive and anatomical study of representative members of the bryophytes studied in theory using cleared whole mount preparation and sectioning (*Riccia*, *Marchantia*, *Porella*, *Pellia*, *Funaria*, *Sphagnum*, *Polytrichum*).
2. Studies on habit and natural habitat of bryophytes.
3. Study of Peristomal teeth (WM).
4. Study of Scales, rhizoids (WM).
5. Study of dehiscence pattern of sporogonium.

**Master of Science in Botany Semester-I**  
**Session 2021-22**  
**Botany Practicals II**  
**MBTP-1078**

(Based on MBTL-1074, MBTL-1075, MBTL-1046)

**Course outcomes:**

After passing this course the student will be able to:

CO1: understand the lab structure of cytogenetics.

CO2: perform the different types of cell division in various plants.

CO3: perform the molecular level of practicals like DNA isolation.

CO4: understand the morphology of various chromosomes and karyotype analysis.

CO5: Understand Water relation of plants with respect to various physiological processes.

CO6: Interpret the Biological nitrogen fixation in metabolism.

**Master of Science in Botany Semester-I**  
**Session 2021-22**  
**Botany Practicals II**  
**MBTP-1078**

(Based on MBTL-1074, MBTL-1075, MBTL-1046)

Time: 6 hrs

Max. Marks- 75

Practical - 60

CA – 15

**Instructions for the paper setter:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Practicals**

**Based on MBTL-1074**

1. Study on principles of pH meter, spectroscopy.
2. Studies on preparation of various concentrations of solutions.
3. Permeability observations on plasma membrane using different concentrations of organic solvents.
4. Effect of temperature on permeability of plasma membrane.
5. Preparation of standard curve of protein (e.g. BSA) and determine the protein content in unknown samples.
6. Estimation of activity of enzyme catalase.
7. Estimation the activity of enzyme glutathione reductase.
8. Determination of osmotic potential of vacuolar sap by plasmolytic method.
9. Determination of the water potential of any tuber by constant weight method.
10. Determination of the water potential of any tuber by Chardakov's dye method.
11. Separation of amino acids in a mixture by paper chromatography and their identification by comparison with standards.

**Based on MBTL-1075:**

12. Learning the cytogenetics laboratory-methods of microscopy, fixation, staining and dehydration
13. Meiotic and mitotic studies in *Allium cepa*
14. Polyploidy induction methods in laboratory organisms-treatment with colchicine
15. Studies on chromosomal aberrations in *Allium cepa*-using DDT and other pesticides
16. DNA isolation, purity and quantitative estimations.
17. Gel Scoring and data analysis
18. Demonstration of principles of Genetics in *Pisum sativum*
19. Numerical exercises on pedigree analysis, gene interactions, population genetics, chi-square & probability
20. Morphological observations in chromosomes- study on polytenic chromosomes of *Drosophila*.
21. Karyotypic analysis of laboratory Organisms-*Allium cepa*, *Vicia faba*, *Drosophila*
22. Studies of human karyotypes and genetic diseases associated.
23. Demonstration of Hardy-Weinberg Law using pea seeds.

**Based on MBTL-1046**

1. Introduction to MS Word
2. Creating Table in MS Word
3. Introduction to Page Formatting
4. Printing in MS Word
5. Page Layout
6. Creating Slide Presentation in MS PowerPoint
7. Viewing the Slideshow
8. Adding Images in MS PowerPoint
9. Inserting Sound and Videos in MS PowerPoint
10. Introduction to MS Workbook
11. Creating different worksheets in MS Excel
12. Inserting Charts in MS Excel
13. Introduction to various functions in MS Excel
14. Literature Searching Using Pubmed
15. Downloading the nucleic and Protein Sequence using Biological sequence.

# **Semester - II**

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Pteridology**  
**MBTL-2071**

**Course outcomes**

After passing this course the student will be able to:

CO1: Comprehend taxonomic and biological features of Pteridophyta.

CO2: Understand taxonomic and biological features of Pteridophyta.

CO3: Understand land adaptations of Pteridophyta.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Pteridology**  
**MBTL-2071**

**Time: 3hrs**

**Max. Marks-50**  
**Theory-40**  
**CA-10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Origin of land floras, differentiation of organs in vascular plants – telome and enation theories, significance and shortcomings. Monophyletic vs polyphyletic origin of pteridophytes, pteridophytic life cycle with reference to alternation of generations, homologous and the antithetic theories of the origin of the sporophyte.

**UNIT-II**

General characters and classification of pteridophytes, occurrence, comparative organography, systematics, reproduction and types of life cycle in: Psilophytales (*Psilophytum*), Rhyniales (*Rhynia*), Psilotales (*Psilotum*), Lycopodiales (*Lycopodium*), Selaginallales (*Selaginella*).

**UNIT-III**

Equisetales (*Equisetum*); Ophioglossales (*Ophioglossum*); Marattiales (*Marattia*); Filicales (*Pteris*, *Dryopteris*); Marsileales (*Marsilea*); Salviniaceae (*Salvinia*, *Azolla*). Evolutionary trends in pteridophytes, prothallial evolution, organization and evolution of sorus in ferns.

**UNIT-IV**

Apomictic life cycle, apogamy, apospory, heterospory and seed habit. Spore structure, pattern of spore germination in ferns, Role of polyploidy and hybridization in speciation in ferns, Utility of ferns for phytoremediation.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**

**Suggested readings:**

1. Parihar, N.S. (1992). The Biology and Morphology of Pteridophytes, Central Book
2. Rashid, A. (1999). An Introduction to Pteridophyta. 2<sup>nd</sup> edition, South Asia Books
3. Sporne, K.R. (1962). Morphology of Pteridophytes, BI Publications, New Delhi.
4. Stewart, W.N. (1983). Palaeobotany and Evolution of Plants. Cambridge University Press, London.
5. Vashishta, P.C. (2010). Botany: For Degree Students: Pteridophyta. 2<sup>nd</sup> edition, S Chand & Company, New Delhi, India.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Diversity and Biology of Gymnosperms**  
**MBTL-2072**

**Course outcomes**

After passing this course the student will be able to:

CO1: Describe general characters of gymnosperms.

CO2: Identify and classify different species of gymnosperm.

CO3: Understand the origin of gymnosperms and their distribution on earth surface.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Diversity and Biology of Gymnosperms**  
**MBTL-2072**

**Time: 3hrs**

**Max. Marks-50**  
**Theory-40**  
**CA-10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Gymnosperms, the first seed plants, diversity of structure and complexity. Classification of gymnosperms and their distribution in India and in the globe in time and space. Geological time scale and important geological formations in India

**UNIT-II**

Morphology, general account, structure and reproduction of Progymnosperms (Aneurophytales, Archeopteridales etc.): Cycadofilicales, Glossopteridales, Pentoxylales, Cordaitales,

**UNIT-III**

Morphology, general account, structure and reproduction of Cycadeoidales, Cycadales, Ginkgoales, Coniferales, Taxales, Ephedrales, Welwitschiales and Gnetales.

**UNIT-IV**

Evolutionary tendencies in gymnosperm organography and life cycle with particular reference to male and female sporophylls, cones, ovules, pollination mechanisms, seeds and archegonia. Cytology of Gymnosperms, general survey of the cytology of gymnosperms.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**

**Suggested readings:**

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New age International, Private Limited.
2. Biswas, C. and Johri, B.M. (1997). Gymnosperms. Narosa Publishing House, New Delhi.
3. Rothwell, G.W. The Role of Comparative Morphology and Anatomy in Interpreting the Systematics of Fossil Gymnosperms, Bot. Rev., 51: 318-327, 1985.
4. Sharma, O.P. (2017). Gymnosperms. XIV edition, Pragati Prakashan, Meerut, India.
5. Sporne, K.R. The Morphology of Gymnosperms, B. I. Publications, Delhi, 1974.
6. Vashishta, P.C., Sinha, A.K. and Kumar, A. (2013). Botany for Degree Students-Gymnosperms, S. Chand & Company Ltd., New Delhi, India.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**General Microbiology**  
**MBTL-2073**

**Course outcomes**

After passing this course the student will be able to:

CO1: Learn about classification, characteristics, ultrastructure of Prokaryotic and Eukaryotic microbes

CO2: Know about organisms and causal factors responsible for plant diseases & methods of studying plant diseases

CO3: Familiarize with some common plant diseases of India

CO4: Gain knowledge on host parasite interaction process

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**General Microbiology**  
**MBTL-2073**

**Time: 3hrs**

**Max. Marks-50**  
**Theory-40**  
**CA-10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Methods in Microbiology: Basic principles of microscopy, micrometry, staining, sterilization methods; culture media, pure culture methods. 2. Classification of bacteria (Bergey's system) characteristics of each group, Nutrition of bacteria, nature of virulence, toxins and extracellular enzymes of pathogenic bacteria, conjugation, transformation and transduction.

**UNIT-II**

Nomenclature and classification of plant viruses, transmission of plant viruses with control measures, Viroids and origin of viruses, morphology and nature of virus particles, infection and replication with reference to TMV and bacteriophage, viral disease with special reference to encephalitis, hepatitis, AIDS, rabies, foot and mouth disease.

**UNIT-III**

Environmental Microbiology: Sewage (waste water) treatment: Ecological impact of raw sewage on receiving water, public health impact of raw sewage discharge. Primary, Secondary and tertiary waste water treatments. Total coliform bacteria analysis, Fecal coliform bacteria analysis in drinking water. Landfills, composting. Bioremediation: Biodegradative organisms, advantages of bioremediations, problem associated with bioremediation, methodology of bioremediation. Aeromicrobiology: Important airborne plant, animal and human pathogens, important airborne toxins, nature of bioaerosols aeromicrobiological pathways, sampling devices for the collection of bioaerosols.

## UNIT-IV

Industrial Microbiology: The Microbe: Primary and secondary metabolites, major industrial products: foods, flavoring agents and food supplement, vitamins and beverages; organic acids; enzymes and microbial transformation; inhibitors; genetically engineered microorganisms – Human insulin and human growth hormones and vaccines Control of Microorganisms by Physical and Chemical Means: Fundamentals of control, physical agents, high temperature, low temperature, desiccation, osmotic pressure, radiation, surface tension and interfacial tension, filtration, characterization of an ideal antimicrobial chemical agent, selection of a chemical agent for practical application, major groups of antimicrobial agents.

### Suggested readings:

1. Cowan, M. K. (2018). Microbiology: a systems approach. McGraw-Hill.
2. Pelczar M. J., Chan E. C. S. and Krieg N. R. (2001). Microbiology. 5th edition. McGraw Hill Book Company.
3. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., and Painter, P. R. (2005). General Microbiology. 5th edition. McMillan.
4. Tortora, G. J., Funke, B. R. and Case, C. L. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
5. Willey J. M., Sherwood, L. M., and Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Cell Biology**  
**MBTL-2074**

**Course outcomes**

After passing this course the student will be able to:

CO1: Learn about structural organization and function of intracellular organelles.

CO2: Gain knowledge on the organization of genes and chromosomes.

CO3: Study about the structure of atoms, molecules and chemical bonds & Composition, structure and function of biomolecules.

CO4: Gain knowledge on cellular communication & cell signaling

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Cell Biology**  
**MBTL-2074**

**Time: 3hrs**

**Max. Marks-50**  
**Theory-40**  
**CA-10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Levels of Structural Organization: Unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems; comparative anatomy. Membrane Structure and Function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

**UNIT-II**

Structural Organization and Function of Cell wall and Intracellular Organelles: nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Organization of Genes and Chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

**UNIT-III**

Cell division and Cell Cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Microbial Physiology: Growth, yield and characteristics, strategies of cell division, stress response Cell Signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.

**UNIT-IV**

Bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing. Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**

**Suggested readings:**

1. Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Lewis, J., Raff, M. and Walter, P. (2013). Essential cell biology. Garland Science.
2. Becker, W.M., Kleinsmith, L.J. and Hardin, J. (2000). The World of the Cell. The Benjamin/Cummings Publishing Company.
3. Clark, D. P. (2009). Molecular Biology: Academic Cell Update Edition. Academic Press.
4. Cooper, G.M. (2000). The Cell – A Molecular Approach. ASM Press, Washington, D.C.
5. Karp, G., Iwasa, J. and Marshall, W. (2015). Cell and Molecular Biology: Concepts and Experiments. 8<sup>th</sup> edition. John Wiley & Sons Inc., New York.
6. Karp, G., Iwasa, J. and Marshall, W. (2018). Karp's Cell Biology Global Edition. John Wiley & Sons Inc., New York.
7. Lodish, H., Darnell, J. E., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P. and Matsudaira, P. (2008). Molecular cell biology. Macmillan.
8. Pollard, T.D. and Ernshaw, W.C. (2002). Cell Biology. Elsevier Science (USA)

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Ecological Modelling and Forest Ecology**  
**MBTL-2075**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand the importance of Ecological models in simulating and analyzing the long-term dynamics and stability properties of complex ecological systems.

CO2: Integrate information from different disciplines.

CO3: Understand different Environmental Law & Policy.

CO4: Understand the distribution of vegetation with respect to environment.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Ecological Modelling and Forest Ecology**  
**MBTL-2075**

**Time: 3hrs**

**Max. Marks-50**  
**Theory-40**  
**CA-10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Exponential Population Growth: Differential equations, finite rate of increase, intrinsic rate of natural increase, stable age distribution, matrix model for population growth. Logistic Population Growth: Differential model for population growth in limited environment. Interaction Between Two Species: Competition – Differential equations, Leslie-Gower Model, Lotka-Volterra model for predator – prey interaction, Leslie model, simple epidemics.

**UNIT-II**

Association Analysis and Community Classification: Chisquare, Cole's measures and point correlation coefficient for association, continuum concept. Species Diversity: Species area relationships, species abundance relationships – information measures of diversity. Brillouin's measure, Shannon-Weaver measure, Simpson's measure. Extinction and formation of single populations, McArthur – Wilson theory of biogeography.

**UNIT-III**

Production and Energy Flow: Production in animal populations, efficiency, measurement of ingestion. measurement of production in plants, litter decomposition. Forest types, climatic region of India, Central, characters and distribution of different forest type of India, Salient features of Indian forest act 1972, different methods employed for conservation of forest, Social and urban forest.

**UNIT-IV**

Environmental Law & Policy: Constitutional provisions, Water (prevention and control of pollution) Act, 1974; Air (prevention and control of pollution) Act, 1981; Environment Protection Act, 1986; Forest (Conservation) Act, 1980; Wildlife (Protection) Act, 1972; the concept of biosphere reserves, International environmental perspectives.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**

**Suggested readings:**

1. Barbour, M.G., Burk, J.H. and Pitts, W.D. (1998). Terrestrial Plan Ecology, 3<sup>rd</sup> edition, Benjamin/Cummings Publication Company, California.
2. Begon, M., Townsend, C. R., & Harper, J. L. (2006). Ecology: from individuals to ecosystems (No. Sirsi) i9781405111171).
3. Chapman, J.L. and Reiss, M.J. (1998). Ecology: Principles and Applications, 2<sup>nd</sup> edition, Cambridge University Press, Cambridge.
4. De, A.K. (1990). Environmental Chemistry. Wiley Eastern Pvt. Ltd., New Delhi.
5. Hapke, A. (2017). Forest Ecology. Callisto Reference
6. Hill, M.K. (1997). Understanding Environmental Pollution. Cambridge University Press, Cambridge.
7. Kimmins, J. P. (2004). Forest Ecology: A foundation for sustainable forest management and environmental ethics in forestry. Prentice Hall.
8. Kormondy, E.J. (1996). Concepts of Ecology. 4<sup>th</sup> edition, Prentice Hall of India Pvt. Ltd., New Delhi.
9. Schulze, E-D., Beck, E. and Müller-Hohenstein, K. (2005). Plant Ecology. Springer-Verlag Berlin Heidelberg

**Master of Science (Botany) Semester–II**  
**Session: 2021-22**  
**Theoretical Biology**  
**MBTL-2336**

**Course outcomes**

After the successful completion of this subject, the students should be able to:

CO 1: Understand linear function, power function and periodic function.

CO 2: Recognize algebraic, exponential, logarithmic function and will come to know how to calculate their differentiation and apply derivatives of sum, difference, product and quotient of two functions.

CO 3: Recognize Integration as an inverse of differentiation and to calculate area under curve and understand integrals as limit of sum and its geometrical interpretation.

CO 4: Understand the concept of mathematical expectation and use it to find out the mean, variance, standard deviation, kurtosis etc. of normal probability distribution.

CO 5: Use Correlation to identify the strength and direction of a linear relationship between two variables and using Regression to predict how much a dependent variable changes based on adjustments to an independent variable and also apply Karl Pearson Correlation coefficient and Spearman's Rank Correlation and Least Square technique for Regression lines.

CO 6: Manage to solve problems using t and Chi-Square test.

**Master of Science (Botany) Semester–II**

**Session: 2021-22**

**Course Title: Theoretical Biology**

**Course Code: MBTL-2336**

Time: 3 Hours

Max. Marks: 50

Theory: 40

CA: 10

**Instructions for the Paper Setters:**

Eight questions of equal marks (08 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The question paper must contain 30% of the article/theory from the syllabus.

The students can use only Non Programmable & Non Storage Type Calculator and statistical tables.

**UNIT-I**

1. Linear Function:  $y=ax$  and  $y=ax+b$
2. Power Function:  $y=ax^n$ .
3. Sine and cosine, trigonometric relations.
4. Exponential and Logarithmic Functions: Exponential function  $y=aq^x$ , logarithmic function.

**UNIT-II**

5. Differentiation and Integration: differentiation of some important functions (Linear function, Power function, Logarithmic, Exponential, Trigonometric functions), product rule and quotient rule of differentiation, chain rule of differentiation.
6. Integration: Rules of integration (Linear function, Power function, Logarithmic, Exponential, Trigonometric Functions), integration by substitution, integration of product of two functions.

**UNIT-III**

7. Probability: Random experiment, sample space events, mathematical definition of probability, addition and multiplication law of probability.

**UNIT-IV**

8. Statistics: Mean, standard deviation, Normal Distribution, Simple linear regression and correlation.
9. Hypothesis testing: Sample Statistics and parameters, standard error, Z-test, t-test as a test of single mean, chi square test as a goodness of fit and association of attributes (For uniformity, ratio and proportion)

**Master of Science (Botany) Semester-II**  
**Session 2021-22**

**Text Books:**

1. Hussain I. et. al. Mathematics, A textbook for class XI, NCERT.
2. Joshi, D.D. et. al. Mathematics, A textbook for class XII, NCERT.
3. S.C Gupta, V.K Kapoor, Fundamentals of Mathematical Statistics

**Reference Books:**

1. Batschelet, E. (1971). Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin.  
2<sup>nd</sup> edition
2. Ludwig, J and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons, New York.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Botany Practicals I**  
**MBTL-2077**  
(Based on MBTL-2071, MBTL-2072 and MBTL-2073)

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Understand Morphological, reproductive and anatomical structures of plants.

CO2: Understand wood anatomy of gymnosperms.

CO3: Perform different experiments based on microorganisms.

CO4: Culture microorganisms on different media and their future potential.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Botany Practicals I**  
**MBTL-2077**  
(Based on MBTL-2071, MBTL-2072 and MBTL-2073)

**Time: 6 hrs**

**Max. Marks-75**  
**Theory-60**  
**CA-15**

**Instructions for the paper setter:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Practicals**

**Based on MBTL-2071:**

1. Morphological, reproductive and anatomical study of representative members of the pteridophytes studied in theory using cleared whole mount preparation and sectioning (*Selaginella*, *Lycopodium*, *Equisetum*, *Pteris*, *Dryopteris*, *Marselia*, *Salvinia*).
2. Studies on habit and natural habitat of pteridophytes.
3. Study of spore morphology.
4. Study of spore germination on Knop's medium.

**Based on MBTL-2072:**

1. Study of morphology, structure and reproduction in *Cycas*, *Pinus*, *Cedrus*, *Ginkgo*, *Ephedra*, *Taxus*, *Podocarpus*, *Gnetum*.
2. Study of fossils: *Williamsonia*.
3. Understanding wood anatomy using T.S, T.L.S and R.L.S in *Pinus* and *Cedrus*.
4. Study of secondary growth in stem and root.

**Based on MBTL-2073:**

1. Acquaintance with working, principle, parts and precautions of most commonly used instruments in a microbiology lab.
2. Calibration of microscope: determination of dimensions of microorganisms.
3. Acclimatization with aseptic techniques-sterilization, preparation and cultivation media for bacteria.
4. To prepare temporary and permanent cotton plugs.
5. To prepare solid and liquid culture media.
6. To culture or cultivate bacteria.
7. To stain and study bacteria.
8. To measure bacterial cells through ocular micrometry.
9. Microscopic examination of milk and curd.
10. To isolate micro-organisms from mixed culture and grow a pure culture.

11. Isolation of microbes from soil sample by streaking method.
12. Isolation of microorganisms from given water sample by serial dilution.
13. Methylene blue reduction test for examining the microbial activity of milk.
14. To study radial growth of fungi on nutrient media.
15. To determine antibiotic staining of bacterial strain.
16. Demonstration of Lambert Beer's law by colorimeter.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Botany Practicals II**  
**MBTL-2078**  
(Based on MBTL-2074, MBTL-2075 and MBTL-2336)

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Understand structures of various cell organelles.

CO2: Examine cell divisions in plant cells.

CO3: Perform different experiments based on plant ecology.

CO4: Analyze nutrients and pigment contents in plants using various techniques.

**Master of Science (Botany) Semester-II**  
**Session 2021-22**  
**Botany Practicals II**  
**MBTL-2078**  
(Based on MBTL-2074, MBTL-2075 and MBTL-2336)

**Time: 6 hrs**

**Max. Marks-75**  
**Theory-60**  
**CA-15**

**Instructions for the paper setter:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Practicals**

**Based on MBTL-2074:**

1. Understanding the cytology laboratory- components of compound/electron microscope.
2. Examination of electron micrographs of eukaryotic cells with special reference to organelles.
3. Examination of various stages of mitosis and meiosis using appropriate plants material (e.g. onion root tips, onion flower buds).
4. Calculation of Mitotic and meiotic index from dividing root tip cells and pollen grains.
5. Study on cyclosis in *Tradescantia* and *Hydrilla* leaves.
6. Observations on Barr bodies in Squamous epithelium.
7. Preparation of Feulgen stained chromosomes in root tip cells.
8. Effect of colchicine on chromosome movements during mitosis.
9. Use of fluorescent dye to visualize cell components.

**Based on MBTL-2075:**

1. To determine minimum size and number of quadrats required for reliable estimate of biomass in grassland.
2. To find out association between grassland species using chi square test.
3. To analyse plant communities using Bray-Curtis ordination method.
4. To determine soil moisture content, porosity, bulk density of different soil samples collected from different locations.
5. To study chlorophyll content of SO<sub>2</sub> fumigated and unfumigated plant leaves.
6. To determine Na, K concentration of water sample using flame photometer.
7. To determine water holding capacity of different soil samples.
8. To determine percent organic Carbon and organic matter in different soil samples.
9. To estimate chlorophyll content in SO<sub>2</sub> fumigated and unfumigated plant leaves.
10. To estimate rate of CO<sub>2</sub> evolution from different soil using soda lime or alkali absorption method.
11. To determine sulphate content of water samples.
12. To determine O<sub>2</sub> content of water samples.

# **Semester - III**

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Developmental Botany**  
**MBTL-3071**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Know the structure and development of monocot and dicot embryos.

CO2: Compare the function and morphology of pollen grains.

CO3: Understand different aspects of embryology.

CO4: Understand role of Embryology in Plant Breeding.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Developmental Botany**  
**MBTL-3071**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**Unit-I**

**Pollination:**

Ultrastructural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen-pistil interaction, role of pollen pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, methods of overcoming incompatibilities, intra-ovarian pollination, in vitro pollination.

**Unit-II**

**Fertilization:**

Heterospermy, differential behaviour of male gametes, discharge and movement of sperms, syngamy and triple fusion, post fertilization metabolic and structural changes in embryo sac.

**Endosperm:**

Types, ultrastructure, cellularization in nuclear endosperm, endosperm haustoria, their extension and persistence, function, storage, metabolites, endosperm culture.

**Unit-III**

**Embryo:**

Polarization of zygote, embryogenic types, histology and organogenesis of dicotembryos, organelles (undifferentiated) embryos, delayed and differentiation of embryo, structure, cytology and function of suspensor, physiological and morphogenetical relationship of endosperm and embryo, embryo culture for rescue of hybrid embryo. Polyembryony: Types, genetic and somatic, pollen embryos.

**Apomixis:**

Apospory, Parthenogenetic Development of Embryo, Importance. Seed: Growth and Development, Seed Appendages.

**Master of Science (Botany) Semester-III  
(Session 2021-22)**

**Unit-IV**

**Embryology & Taxonomy:**

Diagnostic embryological characters, Primitive and advanced characters, Role of embryology and palynology in taxonomy.

**Role of Embryology in Plant Breeding:**

Embryology of hybrids, disfunction of endosperm, arrested development of embryo.

**Books Recommended**

1. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd, Delhi.
2. Dafni, A., Hesse, M., and Pacini, E. (2012). Pollen and pollination. Springer Science & Business Media.
3. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co.Ltd. Bombay.
4. Grossniklaus. U. (2019). Plant Development and Evolution. Academic Press
5. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Company Ltd. Bombay – New Delhi.
6. Parihar NS (1993) An Introduction to Embryophyta: Vol I – Bryophyta, Vol II – Pteridophyta, Central Book Dept. Allahabad.
7. Raghavan, V. (2012). Developmental biology of flowering plants. Springer Science & Business Media.
8. Raghavan, V. (1997). Molecular embryology of flowering plants. Cambridge University Press.
9. Shivanna KR (2003) Pollen Biology and Biotechnology, Science Publisher
10. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., New York.
11. Timmermans M. C.P. (2010). Plant Development. Academic press.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Molecular Biology**  
**MBTL – 3072**

**Course outcomes:**

After passing this course the student will be able to:

CO1: exhibit a knowledge base in genetics, cell and molecular biology.

CO2: understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

CO3: Exhibit clear and concise communication of scientific data

CO4: understand different techniques related to molecular biology.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Molecular Biology**  
**MBTL – 3072**

**Time: 3 hrs**

**Max. Marks- 50**

**Theory - 40**

**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**Unit-I**

The Law of DNA constancy and C-value paradox, DNA sequencing. Organization of transcriptional units; mechanism of transcription of prokaryotes and eukaryotes; RNA processing (capping polyadenylation, splicing, introns and exons); ribonucleo–proteins, structure of mRNA.

**Unit-II**

Recombinant DNA technology, host cell restriction, restriction endonucleases, DNA ligases, topoisomerases, gyrases and methylases. Cloning strategies, selection and screening of recombinant clones, genomic DNA and cDNA libraries, biological and physical containment of recombinant DNA clones. Agarose gel electrophoresis, Southern/Northern/ Western blotting.

**Unit-III**

Cloning vehicles, plasmids, bacteriophages, viruses, cosmids, Ti-plasmid, CaMv plasmid, construction of plasmid vectors, M13 vectors, their use in cloning and sequencing, expression vectors, lysogeny and lytic cycles in bacteriophages.

**Unit-IV**

Genetic colonization of plants by Agrobacterium infection and tumour growth, Ti – plasmids, neoplastic transformation of plant cells, organization of T-DNA, nucleotide sequences of T-DNA. PCR, DNA fingerprinting by RAPDs and RFLPs.

Genomics and proteomics: Genetics and physical mapping of genes, molecular markers for transgenic plants, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

**Master of Science (Botany) Semester-III  
(Session 2021-22)**

**Books Recommended**

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertonni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNATechnology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
5. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
6. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani Publishers, Delhi
7. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008)
8. Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Breeding and IPR**  
**MBTL –3073**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand historical evolution of plant breeding and different centers of origin.

CO2: Understand sources and types of genetic variation and explain their importance for plant improvement.

CO3: Describe methods that are used in plant breeding.

CO4: Understand IPR (Intellectual property right)

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Breeding and IPR**  
**MBTL –3073**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**Unit-I**

Primary and secondary centres of diversity, utilization of wild plants in crop improvement, introduction and domestication as methods of plant breeding.

Types and introduction, vegetative sexual and apomictic, their effects on generating and fixing genotypic variation, male sterility and self-incompatibility mechanisms.

**Unit-II**

Breeding systems of crop species; systems of mating in sexually reproducing species and their genetic consequences. Breeding methods for self and cross pollinated crops; pureline and mass selection, recurrent selection and clonal selection.

Hybridization in self and cross pollinated crops. Inbreeding depression and hybrid vigor, genetic and physiological basis of heterosis, hybrid varieties, synthetic and composite varieties.

**Unit-III**

Breeding for disease resistance, classification of resistance, responses of the host to pathogens, variability systems of pathogenic fungi, breeding disease resistant varieties; multiline varieties.

Heritability, genetic advance, correlation of characters, path analysis, multiple comparison test, discriminant function and cluster analysis.

**Unit-IV**

Mutations, aneuploidy and polyploidy as methods of plant improvement, interspecific and intergeneric hybrids, role of genetic engineering.

Intellectual Property Rights: (IPR/TRIPS), International Intellectual Property System; Plant Variety Protection; the regular patent systems, trade secrecy, biosafety; laws and conventions related to intellectual property rights.

**Master of Science (Botany) Semester-III  
(Session 2021-22)**

**Books Recommended**

1. Agrawal, R.L. (1998). Fundamentals of Plant Breeding and Hybrid Seed Production Oxford and IBM Publ. Co. Pvt. Ltd., New Delhi.
2. Allard, R. W. (1981), Principles of Plant Breeding. John Wiley & Sons, N. York.
3. Anonymous (1997). National Gene Bank: Indian Heritage on Plant Genetic Resources(Booklet). National Bureau of Plant Genetic Resources, New Delhi.
4. Bhandari, M.M. (1974). Practicals in Plant Breeding. A Manual cum practical record. Oxford and IBH Publ. Co. New Delhi.
5. Chopra, V.L. (Ed.) (2018). Plant Breeding: Theory and Practice. Oxfordand IBH Publ. Co. Pvt. Ltd., New Delhi.
6. Gupta SK. 2005. Practical Plant Breeding. Agribios
7. Poehlman, J.M. and Sleper, D.A. (1995). Breeding Field Crops (4th Edition) Panima Publishing Corporation, New Delhi.
8. Priyadarshan, P.M. (2019). Plant Breeding: Classical to Modern. Springer Singapore
9. Raghuvanshi, R.K., Chauhan, A.K.S and Sidhigui, B.A. (1995). Practical Excercises in Cytology, Genetics, Plant Breeding and Biostatistics (1st Edition). CBS Publishers and Distributors, New Delhi.
10. Roy Darbeshwar (2000). Plant Breeding - Analysis and Exploitation of Variation.Narosa Publishing House, New Delhi.
11. Sharma A.K. and Sharma A. (1999). Plant Breeding. Lecture Notes on Patents November 1999). Technology Information, Forecasting and Assessment Council(TIFAC), Department of Science and Technology(DST), Technology Bhavan, New Mehrouli Road, New Delhi.
12. Sharma, J.R. (1994). Principles and Practice of Plant Breeding, Tata McGraw Hill Publ.Comp. Ltd., New Delhi.
13. Singh, B.D. (2005), Plant Breeding - Principles and Methods, KalyaniPublishers,Ludhiana.
14. Singh, S.andPawar, I. S. 2006. Genetic Bases and Methods of Plant Breeding. CBS Publishers & Distributors
15. Stoskopf, N. C., Tomes, D. T., Christie, B. R., & Christie, B. R. (2019). Plant breeding: theory and practice. CRC Press.
16. Sundararaj, D.D. and Tulsidas G. (1993). Botany of Field Crops (2nd Edition), MacMillan India Ltd., New Delhi.
17. Vijendra Das L.D (1998). Plant Breeding. New Age International Publishers, New Delhi.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Biochemistry**  
**MBTL – 3074**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand cellular chemistry, its plant specific components.

CO2: Understand metabolism of lipids and carbohydrates.

CO3: Describe structure, functions and the mechanisms of action of enzymes.

CO4: Learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Biochemistry**  
**MBTL – 3074**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**Unit-I**

**Cellular Chemistry:** Covalent and non-covalent interactions, hydrogen bond, electrostatic interactions, hydrophobic interactions, Van der Waals forces and their significance, structure and properties of water and its biological significance, pH and its significance, pH scale, Henderson-Hasselbach equation, buffers (inorganic and organic) and their importance, ATP-the energy currency, phosphorylation / dephosphorylation of proteins.

**Unit-II**

**Metabolism of Carbohydrates:** Overview of intermediary metabolism, carbohydrates and lipids of physiologic significance, glycolysis and oxidation of pyruvate, citric acid cycle, catabolism of acetyl- CoA, metabolism of glycogen, gluconeogenesis and control of the blood glucose, pentose phosphate pathway and other pathways of hexose metabolism like uronic acid fructose metabolism pathways.

**Unit-III**

**Lipid Metabolism:** Biosynthesis of fatty acids, oxidation of fatty acids, ketogenesis, metabolism of fatty acids, ketogenesis, metabolism of acylglycerols and sphingolipids, lipid transport and storage, cholesterol, synthesis, transport and excretion, integration of metabolism and provision of tissue fuels.

**Unit-IV**

**Enzymology:** Introduction to enzymology, history of enzymes, nomenclature and classification. Specificity of enzymes: group specificity, absolute specificity, stereochemical specificity. Mechanism of enzyme catalysis: Activation energy, Nature of active sites, enzyme-substrate complex, induced fit hypothesis, strain and distortion theory.

**Enzyme Kinetics:** Michaelis-Menton Equation, Lineweaver-Burk plot. Regulation of enzyme activity and concentration: Brief account of enzyme induction and repression, covalent modification, isoenzymes and allosteric enzymes

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**

**Books Recommended**

1. Bowsher, C., Steer, M., & Tobin, A. (2008). Plant biochemistry. Garland Science.
2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). Biochemistry and molecular biology of plants. John Wiley & Sons.
3. Heldt, H. W., and Piechulla, B. (2010). Plant biochemistry. Academic Press.
4. Lubert, S., Berg, J., Tymoczko, J, and Gatto, G. (2019). Biochemistry, ninth edition. Macmillan Publishers.
5. Murray, R. K., Granner, D. K., Mayes, P. A., and Rodwell, V. W. (2014). Harper's illustrated biochemistry. McGraw-hill.
6. Nelson, D. L., Lehninger, A. L., and Cox, M. M. (2017). Lehninger principles of biochemistry. Seventh Edition. Macmillan.
7. Voet, D., Voet, J. G., & Pratt, C. W. (2018). Principles of biochemistry, 5<sup>th</sup> Edition, Global Edition. John Wiley & Sons.
8. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of biochemistry: life at the molecular level. John Wiley & Sons.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Applied Botany**  
**MBTL – 3075**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Demonstrate knowledge of the value of plants in our everyday lives

CO2: Identify and describe the impact of economic botany on the environment and society.

CO3: Understand commercial use of different forest products.

CO4: Demonstrate the ability to interpret scientific data and employ critical thinking to solve problems in applied botany.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Applied Botany**  
**MBTL – 3075**

**Time: 3 hrs**

**Max. Marks- 50**

**Theory – 40**

**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**Unit-I**

**Food Plants:** History and nature of food plants, major and minor cereals, legumes and pulses, vegetables, fruits and nuts. Extraction of sugar from sugarcane. Flow diagram of the process with a critical study of the steps involved, problems faced by the sugar industry in India. By-products of sugar industry, distillation of alcohol and other products with special reference to distilleries in Punjab. Food adjuncts: Spices condiments and other flavoring agents, beverages, fumitory and masticatory materials; functional foods.

**Unit-II**

**Forest Products:** Wood & Oak. Physical characteristics of Indian woods, methods of seasoning and chemical treatment of specialized use, fireproofing of the wood. Industrial manufacturing of packing material and plywood and the classifications of plywoods according to their use. Some important commercial woods: *Dalbergia spp.*, *Shorea robusta*, *Tectona grandis*, *Cedrus deodara*, Bamboo-the ‘greengold’ of India.

**Unit-III**

**Industrial Plant Products:** Essential oil yielding plants of India, their use in perfumery, vegetable oils, fats and waxes, starches and other cellulose products. Manufacturing of paper and board from raw plant material. Manufacturing of crude and high quality paper, recycled paper; bio fuel producing plants.

**Fibres:** Different types of fibre yielding plants, classification of fibres, physical and chemical processes involved in the manufacturing of fibre.

**Unit-IV**

**Rubber and Latex Products:** The Rubber Plants of India, latex yielding plants, Extraction of Raw Rubber and its Chemical Processing for the Manufacturing of Finished Rubber. Sources of gums and resins and their classifications according to their chemical nature. Extraction of the raw resin and down the line processing for turpentine and other products. Sources of natural dyes and tannins in India and their extraction methods, merits and limitations of plant based dyes.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**

**Books Recommended**

1. Ambasta, S. P. (1994). The Useful Plants of India (3rd Ed.). Publications & Information Directorate, New Delhi.
2. Brown, H. P. (1989). An Elementary Manual on Indian Wood Technology (Reprinted). International Book Distributors, Dehra Dun, India.
3. Joshi, S. G. (2000). Medicinal Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Kochhar, S. L. (1998). Economic Botany in the Tropics. MacMillan India Limited, Delhi.
5. Pandey, B. P. (1984). Economic Botany (3rd Ed.). S. Chand & Company Ltd., New Delhi.
6. Seidemann, J. (2005). World spice plants: economic usage, botany, taxonomy. Springer Science & Business Media.
7. Trotter, H. (1982). The Common Commercial Timbers of India and Their Uses. The Controller of Publications, Delhi.
8. Wickens, G.E. (2004) Economic Botany: Principles and Practices, Springer, ISBN 978-0-7923-6781-9.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Morphogenesis**  
**MBTL – 3076**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Learn about morphogenesis and organogenesis in plants.

CO2: Understand basic principles in plant development.

CO3: Read plant development biology literature.

CO4: Understand different factors affecting plant morphogenesis.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Plant Morphogenesis**  
**MBTL – 3076**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**Unit-I**

**Correlation:** Physiological and genetic correlations.

**Polarity:** Polarity as expressed in external and internal structures, polarity in isolated cells, polarity in plasmodia and coenocytes, physiological manifestations of polarity, developmental patterns.

**Unit-II**

**Symmetry:** Inorganic and organic symmetries, radial symmetry bilateral symmetry, dorsi-ventral symmetry, development of symmetry.

**Differentiation:** Growth and differentiation, differentiation as expressed in structure, external and internal differentiation, differentiation during ontogeny, differentiation in relation to environment, physiological differentiation, differentiation without growth.

**Unit-III**

**Regeneration:** Regeneration in lower plants, regeneration in higher plants, reconstitution, restoration, reproductive regeneration.

**Tissue Mixtures:** Stock – scion interrelations, chimeras, somatic mutations.

**Unit-IV**

**Abnormal Growth:** Abnormal development of organs, production of new types of organized structures, amorphous structures.

**Morphogenetic Factors:** Introduction to factors-light, water temperature, physical factors, genetic factors and chemical factors in general.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**

**Books Recommended**

1. Ainsworth C (2006) Flowering and its Manipulation, Annual Plant Reviews, Vol. 20. Blackwell Publishing, Oxford, U.K.
2. Brown TA. (2002) Genomes, BIOS Scientific Publishers Ltd, Oxford, UK.
3. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd, Delhi.
4. Davies, J. (2013). Mechanisms of morphogenesis. Academic Press.
5. Eames, A.J. (1961) Morphology of the Angiosperms. Tata McGraw Hill Publishing Co. Ltd. Bombay.
6. Lyndon, R. F. (2012). Plant development: the cellular basis (Vol. 3). Springer Science & Business Media.
7. Maheshwari, P. (1950), An Introduction to the Embryology of Angiosperms.
8. Raghavan, V. (1997). Molecular embryology of flowering plants. Cambridge University Press.
9. Raghavan, V. (2012). Developmental biology of flowering plants. Springer Science & Business Media.
10. Sinnet, E.W. (1960), Plant Morphogenesis, McGraw Hill Book Company Inc., New York.
11. Wardlaw, C. W. (1952). Morphogenesis in plants. London: Methuen.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Botany Practicals I**  
**MBTP-3077**

(Based on MBTL-3071, MBTL-3072 and MBTL-3073)

**Course Outcomes:**

After passing this course the student will be able to:

CO1: Perform immobilization of enzymes.

CO2: Wide application of enzymes and their future potential.

CO3: Perform different experiments based on plant pollination.

CO4: Understand embryology of dicot and monocot plants.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Practical-I**  
**MBTP-3077**  
(Based on MBTL-3071, MBTL-3072 and MBTL-3073)

**Time: 6 hrs**

**Max. Marks- 75**  
**Practical – 60**  
**CA – 15**

**Instructions for the Paper Setters:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Practical's from MBTL-3071**

1. Examination of the following with the help of hand sections, dissections and prepared longitudinal, transverse of Flowers: Transmitting tissue/canal in the stigma and style, Various types of flowers and placentation, Special types of flowers with emphasis on vasculature of androecium and gynoecium.
2. Study from permanent preparations, development and structure of anther, pollen, ovules, megasporogenesis, embryo sac, endosperm and embryo.
3. Study of microsporogenesis and gametogenesis in sections of anther.
4. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa*, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena*).
5. Test for pollen viability using stain and in vitro pollination. Pollen germination using hanging drops, sitting drop culture and suspension culture.
6. Estimating percentage and average pollen tube length in vitro.
7. Field study of several types of flowers with different pollination mechanisms (wind, insects, bird pollination)

**Suggested Practical's from MBTL-3072**

1. Identification of the parts of bright- field microscope and demonstration of its use and care.
2. Perform basic microbiological techniques such as sterile plating and isolation of single colonies.
3. Isolation of DNA from biological samples.
4. Characterization of isolated DNA using agarose gel electrophoresis.
5. Graph and analyze agarose gel data.
6. Genetic transformation of bacteria.
7. Screening and selection of transformants.
8. Demonstration of PCR technique.
9. Spectrophotometric estimation of DNA.
10. Demonstration of DNA sequencing technique.

### **Suggested Practical's from MBTL-3073**

1. Floral biology in self and cross pollinated species,
2. Selfing and crossing techniques.
3. Numerical exercises on probability and biostatistics
4. Maintenance of experimental records;
5. Learning techniques in hybrid seed production
6. To study Breeders kit.
7. Studies on centres of origin of various useful crops.
8. To study Vegetative Propagation in – Potato, Onion bulb, Sugarcane, Ginger.
9. To perform exploration for determination of male sterility.
10. To perform Field exploration for determination of Dichogamy, Heterostyly and Dioecy.
11. To estimate Pollen viability in *Zea mays* and *Hibiscus*.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Botany Practicals II**  
**MBTP-3078**  
(Based on MBTL-3074, MBTL- 3075 and MBTL-3076)

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand concept of gene, gene cistron relationship in prokaryotes and eukaryotes.

CO2: Understand types of DNA damage, DNA repair pathways.

CO3: Exhibit clear and concise communication of scientific data.

CO4: Understand different techniques related to molecular biology.

**Master of Science (Botany) Semester-III**  
**(Session 2021-22)**  
**Botany Practicals II**  
**MBTP-3078**  
(Based on MBTL-3074, MBTL- 3075 and MBTL-3076)

**Time: 6 hrs**

**Max. Marks- 75**  
**Practical - 60**  
**CA – 15**

**Instructions for the Paper Setters:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested Practical's based on MBTL-3074**

1. Preparation of the solutions of different concentrations. Preparation of the inorganic and organic buffers of different conc. and pH.
2. Preparation of the standard curve of protein and determine the protein content in unknown samples by Lowry's method.
3. Estimation of the protein content in given plant sample by Bradford's method
4. Estimation of the protein content in given plant sample by Biuret's method
5. Estimation of the carbohydrates in given plant sample Anthrone's reagent.
6. Estimation of the carbohydrates in given plant sample Dubois's method
7. Estimation of the activity of enzyme catalase
8. Estimation of the activity of enzyme peroxidase.
9. Preparation of the standard curve of proline and determine the proline content in unknown samples by Bates's method.
10. SDS-PAGE for soluble proteins extracted from the given plant material and comparison of their profile by staining with Coomassie brilliant blue.

**Suggested Practical's based on MBTL-3075**

**To study economic importance, distribution, centres of origin of following specimens:**

1. Study of morphology and microchemical tests for stored food material for cereals: Wheat (*Triticum aestivum*), Rice (*Oryza sativa*), Maize (*Zea mays*)
2. Study of morphology and microscopic study of fibres: Cotton (*Gossypium sp.*), Jute (*Corchorus capsularis*), Flax (*Linum usitatissimum*) Sugar yielding plant: Sugarcane (*Saccharum officinarum*)
3. Study of morphology of oil yielding plants: Groundnut (*Arachis hypogea*), Mustard (*Brassica sp.*), Coconut (*Cocos nucifera*), Castor (*Ricinus communis*), Soyabean (*Glycine max*) and performing tests for oil.
4. Study of morphology and alkaloid present in spices: Ginger (*Zingiber officinale*), Turmeric (*Curcuma longa*), Coriander (*Coriandrum sativum*), Clove (*Eugenia aromaticum*), Black Pepper (*Piper nigrum*), Cinnamon (*Cinnamomum zeylanicum*)
5. Study of morphology and medicinal value for medicinal plants: Amla (*Emblica officinalis*), Bahera (*Terminalia belerica*), Harhar (*Terminalia chibula*), Sarpagandha (*Rauwolfia*)

- serpentine*), Ashwgandha (*Withania somnifera*), Liquorice (*Glycyrrhiza glabra*), Poppy (*Papaver somniferum*), Arjuna (*Terminalia arjuna*)
6. Study of morphology and nutrition value for pulses: Green Gram (*Phaseolus aureus*), Black Gram (*Phaseolus mungo*), Pigeon Pea (*Cajanas cajan*), Kidney Bean (*Phaseolus vulgaris*)
  7. Study of morphology of plants producing fruits Citrus (*Citrus sp*), Apple (*Malus pumila*), Mango (*Mangifera indica*), Banana (*Musa sapientum*), Pineapple (*Ananas comosus*), Grapevine (*Vitis sp*)
  8. Vegetables: Potato (*Solanum tuberosum*), Radish (*Rapahnus sativus*), Turnip (*Brassica rapa*)
  9. Study of morphology of Beverages: Tea (*Thea sinensis*), Coffee (*Coffea arabica*) and knowledge of processing method.

### **Suggested Practical's based on MBTL-3076**

1. Emasculation, bagging, hand pollination to study pollen germination, seed set and fruit development.
2. Study of cleistogamous flowers and their adaptations.
3. Study of nuclear and cellular endosperm through dissection and staining.
4. Isolation of zygotic globular, heart shaped, torpedo stage and mature embryos from suitable seed.
5. Study of seed dormancy and methods to break dormancy
6. Study the primitive and advanced characters of plants in angiosperms
7. Study various methods of asexual reproduction and vegetative reproduction
8. Study effects light, gravity, humidity temperature on plants
9. To study effect of bending on plant morphogenesis.

# **Semester - IV**

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Plant Anatomy**  
**MBT L –4071**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand anatomy of different types of woods and their commercial utilization.

CO2: Compare anatomy of vegetative and floral parts of flowering plants.

CO3: Relate anatomy of the plant part with their physiological role.

CO4: Understand role of anatomy in taxonomy.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Plant Anatomy**  
**MBT L –4071**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**The Shoot and Root System:** Primary structure and basic vasculature, the root-stem transition, secondary growth in stems and roots, the origin of cambium and its activity, anomalous secondary growth, polycyclic vasculature, secondary meristems, origin and function, the role of pericycle, phellogen, phellem, phelloderm, distribution of sclerenchyma in leaves, stem and roots.

**Nodal Anatomy:** Types of nodes in dicots and monocots, the node-internode transition, formation of leaf and branch traces.

**UNIT-II**

**Histology of Wood:** Growth rings, types and ultrastructure of tracheids, vessels and wood rays, longitudinal parenchyma and its arrangement, grain and texture, knots, formation of resin cavities and tyloses, anatomy and chemistry of lignification, physical and anatomical features of common hard and soft woods of India, importance of density and weight in commercial utilization of woods.

**UNIT-III**

**Floral Anatomy:** The anatomy of floral axis and the whorls, the leaf origin of carpel, evidences from anatomy of essential and accessory whorls.

**Fruit and Seed Anatomy:** Gross and ultrastructural surface features of the fruits and seeds, role in taxonomy, internal anatomy of dicot and monocot seeds, organ and cellular anatomy of typical monocot and dicot seeds.

**UNIT-IV**

**Laticifers and Lenticels:** Types and distribution, anatomy in relation to physiological roles

**Functional Anatomy:** Anatomy of leaf in relation to photosynthesis and transpiration, modification of the root stem and leaf anatomy in relation to habit and habitat with special reference to aquatics, nitrogen fixers, xerophytes parasites and mycorrhizas.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**

**Suggested Readings:**

1. Carlquist S (2001). Comparative Wood Anatomy, Springer-Verlag, Germany.
2. Crang R., Lyons-Sobaski S., & Wise R. (2018). Plant anatomy: a concept-based approach to the structure of seed plants. Springer.
3. Cutler DF, Botha CEJ, Stevenson DW (2007). Plant Anatomy - An Applied Approach, Blackwell Publishing, USA
4. Cutter EG (1978) Plant Anatomy, Part I & II, Edward Arnold, United Kingdom.
5. Dickinson WC (2000). Integrative Plant Anatomy, Harcourt Academic Press, USA.
6. Nair MNB (1998). Wood Anatomy and Major Uses of Wood, Faculty of Forestry, University of Putra Malaysia, Malaysia.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Structure and Metabolism of Plant Hormones**  
**MBTL – 4072**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand role of different types of plant hormones in growth and development of plants.

CO2: Understand the mechanism of action and bioassays of plant hormones and their commercial use.

CO3: Relate microbial association with the production of growth regulators.

CO4: Understand biosynthesis of different plant growth regulators.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Structure and Metabolism of Plant Hormones**  
**MBTL – 4072**

**Time: 3 hrs**

**Max. Marks- 50**

**Theory - 40**

**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**General Features of Plant Hormones, their Analysis, and Quantitation:** Discovery of auxin and other hormones, characteristics of plant hormones, hormone vs plant growth regulator, hormonal responses to a physiological state, bioassays, hormone extraction, analysis, and quantitation, determination of hormone synthetic pathways, regulation of hormone levels (hormonal homeostasis).

**Auxins:** Structure of auxins, physiological roles of IAA, IAA biosynthesis in higher plants, regulation of IAA levels (IAA homeostasis), inhibitors of IAA action, other naturally occurring auxins, synthetic auxins, structural diversity of auxins.

**UNIT-II**

**Gibberellins:** Discovery, structure of gibberellins (GAs) in higher plants, physiological roles of GAs in higher plants, terpenoid pathway, biosynthesis of GAs, regulation of GA levels in the plant, endogenous levels, why are there so many GAs?, other substances with GA-like activity.

**Cytokinins:** Discovery, biological functions and bioassays, structure of cytokinins, occurrence of cytokinins in the cytoplasm and as components of tRNA, relative distribution of natural cytokinins among plants, biosynthesis in higher plants, regulation of cytokinin levels, synthetic compounds with cytokinin like activity, cytokinin antagonists (anticytokinins).

**UNIT-III**

**Brassinosteroids:** Discovery, structure and distribution, physiological roles and bioassays, biosynthesis of brassinolide, synthesis mutants and their wild-type genes, inhibitors of brassinosteroid biosynthesis, brassinosteroid structure and biological activity regulation of castasterone and brassinolide levels.

**Abscissic Acid:** Discovery, structure and occurrence in plants and fungi, physiological roles of abscisic acid (ABA), biosynthesis of ABA, carotenoid and/or ABA synthesis, mutants, ABA synthesis inhibitors, regulation of ABA levels.

**Ethylene:** Discovery as a hormone, structure, distribution, and internal concentrations, physiological roles and bioassays, biosynthesis in higher plants, ethylene synthesis mutants, regulation of ethylene levels in the plant, synthetic compounds that produce ethylene, inhibitors of ethylene action.

#### UNIT-IV

**Jasmonates and other Defense-Related Compounds:** Introduction, discovery, distribution, and structure of jasmonates, physiological roles of jasmonates, biosynthesis of jasmonic acid (JA), JA synthesis mutants, JA synthesis inhibitors, regulation of endogenous levels of JA.

**Microbial Synthesis of Plant Hormones:** Microbial associations with plants, infection by *Agrobacterium*, tumor induction by *Pseudomonas*, microbial genes involved in IAA and CK biosynthesis, expression of bacterial genes in higher plants, biology of genetic transformation by *A. tumefaciens*, production of plant hormones by other microorganisms.

#### **Suggested Readings:**

1. Buchanan, B. B., Gruissem, W., & Jones, R. L. (Eds.). (2015). *Biochemistry and molecular biology of plants*. John Wiley & Sons. American Society of Plant Physiologists, Maryland.
2. Davies, P. J. (Ed.). (2004). *Plant hormones: biosynthesis, signal transduction, action!* Springer Science & Business Media.
3. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). *Plant Metabolism*. Longman, Essex.
4. Galston, A.W. (1989). *Life Processes in Plants*. Scientific American Library, Springer-Verlag, New York.
5. Hooykaas, P.J.J., Hall, M.A., and Libbenga, K.R. (eds) (1999). *Biochemistry and Molecular Biology of Plant Hormones*. Elsevier, Amsterdam.
6. Hopkins, W. G. (2007). *Introduction to plant physiology* 4th edition. John Wiley & Sons, Inc., New York.
7. Lodish, H., Berk, A., Zipursky, S.I., Matsudaira, P., Baltimore, D., and Darnell, J. (2000). *Molecular Cell Biology*. W.H. Freeman and Company, New York.
8. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). *Plant physiology and development*, Sinauer Associates Inc

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Plant Tissue Culture and Biotechnology**  
**MBTL – 4073**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand the concept of cytogenetics and differentiation in cell and tissue culture.

CO2: Understand mechanism, advantage and disadvantages of micro-propagation.

CO3: Describe the role of tissue culture in the production of different types of transgenic plants.

CO4: Explain role of plant tissue culture and biotechnology in different fields of human interest.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Plant Tissue Culture and Biotechnology**  
**MBTL – 4073**

**Time: 3 hrs**

**Max. Marks- 50**

**Theory - 40**

**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Introduction and Historical aspects of Tissue Culture, Micropropagation: Types, Cytogenetics and differentiation in cell and tissue culture, plant regeneration from callus, shoot apex culture and anthers. Stages, somatic embryogenesis, usefulness, hardening of micropropagated plantlets, advantages and disadvantages, application of the technique in crop improvement.

**UNIT-II**

Somaclonal variations and isolation of useful mutants at cellular level, disease resistance, herbicide resistance and salt tolerance. Production of pathogen free plants through tissue culture. Production of artificial seeds, their use and application.

**UNIT-III**

Techniques for the production of transgenic plants: Concept, vector less transgenesis, gene targeting tools, crop improvement through transgenics, benefits and risk of producing transgenic plants, commercialization of transgenics. Cell culture and secondary metabolites like cinnamic acid, shikonin, flavonoids and related compounds production.

**UNIT-IV**

Cryobiology of plant cell cultures and establishment of plant banks, freeze preservation technology, factors influencing revival of frozen cells and future prospects. Terminator technology, verminator technology, apprehensions and challenges. Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**

**Suggested Readings:**

1. Bhojwani, SS and Dantu, PK (2013) Plant Tissue Culture: An introductory text, Springer Publications.
2. George, F.E., Hall, M., Klerk G. J (2008) Plant propagation by Tissue culture 3rd edition Voll, Springer Publications.
3. Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.
4. Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, Butter Worths, London.
5. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation, And Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
6. Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Analytical Techniques**  
**MBTL – 4074**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand working of different microscopes.

CO2: Understand the basics of the major analytic techniques including sample preparation, standardization and data analysis of each technique.

CO3: Evaluate strengths and weakness of different analytical techniques.

CO4: Understand theory and practice of different bioanalytic techniques.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Analytical Techniques**  
**MBTL – 4074**

**Time: 3 hrs**

**Max. Marks- 50**

**Theory - 40**

**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Principles and application of light, phase contrast, fluorescence scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining.

**UNIT-II**

Principles and applications of gel filtration, ion-exchange and affinity chromatography, thin layer and gas chromatography, high pressure liquid chromatography (HPLC), electrophoresis and electrofocussing, ultra-centrifugation (velocity and density gradient).

**UNIT-III**

Principles of biophysical methods used for analysis of biopolymeric structure, X-ray diffraction fluorescence UV/CD, visible Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR) spectroscopy, hydrodynamic methods, Atomic absorption and plasma emission spectroscopy.

**UNIT-IV**

Principles and techniques of nucleic acid: hybridisation and Cot curves; Sequencing of proteins and nucleic acids; Southern, Northern and Western blotting techniques; Polymerase chain reaction.

**Suggested Readings:**

1. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology -Basic Experiments in Gene Manipulation.2nd Ed. Benjamin Publ. Co.
2. Principles of Electroanalytical Methods. John Wiley and Sons Ltd., Chichester England.
3. Sambrook J & Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold
4. Spring Harbor Lab. Press. Sheehan, D. (2000). Physical Biochemistry: Principles and Applications, John Wiley andSons Ltd., Chichester, England.
5. Singh BD. 2005. Biotechnology, Expanding Horizons. Kalyani Publishers, Delhi
6. Wilson K. and Walker J. (Eds.) (2012). Practical Biochemistry: Principles and Techniques,Cambridge University Press, U.K. Riley, T. and Tomilson, C. (198)

**Master of Science (Botany) Semester-IV  
(Session 2021-22)  
Diversity and Biology of Angiosperms  
MBTL – 4075**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Learn about different systems of classification with their merits and demerits.

CO2: Understand principles of plant nomenclature and plant taxonomy.

CO3: Know about the National and international herbaria and botanical gardens.

CO4: Understand terminology related to plant taxonomy.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Diversity and Biology of Angiosperms**  
**MBTL – 4075**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

Historical perspective of plant classification, phenetic versus phylogenetic system; cladistics in taxonomy, relative merits and demerits of major system of classification, a study of phylogenetic system of classification after Engler & Prantl, Bessey, Hutchinson, Cronquist, Takhtajan, Dahlgren and Thorne.

**UNIT-II**

Principles of plant nomenclature; salient features of the International code of Botanical Nomenclature, working knowledge of botanical latin, important herbaria of the World. Origin of angiosperms; interrelationships of dicots and monocots; Phylogeny of Ranales, Amentiferae, Centrospermae, Tubiflorae and Helobiales and their treatment in the modern systems of classification.

**UNIT-III**

Principles of plant taxonomy, alpha taxonomy vs modern taxonomy; chemotaxonomy, cytotaxonomy, numerical taxonomy, anatomy, palynology and embryology in relation to taxonomy. Biosystematic approach to taxonomy, biosystematic categories parameters in biosystematic analysis with particular examples of taxonomic problems; taxonomic study of agamic, hybrid and polyploid complexes; phylogenetic trees.

**UNIT-IV**

Taxonomic tools: Herbarium; floras; serology; electrophoresis; nucleic acid hybridization; computers and GIS. Concepts of phytogeography and its relevance, phytogeographic regions of the world and India, approaches to phytogeography, principles and practices; factors determining vegetational types, endemism, hotspots and hottest hotspots, plant explorations, invasions and introductions, local plant diversity and its socioeconomic importance.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**

**Suggested Readings:**

1. Angiosperm Phylogeny Group (2003) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.
2. Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London Cracknell AP, Hayes L (2009) Introduction to Remote Sensing. CRC Press, Boca Raton, USA (Special Indian Edition)
3. Crawford DJ (2003) Plant Molecular Systematics. Cambridge University Press,
4. Cambridge, UK.: Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun
5. Davis P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Kreiger. Co., New York.
6. Judd WS, Campbell CS, Kellogg EA, Stevens PA and Donoghue MJ (2002) Plant Systematics: A Phylogenetic Approach. Sinauer Associates, Inc., Massachusetts.
7. Nei M and Kumar S (2000) Molecular Evolution and Phylogenetics. Oxford University Press, New York.
8. Raven PH, Begr LR, Hassenzahl DM (2008) Environment. 6th edition. John Wiley & Sons, Inc., New York.
9. Semple C and Steel MA (2003) Phylogenetics. Oxford University Press, Oxford

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Hazardous Chemicals**  
**(Optional Paper)**  
**MBTL-4076 (Opt-A)**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand different types of hazardous chemicals and how we can expose to them.

CO2: Understand control measures that reduce the risk associated with hazardous chemicals.

CO3: Manage hazardous chemicals effectively.

CO4: Describe the processes involved in hazardous waste treatment.

**Master of Science (Botany) Semester-IV  
(Session 2021-22)  
Hazardous Chemicals  
(Optional Paper)  
MBTL-4076 (Opt-A)**

**Time: 3 hrs**

**Max. Marks- 50  
Theory - 40  
CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**Physical Properties of Chemicals:** Vapour pressure, vapour density, solubility, octanol/water partition, coefficient odor.

**Toxic Properties:** Absorption and excretion detoxification and bioactivation, common terms used for toxicology.

**Target Organs:** Injury to liver, kidney, immune system, respiratory tract, skin, eyes, nervous system, cardiovascular system, carcinogens and teratogens.

**Combustible and Explosive Properties:** Flashpoint and autoignition temperature of some chemicals, explosive properties.

**UNIT-II**

**Aldehydes:** Acrolein.

**Alkaloids:** Nicotine, Morphine, Heroin, LSD, Colchichine.

**Amines:** Ethylenimine, aniline, benzidine, O-toluidine, Phenylhydrazine.

**Azodyes:** Acid Yellow 3, Sudan orange, acid red 18, acid blue-9, acid green-3.

**Chlorohydrins:** Ethylene, chlorohydrin.

**Nitriles:** Acrylonitrile, acetonitrile.

**Cyanides:** HCN, Sodium cyanide, potassium cyanide, cyanogen.

**Organic Isocyanates:** Methyl isocyanate.

**UNIT-III**

**Dioxins:** 2,3,7,8 – Tetrachlordibenzo-p-dioxin (TCDD).

**Epoxy Compounds:** Ethylene dioxide.

**Halogenated Hydrocarbons:** Chloroform, carbon tetrachloride, dichlorobenzene.

**Aromatic Hydrocarbons:** Benzene, Xylene.

**Polynuclear Aromatics:** Benzo - $\alpha$ - pyrene, Benzo -  $\alpha$ - anthracene.

**Toxic Gases:** Arsine, Mustard Gas, Phosgene.

**Explosives:** Nitroexplosives – Nitroglycerine, dynamite, Nitrocellulose, 2,4,6-Trinitrotoluene, Picric acid

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**

**UNIT-IV**

**Pesticides:** Structure, LD50/ LC50, health hazards and exposure limit of following pesticides:

**Carbamates:** Aldicarb, Carbaryl, Carbofuran, Methiocarb.

**Organochlorines:** Aldrin, Dieldrin, Endrin, Heptachlor, Chloradane, Endsulphan, DDT, Methoxychlor, Lindane.

**Organophosphorus Pesticides:** Parathion, Dichlorophos, Monocrotophos, Chloropyriphos.

**Herbicides:** 2,4 D, 2,4, T, Silvex, Atrazine, Metribuzin, Monouron, Diuron, Paraquat, Tribunil, Alchlor

**Suggested Readings:**

1. Patnaik, P. (1999). A Comprehensive Guide to the Hazardous Properties of Chemical Substances. Wiley, New York.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Immunology**  
**(Optional Paper)**  
**MBTL-4076(Opt-B)**

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand principles of immunology.

CO2: Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens.

CO3: Understand role of immunity in keeping our body healthy.

CO4: Exhibit clear and concise communication of scientific data.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Immunology**  
**(Optional Paper)**  
**MBTL-4076(Opt-B)**

**Time: 3 hrs**

**Max. Marks- 50**  
**Theory - 40**  
**CA – 10**

**Instructions for the Paper Setters:**

Eight questions of equal marks (i.e. eight marks each) are to be set, two in each of the four sections (A-D). Questions of section (A-D) should be set from Unit (I-IV) of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**UNIT-I**

**An Overview of the Immune System:** Historical perspective, an introduction to the immune system – innate and adaptive immunity. Immuno deficiencies: secondary immunodeficiency disorders.

**UNIT-II**

**Antigens and Antigen Recognition:** Antigens: prerequisites for immunogenicity, relative immunogenicity of different types of molecules, Molecules that enhance immunogenicity. Activators of lymphocytes: antigens, super antigens, mitogens. Antigen recognition by cells of innate immunity & adaptive immunity.

**UNIT-III**

**Antibodies:** Gamma globulins; structure, bifunctional property of antibodies, determining bifunctionality, cross reactivity, Antigen antibody interactions: primary interactions, secondary interactions. Classification of antibodies: Isotypes, Allotypes, properties & biological functions of antibody isotypes, IgG, IgE, IgM, IgD, IgA, Monoclonal antibodies

**UNIT-IV**

**Cells and Tissues of Immunity:** Lymphoid tissues: primary & secondary lymphoid tissues, cells of innate immunity: phagocytes, antigen presenting cells, natural killer cells, Eosinophils, mast cells and basophil, B- cells, secondary immune responses. The major histocompatibility complex, antigen process and antigen presentation, complement. The immune system in Health & Disease, specially AIDS.

**Books Recommended**

1. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). Roitt's essential immunology. John Wiley & Sons.
2. Goldsby, R.A. Kindt, T.J., Osborne B.A., Kuby, J. (2003). Immunology. W.H. Freeman & Company, New York.
3. Punt, J., Stranford, S. A., Jones, P. P., & Owen, J. A. (2019). Kuby immunology. Macmillan Learning
4. Stanley, J. (2002). Essentials of Immunology and Serology. Delmar Thomson Learning, USA.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Botany Practicals I**  
**MBTP -4077**

(Based on MBTL-4071, MBTL-4072 and MBTL-4073)

**Course outcomes:**

After passing this course the student will be able to:

CO1: Develop skills of dissection, formation of temporary and permanent slides.

CO2: Understand commercial applications of plant growth hormones.

CO3: Perform bioassays of plant growth regulators.

CO4: Study the functions and operations of various instruments used in PTC

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Botany Practicals I**  
**MBTP -4077**

(Based on MBTL-4071, MBTL-4072 and MBTL-4073)

**Time: 6 hrs**

**Max. Marks- 75**

**Practical – 60**

**CA – 15**

**Instructions for the Paper Setters:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested practical's based on MBTL-4071**

1. Study of apical meristems with the help of dissections, whole mount preparations, sections and permanent slides.
2. Study of xylem and phloem elements using maceration, staining, light and electron micrographs (xerophytes, hydrophytes and halophytes).
3. Study of secretory structures (nectaries and laticifers).
4. Study of leguminous roots with different types of nodules.
5. Anatomical studies of young and mature stem of *Helianthus*.
6. Comparative anatomy of dicot and monocot root, stem and leaf
7. To study anomalous stem behaviour in stem (*Mirabilis jalapa*, *Nyctanthus*, *Boerhaavia diffusa*, *Bignonia*, *Dracaena*.)
8. Study of anatomical features in xerophytes e.g. (leaf of *Nerium*. stem and leaf of *Calotropis*, phyllocladode of *Ruscus*.)
9. Study of anatomical features in hydrophytes e.g. (*Nelumbo* petiole, *Hydrilla* stem and leaf, *Eichhornia* petiole, leaf lamina, *Typha*)
10. To study anatomy of storage roots of e.g. (*Raphanus sativa*, *Beta vulgaris*.)
11. To study anatomy of halophytes e.g. (*Chenopodium* stem)
12. To study permanent tissues slides.

**Suggested Practical's based on MBTL-4072**

1. Study the effect of IAA on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
2. To study the effect of IBA on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
3. Study the effect of Gibberellins on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
4. Study the effect of Cytokinin on morphological parameters such as shoot length, root length, fresh weight and dry weight of seven days old seedlings.
5. Estimation of the catalase activity by Aebi's Method.
6. Study of bioassays of Auxins, Gibberellins, Cytokinin, Ethylene, Abscissic Acid and Brassinosteroids.
7. Study of antagonistic effect of cytokinin/ethrel on senescence behavior of leaves of different field crops.

### **Suggested Practical's based on MBTL-4073**

1. To study the functions and operations of various instruments used in PTC like Laminar Air Flow, Autoclave, incubators, oven, Distillation unit, Weighing balance, pH meter
2. Laboratory design set up of PTC lab Sterilisation techniques
3. Different types of Enclosures used in PTC
4. Preparation of stock solutions and media preparation
5. Selection, preparation and inoculation of explant Synthetic Seed Production
6. Micropropagation and its different steps. Significance of growth hormones in culture
7. Induction of callus from different explants Anther culture and ovary culture

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Botany Practicals II**  
**MBTP -4078**

(Based on MBTL-4074 and MBTL-4075)

**Course outcomes:**

After passing this course the student will be able to:

CO1: Understand and perform experiments based on different analytic techniques.

CO2: Identify different plants using identification keys.

CO3: Explore rich plant biodiversity.

CO4: Compare different species of a genus and different genera of family.

**Master of Science (Botany) Semester-IV**  
**(Session 2021-22)**  
**Botany Practicals II**  
**MBTP -4078**  
**(Based on MBTL-4074 and MBTL-4075)**

**Time: 4 hrs**

**Max. Marks- 75**  
**Practical – 60**  
**CA – 15**

**Instructions for the Paper Setters:** Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same may be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

**Suggested practical's based on MBTL-4074**  
**(Experiments based on following techniques):**

1. Paper Chromatography
2. Thin Layer chromatography
3. Column chromatography
4. Gel Filtration Chromatography
5. Ion Exchange Chromatography
6. Affinity Chromatography
7. Electrophoresis: AGE and SDS-PAGE
8. UV-Vis Chromatography
9. Demonstration of PCR
10. Centrifugation
11. Flourescent Microscopy

**Suggested Practicals based on MBTL-4075**

Description of specimen from representatives of locally available families. This list is indicative only

- Ranunculaceae: *Ranunculus*, *Delphinium*,
- Brassicaceae: *Brassica*, *Iberis*
- Malvaceae: *Hibiscus*
- Rutaceae: *Murraya*, *Citrus*
- Fabaceae: *Lathyrus*, *Cassia*, *Acacia*, *Mimosa*
- Rosaceae: *Rose*, *Prunus*
- Asteraceae: *Helianthus*, *Ageratum*, *Sonchus*
- Apiaceae: *Coriandrum*, *Foeniculum*
- Apocynaceae: *Vinca*, *Nerium*, *Thevetia*
- Asclepiadaceae: *Calotropis*
- Solanaceae: *Petunia*, *Solanum*, *Datura*
- Euphorbiaceae: *Euphorbia*, *Phyllanthus*
- Lamiaceae: *Ocimum*, *Salvia*
- Chenopodiaceae: *Chenopodium*
- Liliaceae: *Asparagus*, *Asphodelus*
- Poaceae: *Triticum*, *Avena*

1. Location of key character and use of keys at family level.
2. Field trips within and around the campus; compilation of field note and preparation of herbarium sheets of such plant, wild or cultivated as are abundant.
3. Training in using flora and herbaria for identification of specimen described in the class
4. Comparison of different species of a genus and different genera of family to calculate similarity coefficients.