Curriculum for MS Examination: 2024 DEPARTMENT OF BOTANY Faculty of Biological Sciences

# Outcome-based Education (OBE) Curriculum for Master of Science (MS) in Botany

## Session: 2019-2020

## Examination: 2024

**1st, 2nd & 3rd Semester**


**Department of Botany**
**Faculty of Biological Sciences**
**University of Rajshahi**
**Rajshahi 6205, Bangladesh**

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## Examination: 2024

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**Department of Botany**
**Faculty of Biological Sciences**
**University of Rajshahi**
**Rajshahi 6205, Bangladesh**

# Content

# Academic Calendar

| Years | Class begins | Class ends | Exam begins | Result/ Remarks |
|---|---|---|---|---|
| MS 1st Semester | | | | |
| MS 2nd Semester | | | | |
| MS 3rd Semester | | | | |

# Class Routine

| Periods / Days | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **Sunday** | | | | | | | | |
| **Monday** | | | | | | | | |
| **Tuesday** | | | | | | | | |
| **Wednesday** | | | | | | | | |
| **Thursday** | | | | | | | | |

# Assignments

| Course Tutor | Course Title | Deadline |
|---|---|---|
| | | |
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| | | |

# Personal Notes

**Name:**

**Class Roll No.:**

**Registration No.:**

**Student ID:**

**Batch No.:**

**Society Membership ID:**

**National ID:**

**Blood Group:**

**Emergency Contact:**

**Next to Kin:**

**Residential Address:**

**Others:**

## 1. Title of Academic Program

MS Program

## 2. Name of the University

University of Rajshahi

## 3. Vision of the University

To pursue enlightenment and creativity for production world-class human resources to cater for the needs of changing time.

## 4. Mission of the University (MU)

| | |
|---|---|
| **MU1** | To ensure a world-class curriculum with talented academicians and conducive academic and research environment for generation and dissemination of knowledge. |
| **MU2** | To maintain international standards in education with focus on both knowledge and skills, and humanitarian and ethical values to meet the needs of the society and state. |
| **MU3** | To develop strategic partnerships with leading national and international universities, and organizations for academic as well as research collaborations. |

## 5. Name of the Program Offering Entity (POE)

Department of Botany, Faculty of Biological Sciences, University of Rajshahi

## 6. Vision of the Program Offering Entity (VE)

| | |
|---|---|
| **VE1** | To develop interest and enthusiasm among the students towards the subject |
| **VE2** | To attain excellence in teaching in Botany in general and Research in particular |
| **VE3** | To enrich the students through knowledge and Botanical information |
| **VE4** | To enhance and improve the inherent potential of the students |
| **VE5** | To cultivate ethical values and make responsible citizens |
| **VE6** | To apply botanical knowledge to social programmes like Haritha Haram etc. |
| **VE7** | To provide resource persons to conduct various awareness programmes like World Environment Day, DNA Day, Wetland Day, National Forest Day, National Science Day, Soil Day etc. |

## 7. Mission of the Program Offering Entity (ME)

| | |
|---|---|
| **ME1** | To foster a culture of scientific inquiry, critical thinking and debate; |
| **ME2** | To create, through participatory management, a working environment in which everyone can develop to his or her full potential; |
| **ME3** | To train students in fundamental knowledge and the application of the scientific method; |
| **ME4** | To extend the fundamental knowledge of botany by leading and innovative research, to create a positive impact on society and industry; |
| **ME5** | To follow a multidisciplinary research strategy by harnessing the diversity of expertise within the department; |
| **ME6** | To use our central position within the faculty and university to bring about change through innovative and novel approaches to teaching and learning. |

## 8. Objectives of the Program Offering Entity (OE)

| | |
|---|---|
| **OE1** | To provide professional graduate in the field of plant sciences and the multidisciplinary areas according to the requirements of contemporary job markets |
| **OE2** | To disseminate botanical knowledge in the diversified field of agriculture, industry, medical sciences and academia to ensure its effective application |
| **OE3** | To publish leading professional journals to contribute the theoretical development and application of plant sciences addressing substantive problems through scholarly research |
| **OE4** | To deliver adequate, relevant and advanced knowledge of plant sciences for facilitating research, planning and decision making process of the government and the community for achieving Sustainable Development Goals (SDGs) of Bangladesh |

**9. Name of the Degree**

MS in Botany

**10. Description of the Program**

The Masters Program in Botany was introduced more than 50 years ago with a view to providing advance knowledge of plant science and to enhance the application of plants in social, environmental, and economical development.

Since in the year 2005, the Department of Botany has been offering MS degree comprised of three specialized branches with an aims to provide students with deeper integrate into a particular branch after passing B.Sc. (Honors) where they acquired basic knowledge in Botany.

**Branches:** Advanced Botany, Plant Biotechnology and Environmental Botany

Currently the MS in Botany is running a one and half year postgraduate program in three semesters. Each branch includes six different courses covering both taught course and research. The practical and project works are included for general group but for thesis group it is not applicable. The modular formats of the three specialized branches in MS allow the students who have already gained the basic knowledge of plant science in B. Sc. (Hon's) and for further step to advance in MS level with an aim to:

(a) Provide in-depth expertise in their respective field required to pursue the vast arena of scientific research in plant science or occupying jobs in educational institutions/ research organizations/ NGOs and industries in future.

(b) Enable the students to contribute their own efforts in diverse eco-management level, environment, biodiversity, development activities and to improve the quality of life.

Every student has equal opportunity to take six courses from each group considering his/ her future career development. The number of students in any group however, will not exceed, one third of the total students.

**Content description:** The detailed description of the teaching, learning, lectures, laboratory assignments, fieldwork and examinations features are followed.

There shall be two groups in MS course, GENERAL GROUP and THESIS GROUP. A degree of MS in Botany shall be given to the students and their specialization will be mentioned in transcript/testimonial based on their respective courses and thesis. A thesis may be offered to the student (s) on any course from intended specialized group.

**GENERAL GROUP**

In GENERAL GROUP, there shall be six theoretical courses (3 courses from 1st Semester and 3 courses from 2nd Semester). Each course will carry 100 marks with 4 hours examination of 70 marks at the end, and class attendance and class assessment of 30 marks. General viva-voce examination, practical examination and research project/field work/internship will be conducted on 3rd Semester. General viva voce examination covering all the courses taught will carry 50 marks. There shall be six practical courses each carrying 33.33 marks covering the subject matters of six theoretical courses. Practical examination of each course will be of six hours duration. Records of practical works and laboratory assessment/ attendance are included in practical examination. Research project/internship, etc. will carry 50 marks. For detail distribution of marks, please see the chart given below.

**MARKS DISTRIBUTION OF GENERAL GROUP**

| Semester | Description | Marks | Units | Cr. |
|---|---|---|---|---|
| **1st Semester** | 3 courses of 100 marks<br>Each course: 70 (theory) + 10 (attendance) +20 (assessment) | 3×100 = 300 | 3 | 12 |
| **2nd Semester** | 3 courses of 100 marks<br>Each course: 70 (theory) + 10 (attendance) +20 (assessment) | 3×100 = 300 | 3 | 12 |
| **3rd Semester** | General viva voce | 50 | 0.5 | 2 |
| | Practical: 200 marks<br>Each course: 33.33 marks; Examination (20) + lab assessment (10) + lab attendance (3.33) | 6×33.33 = 200 | 2 | 8 |
| | Research Project | 50 | 0.5 | 2 |
| **Grand Total =** | | **900** | **9.0** | **36** |

**THESIS GROUP**

There shall be six theoretical courses each carrying 100 marks same as the General Group. There shall be no practical examination for thesis students. Students with minimum CGPA 3.25 in the B.Sc. (Hons) / equivalent will be assigned to a supervisor for carrying out research and submitting a thesis (200 for thesis paper and 50 for viva/defense on thesis workout totaling 250) in lieu of practical courses. Thesis students are encouraged to give input to the research topic to exhibit interest in the problem, which must be relevant to his/her course and within the scope of the branch/department. They have to complete their research work and writing up of the thesis within three months after completion of the written examination. There will be general viva voce of 50 marks covering the six theory courses taught in 1st Semester and 2nd Semester. For detail distribution of marks, please see the chart given below.

**MARKS DISTRIBUTION OF THESIS GROUP**

| Semester | Description | Marks | Units | C |
|---|---|---|---|---|
| **1st Semester** | 3 courses of 100 marks<br>Each course: 70 (theory) + 10 (attendance) + 20 (assessment) | 3×100 = 300 | 3 | 12 |
| **2nd Semester** | 3 courses of 100 marks<br>Each course: 70 (theory) + 10 (attendance) +20 (assessment) | 3×100 = 300 | 3 | 12 |
| **3rd Semester** | General Viva Voce | 50 | 0.5 | 2 |
| | Thesis | 200 | 2 | 8 |
| | Thesis viva voce/presentation/defense | 50 | 0.5 | 2 |
| **Grand Total =** | | **900** | **9.0** | **36** |

## 11. Graduate attributes (Based on need assessment)

| |
|---|
| 1. **Scholars:** Our graduates are expected to have broad knowledge on plant science discipline and will be expertise. |
| 2. **Problem solvers:** With an adequate knowledge of disciplinary expertise and problem domain, our graduates will be in a position to formalize any problem and solve that in a methodical way. |
| 3. **Innovators:** Our graduates are expected to be critical thinkers, creative designers and efficient makers, and will be capable of developing unique and sustainable technology. |
| 4. **Leaders:** Graduates of our department will be trained up to take personal responsibilities and to work with a team. They will be confident, inclusive inspiring and influential through various extra-curricular activities of our department. |
| 5. **Global Citizens:** Graduate of our department will be produced to meet the challenges locally and globally. They will be aware about global issues and act with integrity sensitivity and fluency across cultures and perspectives, and are committed to the betterment of the society as whole. |

## 12. Program Educational Objectives (PEOs)

| | |
|---|---|
| **PEO 1** | Make the students to be aware about conservation and sustainable use of plants, application of different plants in various industries, agriculture and other related fields to make the country self-sufficient. |
| **PEO 2** | Enrich the students with the latest developments in the field of environmental science, microbiology, biotechnology, information and communication technology, bioinformatics, bio-prospecting and other related field of research and development. |
| **PEO 3** | Develop skill in practical works including- conducting experiments, operation of advanced equipments and laboratory techniques along with collection and interpretation of biological materials and data. |
| **PEO 4** | Provide skilled scientists, medics, academicians and entrepreneurs to mitigate national and global demand. |
| **PEO 5** | Understand and appreciate the role of biology in social issues such as environment and biological resources, biodiversity, ethics, human health and diseases, and to give the awareness to the public to protect the planet from all kinds of exploitation. |

**13. Program Learning Outcomes (PLOs)**

Upon completion of the MS Botany Programme, the graduates will be able to:

| | |
|---|---|
| **PLO 1** | Understand microbes to plant forms, diversity, classification, cellular mechanisms, heredity, environmental relationship, molecular biology, biotechnology and other plant related fields. |
| **PLO 2** | Know all aspects of plant sciences from biomolecules to ecosystem by studying microbes, lower to higher plant groups, their attributes and interaction with environments, and the way to explore present and future prospects for sustainable development. |
| **PLO 3** | Assimilate knowledge and ideas, construct and test hypothesis; carry out practical work in the field and laboratory, analyze data using appropriate statistical methods and computer packages; use of ICT to communicate of scientific ideas, effective report writing, design documentation, presentation and career planning. |
| **PLO 4** | Create, select, and apply appropriate techniques, resources, and modern instruments and equipment related to plant science with an understanding of the application and limitations. |
| **PLO 5** | Apply the contextual knowledge to assess plants and its importance for society, health, biosafety and the consequent responsibilities. |
| **PLO6** | Demonstrate the knowledge for legal and ethical principles, bioethics and environmental issues. |
| **PLO 7** | Apply the knowledge to develop skilled and competent human resources to adapt the challenges globally. |

**14. Mapping Mission of the University with PEOs**

| **Program Educational Objectives (PEOs)** | **Mission of the University (MU)** | | |
|---|---|---|---|
| | **MU 1** | **MU 2** | **MU 3** |
| PEO 1 | 3 | 2 | 2 |
| PEO 2 | 3 | 3 | 2 |
| PEO 3 | 2 | 3 | 1 |
| PEO 4 | 3 | 3 | 2 |
| PEO 5 | 3 | 2 | 1 |

Note: 3 - High, 2 – Medium, 1 – Low

**15. Mapping PLOs with PEOs**

| **Program Educational Objectives (PEOs)** | **Program Learning Outcomes (PLOs)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** |
| PEO 1 | 2 | 3 | 2 | 3 | 1 | 3 | 3 |
| PEO 2 | 1 | 3 | 3 | 1 | 2 | 3 | 2 |
| PEO 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 |
| PEO 4 | 3 | 2 | 3 | 2 | 3 | 3 | 1 |
| PEO 5 | 2 | 3 | 2 | 3 | 2 | 1 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

## COURSES FOR MS DEGREE

**Specialization 1: Advanced Botany**

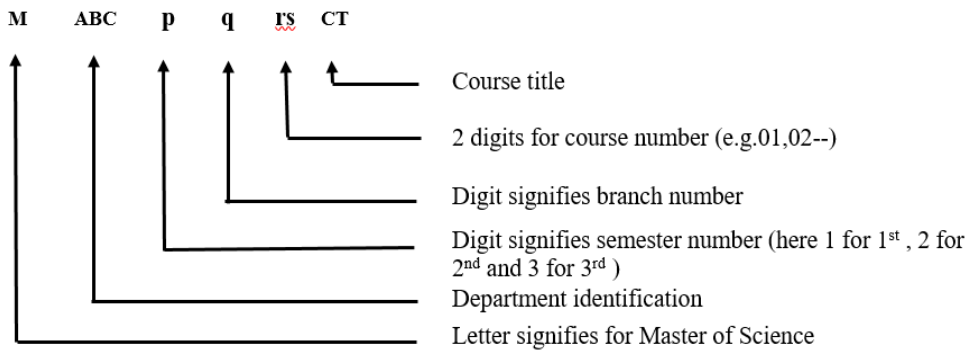
| Semester | Course No. | Course Title |
|---|---|---|
| **1st Semester** | **Theory (Core Courses)** | |
| | MBOT 1101 | Plant Systematics |
| | MBOT 1102 | Physiology of Higher Plants |
| | MBOT 1103 | Applied Mycology |
| | MBOT 1104 | Fern Biology |
| **2nd Semester** | **Theory (Core Courses)** | |
| | MBOT 2101 | Plant Histology |
| | MBOT 2102 | Plant Pathology and Plant Protection |
| | MBOT 2103 | Seed Science and Technology |
| | MBOT 2104 | Cytotaxonomy and Chemotaxonomy |
| **3rd Semester** | **Viva-voce** | |
| | MBOT 3101 | General viva-voce |
| | **Practical** | |
| | MBOT 3102 | Plant Systematics |
| | MBOT 3103 | Physiology of Higher Plants |
| | MBOT 3104 | Applied Mycology |
| | MBOT 3105 | Fern Biology |
| | MBOT 3106 | Plant Histology |
| | MBOT 3107 | Plant Pathology and Plant Protection |
| | MBOT 3108 | Seed Science and Technology |
| | MBOT 3109 | Cytotaxonomy and Chemotaxonomy |
| | **Research Project** | |
| | MBOT 3110 | Research Project |
| | **Thesis** | |
| | MBOT 3111 | Thesis |
| | **Thesis presentation and defense/viva** | |
| | MBOT 3112 | Thesis presentation and defense/viva |

**Specialization 2: Plant Biotechnology**

| Semester | Course No. | Course Title |
|---|---|---|
| **1st Semester** | **Theory (Core Courses)** | |
| | MBOT 1201 | Cytogenetics and Crop Improvement |
| | MBOT 1202 | Applied Plant Breeding |
| | MBOT 1203 | Biometrical Genetics |
| | MBOT 1204 | Plant Tissue Culture and Somatic Cell Technology |
| | MBOT 1205 | Cell Biology and Omics Science |
| **2nd Semester** | **Theory (Core Courses)** | |
| | MBOT 2201 | Agricultural Biotechnology |
| | MBOT 2202 | Applied Microbiology |
| | MBOT 2203 | Wood Science and Technology |
| | MBOT 2204 | Developmental Genetics |
| **3rd Semester** | **Viva-voce** | |
| | MBOT 3201 | General viva-voce |
| | **Practical** | |
| | MBOT 3202 | Cytogenetics and Crop Improvement |
| | MBOT 3203 | Applied Plant Breeding |
| | MBOT 3204 | Biometrical Genetics |
| | MBOT 3205 | Plant Tissue Culture and Somatic Cell Technology |
| | MBOT 3206 | Cell Biology and Omics Science |
| | MBOT 3207 | Agricultural Biotechnology |
| | MBOT 3208 | Applied Microbiology |
| | MBOT 3209 | Wood Science and Technology |
| | MBOT 3210 | Developmental Genetics |
| | **Research Project** | |
| | MBOT 3211 | Research Project |
| | **Thesis** | |
| | MBOT 3212 | Thesis |
| | **Thesis presentation and defense/viva** | |
| | MBOT 3213 | Thesis presentation and defense/viva |

**Specialization 3: Environmental Botany**

| Semester | Course No. | Course Title |
|---|---|---|
| **1st Semester** | **Theory (Core Courses)** | |
| | MBOT 1301 | Plant Ecology and Ecosystem Management |
| | MBOT 1302 | Biodiversity and Plant Resources Management |
| | MBOT 1303 | Applied Ethnobotany |
| | MBOT 1304 | Limnology and Aquaculture |
| **2nd Semester** | **Theory (Core Courses)** | |
| | MBOT 2301 | Environmental Microbiology |
| | MBOT 2302 | Molecular Stress Physiology |
| | MBOT 2303 | Agronomy and Crop Management |
| **3rd Semester** | **Viva-voce** | |
| | MBOT 3301 | General viva-voce |
| | **Practical** | |
| | MBOT 3302 | Plant Ecology and Ecosystem Management |
| | MBOT 3303 | Biodiversity and Plant Resources Management |
| | MBOT 3304 | Applied Ethnobotany |
| | MBOT 3305 | Limnology and Aquaculture |
| | MBOT 3306 | Environmental Microbiology |
| | MBOT 3307 | Molecular Stress Physiology |
| | MBOT 3308 | Agronomy and Crop Management |
| | **Research Project** | |
| | MBOT 3309 | Research Project |
| | **Thesis** | |
| | MBOT 3310 | Thesis |
| | **Thesis presentation and defense/viva** | |
| | MBOT 3311 | Thesis presentation and defense/viva |



## 16. Mapping courses with PLOs

| Courses | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO1** | **PLO2** | **PLO3** | **PLO4** | **PLO5** | **PLO6** | **PLO7** |
| **Specialization 1: Advanced Botany** | | | | | | | |
| **1st Semester** | | | | | | | |
| MBOT 1101 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |
| MBOT 1102 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| MBOT 1103 | 2 | 3 | 3 | 2 | 3 | 3 | 3 |
| MBOT 1104 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| **2nd Semester** | | | | | | | |
| MBOT 2101 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| MBOT 2102 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| MBOT 2103 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| MBOT 2104 | 3 | 2 | 2 | 3 | 3 | 2 | 3 |
| **3rd Semester** | | | | | | | |
| **Viva-voce** | | | | | | | |
| MBOT 3101 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Practical** | | | | | | | |
| MBOT 3102 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| MBOT 3103 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| MBOT 3104 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| MBOT 3105 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| MBOT 3106 | 3 | 3 | 3 | 2 | 2 | 2 | 3 |
| MBOT 3107 | 2 | 3 | 2 | 2 | 3 | 3 | 3 |
| MBOT 3108 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| MBOT 3109 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| **Research Project** | | | | | | | |
| MBOT 3110 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Thesis** | | | | | | | |
| MBOT 3111 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Thesis presentation and defense/viva** | | | | | | | |
| MBOT 3112 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| **Specialization 2: Plant Biotechnology** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1st Semester** | | | | | | | |
| MBOT 1201 | 3 | 2 | 2 | 2 | 3 | 3 | 2 |
| MBOT 1202 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| MBOT 1203 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| MBOT 1204 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| MBOT 1205 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |
| **2nd Semester** | | | | | | | |
| MBOT 2201 | 1 | 2 | 2 | | 1 | 2 | 1 |
| MBOT 2202 | 3 | 2 | 2 | 2 | 3 | 2 | 2 |
| MBOT 2203 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| MBOT 2204 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |

| 3rd Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Viva-voce** | | | | | | | |
| MBOT 3201 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Practical** | | | | | | | |
| MBOT 3202 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| MBOT 3203 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| MBOT 3204 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| MBOT 3205 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| MBOT 3206 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| MBOT 3207 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| MBOT 3208 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| MBOT 3209 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| MBOT 3210 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| **Research Project** | | | | | | | |
| MBOT 3211 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Thesis** | | | | | | | |
| MBOT 3212 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Thesis presentation and defense/viva** | | | | | | | |
| MBOT 3213 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| **Specialization 3: Environmental Botany** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1st Semester** | | | | | | | |
| MBOT 1301 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| MBOT 1302 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| MBOT 1303 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| MBOT 1304 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| **2nd Semester** | | | | | | | |
| MBOT 2301 | 2 | 3 | 3 | 3 | 2 | 2 | 3 |
| MBOT 2302 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| MBOT 2303 | 3 | 2 | 2 | 2 | 3 | 2 | 2 |
| **3rd Semester** | | | | | | | |
| **Viva-voce** | | | | | | | |
| MBOT 3301 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Practical** | | | | | | | |
| MBOT 3302 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |
| MBOT 3303 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| MBOT 3304 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| MBOT 3305 | 2 | 2 | 2 | 3 | 2 | 3 | 3 |
| MBOT 3306 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |
| MBOT 3307 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| MBOT 3308 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| **Research Project** | | | | | | | |
| MBOT 3309 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Thesis** | | | | | | | |
| MBOT 3310 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Thesis presentation and defense/viva** | | | | | | | |
| MBOT 3311 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

# List of Present Teachers of the Department of Botany

## Chairman: Professor Dr. Mohammad Shahidul Alam

| Sl | Name of Teachers | Designation | Field of Specialization | Email & Contact No. |
|---|---|---|---|---|
| 1. | Dr. Mohammad Shahidul Alam | Professor | Mycology; Plant Pathology | sarubot61@gmail.com 01715138818 |
| 2. | Dr. Sabrina Naz | Professor | Aquatic Diversity; Conservation Limnology | drsabrina_naz@ru.ac.bd 01715178196 |
| 3. | Dr. Md. Zahangir Alam | Professor | Plant Physiology | zabotbd@ru.ac.bd 01798298832 |
| 4. | Dr. Most. Ferdousi Begum | Professor | Microbiology | ferdrita@yahoo.com 01712122968 |
| 5. | Dr. Lipika Ghosh | Professor | Fern Biology | lipika_ru@yahoo.com 01716389838 |
| 6. | Dr. Gour Pada Ghosh | Professor | Ethnobotany; Climate Change and Plant Adaptation | ghosh.g.p@ru.ac.bd 01716055860 |
| 7. | Dr. Farzana Ashrafi Neela | Professor | Microbiology | nfarzanaashrafi@yahoo.com 01732465793 |
| 8. | Dr. A.H.M. Mahbubur Rahman | Professor | Plant Taxonomy; Biosystematics | drrahmanahmm@ru.ac.bd 01714657224 |
| 9. | Dr. Mst. Ferdowsi Mahal | Professor | Plant Pathology; Seed Science and Technology | mini_mahal@ru.ac.bd 01717769370 |
| 10. | Dr. M. A. K. Azad | Professor | Plant Tissue Culture; Proteomics | azad@ru.ac.bd 01746077255 |
| 11. | Dr. Shamima Nasrin Sima | Professor | Plant Anatomy | sima_bot2006@yahoo.com 01711274531 |
| 12. | Dr. Rubaiyat Sharmin Sultana | Professor | Plant Anatomy; Wood Science | sultanaru@yahoo.com 01715795813 |
| 13. | Dr. Ahmed Imtiaj | Professor | Mycology, Pathology, Mushroom Biology | aimtiajbot@ru.ac.bd 01714118546 |
| 14. | Dr. Md. Sarwar Parvez | Professor | Genetics; Plant Biotechnology | sarwarparvez@yahoo.com 01712192477 |
| 15. | Dr. F M Ali Haydar | Professor | Plant Breeding; Biometrical Genetics | fmalihaydar@gmail.com 01711238081 |
| 16. | Dr. Md. Nasiruddin | Professor | Biotechnology; Plant Breeding and Genetics | mnuddin@ru.ac.bd 01719417225 |
| 17. | Dr. Md. Rezaul Karim (Study Leave) | Professor | Biotechnology, Molecular Biology; Bioinformatics | mrkarimbot@ru.ac.bd/ 01714461267 |
| 18. | Dr. Md. Hasanur Rahman | Professor | Plant Ecology; Environmental Management | hasanur7@yahoo.com 01746108338 |
| 19. | Dr. Uthpal Krishna Roy | Associate Professor | Cell Biology; Plant Stress Biology; Plant Diversity | roy.uthpalbt@ru.ac.bd 01717450897 |
| 20. | Dr. Ahmad Humayan Kabir (Study Leave) | Associate Professor | Molecular Plant Stress Physiology; Phytoremediation | ahmad.kabir@ru.ac.bd 01717134836 |
| 21. | Dr. Umme Qulsum | Associate Professor | Molecular Biology; Bioinformatics | qulsum@ru.ac.bd 01308145565 |
| 22. | Dr. Md. Mostafizur Rahman | Associate Professor | Molecular Plant Stress Physiology | muradbt@ru.ac.bd 01717450964 |
| 23. | Dr. Saika Kabir Nitu | Associate Professor | Plant Ecology | nitu.saikakabir@gmail.com 01712272336 |
| 24. | Dr. Rony Rani | Associate Professor | Plant Taxonomy | ronyranibot@gmail.com 01916536428 |
| 25. | Md. Mamunur Rashid Sarkar | Associate Professor | Cell Biology; Cytogenteics | mrsarkar_bot@ru.ac.bd 01710569271 |
| 26. | Md. Omar Faruq | Assistant Professor | Ethnobotany | omrfrq39@gmail.com 01670754455 |

## Specialization 1: Advanced Botany

The courses offered under this group provide an advanced knowledge in Plant Science. Aim of this group is enabling the students to pursue higher education /research or jobs in the educational / research organizations and/or NGOs dealing with Plant Sciences at any level of their activities.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1101 | | |
| **Course Title** | : Plant Systematics | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : AHM Mahbubur Rahman | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The course highlighted systematics of higher plants and evolutionary history of plant life. It also includes divides plants into taxonomic groups, using morphological, anatomical, embryological, chromosomal, numerical, molecular and chemical data, remote sensing technology, Invasive Alien Species and systematic study of important selected plant families. This knowledge is crucial for improving systematics of angiosperms and helpful for students about plant identification, conservation, modern classification.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | understand the fundamental values of advanced plant systematics and gather knowledge on classification and phylogenetic relationship of plant taxa; | U |
| CLO 2 | analyze the methods and principles of classification and nomenclature; | An |
| CLO 3 | plan desk, lab and field-based studies of angiosperm diversity, identifying morphological specialties and writing short species descriptions and illustrations; | C |
| CLO 4 | identify members of the major angiosperm families by observing their diagnostic features and phylogenetic importance. | An |

U-Understanding; An-Analyze; C-Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 2 | 1 | 2 | 3 | 2 | 3 |
| CLO 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 |
| CLO 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| CLO 4 | 2 | 3 | 2 | 2 | 3 | 3 | 2 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Origin and evidences of vascular plants (General evolutionary trends in flowering plants)** | **20** | |
| 1.1 | Leaf structure | 1 | 1 |
| 1.2 | Vascular bundles | 1 | 1 |
| 1.3 | Inflorescence | 1 | 1 |
| 1.4 | Flowers | 1 | 1 |
| 1.5 | Fruits | 1 | 1 |
| 1.6 | External morphology | 1 | 1 |
| | Anatomy | 1 | 1 |
| 1.7 | Cytology | 1 | 1 |
| 1.8 | Palynology | 1 | 1 |
| 1.9 | Brief history of chemosystematics | 1 | 1 |
| 1.10 | Chemical characters and their use in plant syatematics | 1 | 1 |
| 1.11 | Brief history and importance of serotaxonomy | 1 | 1 |
| 1.12 | The population concept, causes of variation | 1 | 1 |
| 1.13 | Physical and genetic factors, interaction of a factor, Abrupt and gradual speciation | 1 | 1 |
| 1.14 | The relationships of taxonomy and biosystematics, units of micro-evolutionary dynamics, evolution and differentiation of species | 1 | 1 |
| 1.15 | Methods in biosystematic study and biosystematic categories | 1 | 1 |
| 1.16 | Numerical taxonomy: definition, principles, character correlation and discrimination | 1 | 1 |
| 1.17 | Advantages and application of numerical taxonomy | 1 | 1 |
| 1.18 | Hybridization: types of hybridization, hybrid complexes, taxonomic treatment of hybrids | 1 | 1 |
| 1.19 | Stabilization of hybrids in nature | 1 | 1 |
| 1.20 | Breeding system, out breeding and inbreeding system, reproductive biology study methods | 1 | 1 |
| **2.0** | **Systematics: Principles of Plant Systematics** | **25** | |
| 2.1 | Aims and objectives of plant systematics | 1 | 2 |
| 2.2 | Needs for classification, taxonomic hierarchy, uses of categories | 1 | 2 |
| 2.3 | Taxonomy and systematics | 1 | 2 |
| 2.4 | Concept of taxa: concept of species | 1 | 2 |
| 2.5 | Typological species concept, biological species concept, phylogenetic species concept and alternative species concept | 1 | 2 |
| 2.6 | Traditional concept of species, taxonomic species concept, | 1 | 2 |

| | | | |
|---|---|---|---|
| | microspecies, biosystematic concept of species | | |
| 2.7 | Numerical concept of species, morhospecies, evolutionary species, multi-dimensional and non-dimensional species concept | 1 | 2 |
| 2.8 | The concept of genus, family and above the rank of family level | 1 | 2 |
| 2.9 | Development of Pre-Darwinian and Post-Darwinian plant systematics | 1 | 2 |
| 2.10 | Presentation of phylogenetic relationships | 1 | 2 |
| 2.11 | A critical evaluation of modern plant systematics | 1 | 2 |
| 2.12 | Systematic position of the following plants:Rice, wheat, maize, mango, jackfruit, litchi, pineapple, banana, lemon, plum, wood apple, guava | 1 | 2 |
| 2.13 | Remote Sensing Technology (RST) and vegetation classification: History, principles and types | 1 | 2 |
| 2.14 | Advantages and limitations of Remote Sensing Technology | 1 | 2 |
| 2.15 | Application of Remote Sensing in Forest Resource Management | 1 | 3 |
| 2.16 | Botanical library: Introduction, common terms come across in a botanical library, use of botanical library, | 1 | 3 |
| 2.17 | Major botanical libraries of the world, future information systems | 1 | 3 |
| 2.18 | Invasive Alien Species (IAS) and Alien species | 1 | 3 |
| 2.19 | Control measures of Invasive Alien Species | 1 | 3 |
| 2.20 | Management strategy of Invasive Alien Species | 1 | 3 |
| 2.21 | DNA Barcoding, steps of DNA Barcoding and its application | 1 | 3 |
| 2.22 | Presentation of Data: Monographs | 1 | 3 |
| 2.23 | Revisions | 1 | 3 |
| 2.24 | Floristic works | 1 | 3 |
| 2.25 | Dichotomous keys | 1 | 3 |
| **3.0** | **Detailed study of Families: Study the following families with their phylogenetic and economic importance.** | **15** | |
| 3.1 | Acanthaceae | 1 | 4 |
| 3.2 | Amaranthaceae | 1 | 4 |
| 3.3 | Araceae | 1 | 4 |
| 3.4 | Chinopodiaceae | 1 | 4 |
| 3.5 | Combretaceae | 1 | 4 |
| 3.6 | Convolvulaceae | 1 | 4 |
| 3.7 | Myrtaceae | 1 | 4 |
| 3.8 | Meliaceae | 1 | 4 |
| 3.9 | Malvaceae | 1 | 4 |
| 3.10 | Moraceae | 1 | 4 |

| | | | |
|---|---|---|---|
| 3.11 | Nymphaeaceae | 1 | 4 |
| 3.12 | Rubiaceae | 1 | 4 |
| 3.13 | Sapotaceae | 1 | 4 |
| 3.14 | Sterculiaceae | 1 | 4 |
| 3.15 | Tiliaceae | 1 | 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Bhattacharya, B. and Johri, B.M. 1998. Flowering Plants: Taxonomy and Phylogeny. Narosa Publishing House, New Delhi. India.
2. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, U.S.A.
3. Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd Ltd, Edinburgh, London, UK.
4. International Code of Botanical Nomenclature: Melbourne Code 2011. Australia.
5. Radford, A.E. 1974. Vascular Plants Systematics. Harper and Row Publishers. New York.
6. Sharma, O.P. 2004. Plant Taxonomy. Tata MacGraw Hill Publihing Co. Ltd. New Delhi.
7. Shukla, P. and Misra, S.P. 2003. An Introduction to Taxonomy of Angiosperms. Vikas Publishing House Pvt Ltd. New Delhi, India.
8. Subrahmanyam, N.S. 2004. Modern Plant Taxonomy. Vikas Publishing House Pvt Ltd. New Delhi, India.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1102 | | |
| **Course Title** | : Physiology of Higher Plants | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Md. Zahangir Alam | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

This course is designed to know the major biomolecules, juvenility, maturity and senescence, metabolism and its regulation, address environmental challenges, biochemical pathways, energy relationship, translocation of solutes, and analyze plant traits, plant base defensive products, and crop improvement.

**Course Learning Outcomes (CLOs)**

| CLO no. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | describe chemical composition of plants; | U |
| CLO 2 | perceive and compare the various aspects of plant metabolism; | E |
| CLO 3 | explain the basic aspects of plant metabolic regulation; | Ap |
| CLO 4 | recognize the pattern of senescence, Analyze energy relations and modern concept of ATP synthesis; | Ap, An |
| CLO 5 | develop and design the various methods of crop improvement against stress; Develop basic skills and techniques for qualitative and qualitative analysis of physiological parameters. | C |

U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CLO 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| CLO 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| CLO 4 | 3 | 3 | 2 | 2 | 2 | 2 | 3 |
| CLO 5 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Biomolecules** | **10** | |
| 1.1 | Origin and evolution of biomolecules | 2 | 1 |
| 1.2 | Carbohydrate | 2 | 1 |
| 1.3 | Protein | 1 | 1 |
| 1.4 | Lipid | 2 | 1 |

| | | | |
|---|---|---|---|
| 1.5 | Nucleic acid | 1 | 1 |
| **2.0** | **Metabolism** | **8** | |
| | | | |
| 2.1 | Definition, types, interrelationship between anabolism and catabolism | 2 | 2 |
| 2.2 | Description of Anbolism, catabolism and amphibolism | 2 | 2 |
| 2.3 | Inter-conversion of carbohydrate, protein and lipid | 2 | 2 |
| 2.4 | Phloem loading and unloading, mechanism of translocation through phloem | 2 | 3 |
| | | | |
| **3.0** | **Terpenoids** | **6** | |
| 3.1 | Classification, chemistry distribution and importance | 4 | 1 |
| 3.2 | Essential oils, sesquiterpene, diterpene and gibberellins, triterpenes and steroids and tetraterpenes | 2 | 1 |
| | | | |
| **4.0** | **Senescence physiology** | **7** | |
| 4.1 | Juvenility, maturity and senescence | 1 | 4 |
| 4.2 | Pattern of senescence | 3 | 4 |
| 4.3 | Physiological changes during senescence | 3 | 4 |
| | | | |
| **5.0** | **Fruit development** | **7** | |
| 5.1 | Fruit setting and fruit growth | 2 | 3 |
| 5.2 | Chemical changes during fruit development | 3 | 3 |
| 5.3 | Fruit ripening (natural and artificial) | 2 | 3 |
| | | | |
| **6.0** | **Stress physiology** | **7** | |
| 6.1 | Definition, types | 1 | 5 |
| 6.2 | Water stress (shortage and logging) | 2 | 5 |
| 6.3 | Temperature stress (high and low) | 2 | 5 |
| 6.4 | Ionic toxicity (salt stress) | 2 | 5 |
| | | | |
| **7.0** | **Energy relations** | **9** | |
| 7.1 | Introduction, flow of energy and matter in biological world | 1 | 5 |
| 7.2 | Application of laws of thermodynamics in biological processes | 1 | 5 |
| 7.3 | Standard free energy change and equilibrium constant | 1 | 5 |
| | Phosphorylation: oxidative, photosynthetic and substrate | 3 | 5 |
| 7.4 | Chemi-osmotic theory of ATP synthesis on chloroplast and mitochondrial membrane | 3 | |
| | | | |
| **8.0** | **Metabolic regulation** | **6** | |

| | | | |
|---|---|---|---|
| 8.1 | Control through structure and organization | 2 | 7 |
| 8.2 | Control through competition of metabolites | 2 | 7 |
| 8.3 | Control through enzyme activity | 1 | 7 |
| 8.4 | Control through enzyme synthesis | 1 | 7 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**

1. Fitter, A. and Hay, R. 2012. Environmental Physiology of Plants. Elsevier Publishing House,Netharlands.
2. Hopkins, W. and Huner, N. 2008. Introduction to Plant Physiology. John Willey and sons, Inc. USA.
3. Jain, V.K. 2015. Plant Physiology. S Chand and Co, India.
4. Mukherji, S. and Ghosh, A.K. 2015. Plant Physiology. New Central Book Agency, India.
5. Pandey, S.N. and Sinha, B.K. 2001. Plant Physiology. Vikas Publishing House, India.
6. Ridge, I. 1996. Plant Physiology. Hodder-Arnold publisher, UK.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1103 | | |
| **Course Title** | : Applied Mycology | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Ahmed Imtiaj | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Applied Mycology is concerned with the study of fungi in applied aspect, including their unique features, physiology, genetics, industrial use and biotechnology as a source of medicine, food and entheogens, as well as their toxicity and mode of infections. This course is significant to agriculture, mushroom farming, mushroom bio-products, pharmaceuticals, alternatives medicine, industry, food production and environmental studies as decomposers of organic material and pollutants in recycling nutrients and maintaining global carbon cycle.

**Course Learning Outcomes (CLOs)**

| **CLO No.** | **Expected Course Outcomes**<br>Upon completion of this course, the students will be able to: | **Cognitive Level** |
|---|---|---|
| CLO 1 | define morphological and genetical features with reproduction systems; understand the importance of fungi in natural ecological systems, economics as well as human civilization; | U |
| CLO 2 | explores the need for advance and applied mycology studies to allow the development of various applied disciplines including growth, development, physiology, metabolisms and pathological relation in agriculture and animals; understand fungal different biotechnological processes and applications in agricultural, pharmaceutical and industries; obtain the importance of fungi as a source of alternative resources, renewable energy and biocontrol agents; | An |
| CLO 3 | interpret the role of various fungi (Lichen and Mycorrhiza) in the biomonitoring of environmental quality (fungi as bioindicators); | An |
| CLO 4 | be skilled to apply various biotechnological methods in laboratory, agriculture and industry; | Ap |
| CLO 5 | obtain a global vision of fungi from the perspective of its versatile roles in various disciplines in which they participate. | E |

U-Understanding; Ap-Apply; An-Analyze; E-Evaluate

**Mapping CLOs with PLOs**

| **CLOs** | **Program Learning Outcomes (PLOs)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| CLO 1 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CLO 2 | 2 | 3 | 3 | 2 | 2 | 1 | 3 |
| CLO 3 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| CLO 4 | 2 | 3 | 2 | 2 | 1 | 3 | 2 |
| CLO 5 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction to fungi** | **7** | |
| 1.1 | Comparative approach of fungi with those of animals and plants | 3 | 1,2 |
| 1.2 | The major role of various fungi (especially Mycorrhiza and lichen) in the biomonitoring of environmental quality (fungi as bioindicators) | 2 | 1,2,3 |
| 1.3 | Origin and phylogeny of fungi | 2 | 1 |
| **2.0** | **Vegetative and cellular structure of fungi** | **4** | |
| 2.1 | Architecture of fungal vegetative structures | 2 | 1,3 |
| 2.2 | General and ultra-structure of fungal cell | 2 | 1,3 |
| **3.0** | **Reproduction of fungi** | **7** | |
| 3.1 | Vegetative, asexual and sexual reproduction systems | 3 | 1 |
| 3.2 | Mode of life cycles | 1 | 1 |
| 3.3 | Spore release and dispersal | 2 | 1,3 |
| 3.4 | Dormancy and germination of fungal spores | 1 | 1,3 |
| **4.0** | **Fungal growth and development** | **4** | |
| 4.1 | Mechanisms of fungal growth | 2 | 1 |
| 4.2 | Measurement of kinetics of growth | 2 | 2,3 |
| **5.0** | **Fungal physiology, metabolisms and metabolites** | **9** | |
| 5.1 | Biodegradation, biodeterioration and bioremediation | 2 | 1,2,3 |
| 5.2 | Pathways of carbohydrates, nitrogen and lipid metabolism | 3 | 1,3 |
| 5.3 | Metabolites: Vitamin, toxins, phytoalexins and hormones of fungi | 4 | 3,4,5 |
| **6.0** | **Pathological relationship of fungi in agriculture and animals** | **7** | |
| 6.1 | Saprophytic, parasitic and disease causing fungi | 3 | 1,2 |
| 6.2 | Parasites of plants, human, animals, nematodes and arthropods | 3 | 1,3 |
| 6.3 | Biological control: fungi as agents of biological control | 1 | 2,3 |
| **7.0** | **Mushroom science** | **15** | |
| 7.1 | **(A) Introduction to mushrooms:** Definition; History; Classification; Strategies of identification, isolation and various preservation techniques; Vegetative diversity; toxicity | 7 | 1,3 |
| 7.2 | **(B) Various cultivation techniques of mushrooms**: Suitable conditions; Preparation of solid and liquid cultures; Spawn preparation; Bag, bottle, shelf and log cultivations | 4 | 2,3,4 |
| 7.3 | **(C) Importance of mushrooms**: Nutritional and | 4 | 1,2 |

| | | | |
|---|---|---|---|
| | medicinal values; Cultivation and poverty alleviation; Economic and environmental importance | | |
| **8.0** | **Genetics and applied molecular study for fungi** | **7** | |
| 8.1 | Structure and organization of fungal genome | 2 | 1 |
| 8.2 | Classical (Mendelian) genetics in fungi (*Neurospora*, *Schizophyllum* sp.) | 1 | 1,3 |
| 8.3 | Applied molecular genetics of fungi | 1 | 1,3, |
| 8.4 | Sexual and non-sexual genetic variation | 3 | 1,3 |
| **9.0** | **Biotechnology and industrial use of fungi** | **3** | |
| 9.1 | Industrial mycology: Food processing and spoilage, Alcoholic fermentations and fermented foods | 2 | 5,7,8 |
| 9.2 | Medicines originated from fungi | 1 | 4,7 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Bahl, N., 1984. Handbook of Mushroom. Oxford IBH Publishing Co., New Delhi, Delhi, India.
2. Deacon, J.W., 2006. Fungal Biology (4th Edition). Blackwell Publishing Ltd. 9600 Garsington Road, Oxford OX4 2DQ, UK.
3. Dube, H.C., 1990. An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., New Delhi-110014.
4. Fletcher, J.T. and Gaze, R.H., 2007. Mushroom Pests and Disease Control: A Colour Handbook. CRC Press, Elsevier.
5. Imtiaj, A., 2013. Mushrooms Biology (In Bengali). JatiyaGronthaPrakashan, Dhaka, Bangladesh.
6. Moore-Landecker, E., 1996. Fundamentals of the Fungi. 4th Edition, Prince Hall International.
7. Sharma, O.P., 1999. Textbook of Fungi. Tara McGraw Hill Pub. Comp. Ltd., New Delhi-110008.
8. Vashista, B.R., 1990. Fungi, Botany for Degree Students. 9th Edition, Chand & Company Ltd., Ram Nagar, New Delhi-110055.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1104 | | |
| **Course Title** | : Fern Biology | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Lipika Ghosh | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Ferns have a significant role as a phytogenetic intermediary connecting lower and higher plants. Fern biology course is designed to equip students with the knowledge of sporogenesis, gametogenesis, environmental sex determination, ecology, diversity of ferns and their importance in research, medicine and other industry. This course ensures the resource conservation, preservation and utilization of ferns with the skills through identification and propagation for the benefit of society and the environment.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | Describe various aspects of fern and fern allies; | U |
| CLO 2 | explores various topics including characteristics, habit, habitat, structure, development, physiology, role of different environmental factors, reproduction and sex determination; | Ap |
| CLO 3 | be skilled to apply various techniques used in laboratory, agriculture and industry. | C |

U-Understanding; Ap-Apply; C-create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 3 | 2 | 3 | 3 | 2 |
| CLO 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| CLO 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course Contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction** | **4** | |
| 1.1 | Characters and terminology of fern | 1 | 1, 2 |
| 1.2 | Origin and phylogeny of fern | 1 | 1, 2 |
| 1.3 | Molecular Taxonomy of fern | 1 | 1, 2 |
| 1.4 | Status of fern and fern allies in Bangladesh | 1 | 2,3 |
| | | | |

| | | | |
|---|---|---|---|
| **2.0** | **Economic importance of Fern and Fern-allies** | **3** | |
| 2.1 | General importance | 1 | 1,3 |
| 2.2 | Medicinal importance | 1 | 1,3 |
| 2.3 | Ecological importance | 1 | 1,3 |
| | | | |
| **3.0** | **Reproduction in Fern** | **7** | |
| 3.1 | Monoecious and dioecious | 2 | 1,3 |
| 3.2 | Vegetative, asexual and sexual reproduction | 3 | 1,3 |
| 3.3 | Propagation of sporophyte and gametophyte | 2 | 1,3 |
| | | | |
| **4.0** | **Apogamy** | **3** | |
| 4.1 | Obligate and induced apogamy | 1 | 2 |
| 4.2 | Causes of apogamy | 1 | 2 |
| 4.3 | Cytology of apogamy | 1 | 2 |
| | | | |
| **5.0** | **Apospory** | **3** | |
| 5.1 | Natural and induced apospory | 1 | 2 |
| 5.2 | Causes of apospory | 1 | 2 |
| 5.3 | Cytology of apospory | 1 | 2 |
| | | | |
| **6.0** | **Sporogenesis** | **6** | |
| 6.1 | Sporangial structure | 1 | 2,3 |
| 6.2 | Ontogeny of the sporangium in homosporous and heterosporous fern | 2 | 1,3 |
| 6.3 | Dehiscence of sporangium | 1 | 1,3 |
| 6.4 | Structure of spore | 1 | 1,3 |
| 6.5 | Different types of spore and sorus | 1 | 1,3 |
| | | | |
| **7.0** | **Gametogenesis and fertilization** | **10** | |
| 7.1 | Different type of adult prothallus | 2 | 1,3 |
| 7.2 | Ontogeny of Antheridium and Archegonium | 2 | 1.3 |
| 7.3 | Spermatogenesis | 2 | 1,3 |
| 7.4 | Oogenesis | 2 | 1.3 |
| 7.5 | Fertilization | 2 | 1,3 |
| | | | |
| **8.0** | **Environmental sex determination in pteridophytes** | **6** | |
| 8.1 | Different environmental factors | 2 | 1,3 |
| 8.2 | Protandrous and protogynous | 1 | 1,3 |
| 8.3 | Antheridiogen | 1 | 1,3 |
| 8.4 | Model ferns and their importances | 2 | 1,3 |
| | | | |
| **9.0** | **Ecology** | **4** | |
| 9.1 | Habit and distribution | 2 | 1 |
| 9.2 | Habitat: Terrestrial, Aquatic, Xerophytic | 2 | 1 |
| | | | |
| **10.0** | **Conservation** | **6** | |

| | | | |
|---|---|---|---|
| 10.1 | Levels of threats and the need for conservation | 2 | 1,3 |
| 10.2 | Conservation strategies | 2 | 1,3 |
| 10.3 | Restoration | 2 | 1,3 |
| **11.0** | **Growing fern from spore** | **4** | |
| 11.1 | Sources and collecting of spore | 2 | 1,3 |
| 11.2 | Cleaning and sowing of spore | 2 | 1,3 |
| **12.0** | **Some selective Pteridophytes with their scientific name, English name and family name** | **4** | 3 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Ashoke, M. Bendre, and Kumar, A. 2009. A Text Book of Practical Botany. Rastogi Publications, Gangotri Shivaji Road, Meerut- 250002, India,
2. David, B. Lellinger, 1985. A field manual of the Ferns and Ferns Allies. Smithsonian Institution Press, U.S.A.
3. Raghavan, V. 1989. Developmental Biology of Fern Gametophytes. Cambridge Univesity Press, London.
4. Rajan, S. 1994. Introduction to Pteridophyta . New Age International Publishers Ltd., Wiley Eastern Ltd., New Delhi, Bangalore, Bombay, Calcutta, Guwahati, Hyderabad, Lacknow, Madras, Pune, London.
5. Rashid, A. 1999. An Introduction to Pteridophyta. Vikash Publ. (2nd ed) House Pvt. Ltd. New Delhi.
6. Robin, C. Moran, 2009. A natural History of ferns. Timber Press, U.S.A.
7. Sporne, K.R. 1970. The Morphology of pteridophytes (The structure of Ferns and Allied Plants). Hutchinson University Library, London.
8. Tom, A. Ranker, 2008. Biology and Evolution of Ferns and Lycophytes. Cambridge Univesity Press, London.
9. Tryon, R.M. and Tryon, H.N. 1982. Ferns and Allied Plants. Springer-Verlag, New York.
10. Vashishta, B.R. 2005. Pteridophytes. S. Chand and Com. Ltd. New Delhi.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2101 | | |
| **Course Title** | : Plant Histology | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Shamima Nasrin Sima | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Plant histology, the microscopic study of plant tissues, is crucial for understanding plant structure, function, and growth. It provides insights into tissue types like meristematic, vascular, and dermal, essential for processes like nutrient transport and protection. This knowledge advances agriculture, forestry, and biotechnology, aiding in crop improvement, disease diagnosis, and tissue culture. By addressing challenges like food security and climate change, plant histology underpins sustainable agricultural practices and biodiversity conservation.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | describe Cell, Cell Wall and Epidermis; | U |
| CLO 2 | describe apical meristem, vascular cambium, and vascular differentiation; describe different types of primary and secondary tissues; | U |
| CLO 3 | demonstrate a general familiarity with basic plant structure and organs; the detail structure of roots, stems and leaves of plants; | A |
| CLO 4 | learn types of wood, physical and mechanical characteristics of wood, internal structure of wood of important plants; | E |
| CLO 5 | Apply microtomy technique to internal structure of plant samples. | Ap |

U-Understanding; An-Analyze; E-Evaluate; AP- Apply

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 1 | 2 | 2 | 1 | 1 |
| CLO 2 | 3 | 3 | 1 | 2 | 2 | 1 | 1 |
| CLO 3 | 2 | 2 | 3 | 3 | 3 | 1 | 2 |
| CLO 4 | 2 | 3 | 2 | 3 | 2 | 1 | 2 |
| CLO 5 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Cell** | **3** | |
| 1.1 | Cellular complexity of plants and types | 1 | 1 |

| | | | |
|---|---|---|---|
| 1.2 | Cellular arrangement | 1 | 1 |
| 1.3 | Cellular development and adjustment during growth | 1 | 1 |
| | | | |
| **2.0** | **Cell wall** | **5** | |
| 2.1 | Cell wall development and gross structure | 1 | 1 |
| 2.2 | Ultra structure of different types of thickenings | 1 | 1 |
| 2.3 | Origin, development and structure of middle lamella | 1 | 1 |
| 2.4 | Sculpture, modifications and chemical nature of cell wall | 2 | 1 |
| | | | |
| **3.0** | **Apical meristem** | **10** | |
| 3.1 | Definition, delimitation and structure | 2 | 1,2 |
| 3.2 | Different growth zones initials and their derivatives | 1 | 1,2 |
| 3.3 | Vegetative and reproductive apical meristem | 2 | 1,2 |
| 3.4 | Origin and development of leaves, buds, flowers and inflorescence from apical meristem | 3 | 1,2 |
| 3.5 | Theories of apical organization in plants | 2 | 1,2 |
| | | | |
| **4.0** | **The epidermis** | **3** | |
| 4.1 | Origin,structure ,types and function of stomata trichomes hairs. | 2 | 1,2 |
| 4.2 | Multiple Epidermis | 1 | 1,2 |
| | | | |
| **5.0** | **Vascular cambium** | **4** | |
| 5.1 | Origin, structure, types | 2 | 1,2 |
| 5.2 | Location function and cytoplasmic characters of vascular cambium | 2 | 1,2,3 |
| | | | |
| **6.0** | **Vascular differentiation** | **6** | |
| 6.1 | Pattern of vascular differentiation in higher plant | 1 | 2,3 |
| 6.2 | Origin and development | 2 | 1,2 |
| 6.3 | Structure and function of procambium | 1 | 1,2,3 |
| 6.4 | Differentiation of vascular tissues from procamabial ring | 2 | 2,3,4 |
| | | | |
| **7.0** | **Mechanical tissue in plants** | **4** | |
| 7.1 | Their origin and structure | 2 | 3,4 |
| 7.2 | Distribution and function | 2 | 3,4 |
| | | | |
| **8.0** | **Secretary structure** | **3** | |
| 8.1 | Origin and development | 1 | 2,3,4 |
| 8.2 | Classification, occurrence and function | 1 | 2,3,4 |
| 8.3 | External and internal Secretory Structures | 1 | 2,3,4 |
| | | | |
| **9.0** | **Laticifers** | **2** | |
| 9.1 | Origin and development | 1 | 2,3,4 |

| | | | |
|---|---|---|---|
| 9.2 | Types, structure, function and distribution in plants | 1 | 2,3,4 |
| | | | |
| **10.0** | **Histology of Angiosperms** | **3** | |
| 10.1 | Leaf, Stem and Root | 3 | 2,3,4 |
| | | | |
| **11.0** | **Periderm and lenticels** | **3** | |
| 11.1 | Origin, Types, development and structure | 2 | 2,3,4 |
| 11.2 | Location and function | 1 | 2,3,4 |
| | | | |
| **12.0** | **Wood anatomy** | **6** | |
| 12.1 | Soft and hard wood, properties of wood-moisture | 1 | 4 |
| 12.2 | Density, strength, conductivity, heat and energy | 2 | 4 |
| 12.3 | Growth ring and compression tension | 1 | 4 |
| 12.4 | Grain texture, colour, odor and taste | 1 | 4 |
| 12.5 | Identification of timber | 1 | 4 |
| | | | |
| **13.0** | **Internal structure of wood of important plant species** | **4** | |
| 13.1 | *Tectonagrandis, Shorearobusta, Artocarpusheterophylea, Mangiferaindica, Salmania, malabarica,Magnolia champaka* | 4 | 4 |
| | | | |
| **14.0** | **Plant microtomy** | **4** | |
| 14.1 | Collection, preservation ,fixing paraffin block preparation of plant samples | 2 | 5 |
| 14.2 | Sectioning, staining and mounting of plant materials | 2 | 5 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Charles, B. Beck, 2010. An Introduction to Plant Structure and Development. Cambridge University Press, UK.
2. Cutter, E.G. 1969. Plant Anatomy: Part l and Part ll, Edward Arnold Publ., UK.
3. Dickison, W.C. 2000. Integrative Plant Anatomy. Academic Press, USA.
4. Eames, A.J. and MacDaniels, L.H. 1947. An Introduction to Plant Anatomy: McGraw-Hill, NY.
5. Esau, K. 1953. Plant Anatomy: John Wiletsons, NY.
6. Fahn, A. 1967. Plant Anatomy. Pergamon Press, Oxford.
7. Johansen, D.A. 1940. Plant Microtechnique. McGraw-Hill, NY.
8. Wardlaw, C.W. 1968. Morphogenesis in Plants. Methwen Co. Ltd. UK.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2102 | | |
| **Course Title** | : Plant Pathology and Plant Protection | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Mohammad Shahidul Alam | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Rationale of the course: Phytopathology (Phyton: plant) Greek - Pathos (suffering) + Logos (study) = The study of the suffering plant. Plant pathology is that branch of agricultural, botanical or biological sciences which deals with the study of: Cause of the disease, factor affecting plant diseases, assessment of disease and resulting losses, management of plant disease using host resistance biological control and integrated disease management control protocol.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | know the history and causes of plant diseases; | U |
| CLO 2 | understand, apply and evaluate the knowledge of plant disease management through genetic resistance, biological control and IDM; | E |
| CLO 3 | identify and apply the knowledge of epidemiological factors ; | Ap |
| CLO 4 | remember and apply the knowledge of genetics for host-pathogen interaction during disease; | R |
| CLO 5 | apply skills to evaluate and assess of plant diseases and different models; | An |
| CLO 6 | apply skills to control and evaluate plant disease through chemicals. | C |

R-Remember; An-Analyze; U-Understanding; Ap-Apply; E-Evaluate; C-Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 2 | 2 | 2 | 1 | 2 |
| CLO 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |
| CLO 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| CLO 4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CLO 5 | 2 | 2 | 3 | 3 | 3 | 2 | 3 |
| CLO 6 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 – Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLO |
|---|---|---|---|
| **1.0** | **Plant Pathology and Its History** | **3** | |
| 1.1 | Plant pathology and Fungi as cause of diseases | 1 | 1 |

| | | | |
|---|---|---|---|
| 1.2 | Germ theory of diseases and beginning of modern plant pathology | 1 | 4 |
| 1.3 | Forest pathology | 1 | 1 |
| **2.0** | **Plant Disease Epidemics** | **10** | |
| 2.1 | Host factor that affect development of epidemics | 2 | 3 |
| 2.2 | Pathogen factor that affect development of epidemics | 1 | 3 |
| 2.3 | Environmental factor that affect development of epidemics | 2 | 3 |
| 2.4 | Human factor that affect development of epidemics | 1 | 3 |
| 2.5 | Structure and patterns of epidemics and Decline of epidemics | 2 | 3 |
| 2.6 | Modelling and computer simulation of epidemics | 2 | 3 |
| **3.0** | **Genetics and variability of plant diseases** | **10** | |
| 3.1 | Genes and variability of virus, bacteria and fungi | 4 | 2 |
| 3.2 | Mechanisms of variability of fungi | 2 | 2 |
| 3.3 | Types of resistance of pathogens | 1 | 2 |
| 3.4 | Genetics of virulence in pathogens and resistance of host plants | 2 | 2 |
| 3.5 | Plant breeding for disease resistance | 1 | 2 |
| **4.0** | **Management of disease through host resistance** | **8** | |
| 4.1 | Disease escape, tolerance or endurance and true resistance | 1 | 2 |
| 4.2 | Monogenic, polygenic, vertical, horizontal, specific and general resistance | 2 | 2 |
| 4.3 | Development of resistant varieties | 2 | 2 |
| 4.4 | Testing of resistant varieties and causes of failure of resistance | 2 | 2 |
| 4.5 | Management of resistant varieties | 1 | 2 |
| **5.0** | **Plant Protection** | **3** | |
| 5.1 | Use of transgenic plants and Cross protection | 1 | 6 |
| 5.2 | Fungal antagonists and Pathogen free seeds | 1 | 6 |
| 5.3 | Fumigation and control of insect vector | 1 | 6 |
| **6.0** | **Biological control** | **7** | |
| 6.1 | Introduction and definitions | 1 | 6 |
| 6.2 | Natural biological control: Suppressiveness in conducive soil | 1 | 6 |
| 6.3 | Mode of action of biological agents (BCAs): Antagonism-Exploitation, competition and antibiosis | 1 | 6 |
| 6.4 | Hypovirulence and induction of host resistance | 1 | 6 |
| 6.5 | Characteristics and selection of an effective BCA | 1 | 6 |
| 6.6 | Development, application and establishment of BCAs | 1 | 6 |
| 6.7 | Commercially available BCAs, constraints and future | 1 | 6 |
| **7.0** | **Integrated control of plant disease** | **7** | |
| 7.1 | Introduction, IDM progress, central idea of IDM | 1 | 6 |
| 7.2 | Criteria of priority, phases of IDM and strategies adopted for IDM | 1 | 6 |
| 7.3 | Integrated management of diseases in annual and perennial crops | 1 | 6 |
| 7.4 | Some IDM packages | 1 | 6 |
| 7.5 | Late blight of potato and Citrus canker | 1 | 6 |
| 7.6 | Diseases of Tomato and Cole crops | 1 | 5 |

| | | | |
|---|---|---|---|
| 7.7 | Diseases of Groundnut and Pulses | 1 | 5 |
| **8.0** | **Plant Disease and Pests management** | **7** | |
| 8.1 | Principles and concepts of integrated pest management | 1 | 6 |
| 8.2 | Ecological engineering for pest management | 1 | 6 |
| 8.3 | AIM of Selected IPM strategies and prescriptions | 1 | 6 |
| 8.4 | Tools of Pest Management | 1 | 6 |
| 8.5 | Basic principles of Integrated Pest Management | 1 | 6 |
| 8.6 | Advantage of Integrated Pest Management | 1 | 6 |
| 8.7 | Insect Pests of available crop diseases | 1 | 6 |
| **9.0** | **Disease Assessment** | **5** | |
| 9.1 | Disease-pressure and pathogen-population measurement in soil, air and plants | 1 | 5 |
| 9.2 | Remote sensing | 1 | 5 |
| 9.3 | Scales for disease estimation | 2 | 5 |
| 9.4 | Critical point and multiple point model | 1 | 5 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5<br>CLO 6 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Agrios, G.N., 1997. Plant Pathology (4th Edition). Academic Press, San Diego, USA.
2. Manners, J.G., 1982. Principles of Plant Pathology. Cambridge University Press, London, UK.
3. Rangaswami, G. and Mahadevan, A. 2014. Diseases of Crop Plants in India (4th Edition). PHI Learning Private Limited, Delhi-110092, India.
4. Singh, R.P. 2010. Plant Pathology. Kalyani Publishers. New Delhi, India.
5. Singh, R.S., 1979. Introduction to the Principles of Plant Pathology (2nd Edition). Oxford and IBH Publishers, New Delhi, India.
6. Singh, R.S.1998. Plant Diseases (7th Edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
7. Strange, R.N., 2003. Introduction to Plant Pathology. John Wiley & Sons Ltd., Chichester, UK.

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|---|---|---|---|
| **Course Code** | : MBOT 2103 | | |
| **Course Title** | : Seed Science and Technology | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Mst. Ferdowsi Mahal | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The course focuses on the history, principles, and practices of seed production, quality, and health. Topics include seed vs. grain differences, production and storage techniques, managing seed-borne diseases, and the impact of environmental factors. It covers seed treatment, quarantine, and health testing methods, aiming to improve seed quality, ensure healthy crops, and support sustainable agriculture and seed industries in Bangladesh.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive level |
|---|---|---|
| CLO 1 | know the history of seed science and prospect of seed technology, seed production, processing and storage techniques; the past and present status of seed industries in Bangladesh; | R |
| CLO 2 | identify the storage fungi and seed borne pathogens and transmission seed to plant; | An |
| CLO 3 | apply seed production and seed crop management techniques; | Ap |
| CLO 4 | understand the seed health techniques and eco-friendly treatment procedure; | U |
| CLO 5 | formulate basic skills and techniques for seed production, seed quarantine and seed health tests. | C |

R-Remember; U-Understanding; Ap-Apply; An-Analyze; C-Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| CLO 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 |
| CLO 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| CLO 4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| CLO 5 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hours | | CLOs |
|---|---|---|---|---|
| **1.0** | **Introduction** | **5** | | |
| 1.1 | Brief history of seed science, definition and scope of seed technology | 1 | | 1 |
| 1.2 | Definition, difference between seed and grain and seed | 1 | | 1 |

| | | | | |
|---|---|---|---|---|
| | quality characteristics | | | |
| 1.3 | relationship of seed technology with other sciences | 1 | | 1 |
| 1.4 | past status and present status of Seed industries in Bangladesh | 2 | | 1 |
| **2.0** | **General principles of seed production and storage** | **4** | | |
| 2.1 | Genetic principles of seed production | 1 | | 3 |
| 2.2 | Agronomic principles | 1 | | 3 |
| 2.3 | Seed processing and storage | 1 | | 2 |
| 2.4 | Seed production technique for rice | 1 | | 2, 5 |
| **3.0** | **Seed borne diseases** | **3** | | |
| 3.1 | Definitions and types of seed borne pathogens | 1 | | 1 |
| 3.2 | Economic Significance of seed borne diseases | 1 | | 2 |
| 3.3 | Significance of seed transmission compared to other means of transmission | 1 | | 1 |
| **4.0** | **Storage fungi** | **3** | | |
| 4.1 | Definition and compares between field fungi and storage fungi | 1 | | 1, 2 |
| 4.2 | Conditions during storage in relation to development of damage | 1 | | 3 |
| 4.3 | Harmful effects and Precautions | 1 | | 1 |
| **5.0** | **Entry point of seed infection, establishment of infection and course of disease** | **5** | | |
| 5.1 | Infection directly from the mother plant | 1 | | |
| 5.2 | Infection from outside | 1 | | |
| 5.3 | Infected or contaminated parts of the seed. | 1 | | |
| 5.4 | Intraembryal and extraembryal infection followed by local and systemic infection | 1 | | 4 |
| 5.5 | Seed contamination followed by extrametrical saprophytism and subsequently by local and systemic infection | 1 | | 4 |
| **6.0** | **Environmental physicochemical factors** | **2** | | |
| 6.1 | Influence of physicochemical factors on the predisposition of the host. | 1 | | 1 |
| 6.2 | Influence of physicochemical factors on the course of diseases. | 1 | | 1 |
| **7.0** | **Seed crop management** | **5** | | |
| 7.1 | Location of seed production | 1 | | 4 |
| 7.2 | Cropping and selection of cultivars | 1 | | 5 |
| 7.3 | Reduction or elimination of seed borne and soil borne pathogen | 1 | | 5 |
| 7.4 | Adjustment of cultural practices | 1 | | 5 |
| 7.5 | Chemical protection of seed crops | 1 | | 5 |
| **8.0** | **Seed treatment, procedures and equipment** | **3** | | |

| | | | | |
|---|---|---|---|---|
| 8.1 | Definition and types of procedures | 1 | | 1 |
| 8.2 | Physical procedures | 1 | | 4 |
| 8.3 | Biochemical and chemical procedures | 1 | | 4 |
| | | | | |
| **9.0** | **Quarantine for seed** | **4** | | |
| 9.1 | Definition and importance | 1 | | 1 |
| 9.2 | International spread of seed borne disease dew to export and import of seed | 1 | | 5 |
| 9.3 | Interception of seed borne diseases | 1 | | 4 |
| 9.4 | Principles of setting up quarantine regulations | 1 | | 4 |
| 9.5 | Principles of applying quarantine methods | 1 | | 4 |
| | | | | |
| **10.0** | **Seed Health** | **4** | | |
| 10.1 | Basic requirementsand objectives | 1 | | 1 |
| 10.2 | Basic and specialequipment | 1 | | 1 |
| 10.3 | Incubation tests and procedures of seed health test | 1 | | 5 |
| 10.4 | Blotter, deep freeze, agar plate, sand and seedling symptom methods | 1 | | 5 |
| | | | | |
| **11.0** | **Inspection of plants beyond the seedling** | **3** | | |
| 11.1 | Growing on test procedures | 1 | | 5 |
| 11.2 | field trials | 1 | | 5 |
| 11.3 | inspection of seed crops | 1 | | 5 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Agarwal, RL. 1995. Seed Technology. 2ndEdision. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
2. Alexopoulos, CJ, Mims, CW and Blackwell, M. 1996. Introductory Mycology (4th Ed.) John Wiley &Sons.Inc. New York.
3. ISTA, 1976. International Rules for seed testing - Seed science and Technology 4: 51-177.
4. Jha, DK. 1993. A textbook on seed pathology. Vikas publishing house Pvt. Ltd. New Delhi-110014.
5. Neergaard, P. 1979. Seed Pathology. (Rev. Ed.)(Abridged Edition, 1986). S. Chand & Company Ltd., New Delhi-110055.
6. Richardson, M.J. 1979. An Annotated list of Seed borne diseases (3rd Ed.).CMI, Kew, Surrey, U.K.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2104 | | |
| **Course Title** | : Cytotaxonomy and Chemotaxonomy | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Rony Rani | | |
| **Credit Value** | : 4 | **Credit hours/week: 5** | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The Cytotaxonomy and Chemotaxonomy course teaches the applied approach of plant taxonomy and evolution. The Cytotaxonomy part covers the topics chromosomal characters, karyotype, ideogram, mitochondrial and plastid DNA; cellular differences of Magnolliopsida and Liliopsiada; plants plasticity, heterophylly and cytotaxonomy of pollen and apomixes in plants. Another part Chemotaxonomy provides the knowledge of classify plants according to their phytochemical compositions, occurrences, distribution and types towards specific plant groups like as medicinal, aromatic, toxic and spices plants etc. This course also enlightens the Serotaxonomical study of plants.

**Course learning Outcome (CLO)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | know the fundamental principles and methods of Cytotaxonomy and Chemotaxonomy along with in-depth knowledge; | R, U |
| CLO 2 | understanding of chromosome morphology, structure and karyotyping of plant chromosomes, Idogram.Chemical nature of plant; | U, |
| CLO 3 | analyze the methods and principles Cytotaxonomy and Chemotaxonomy, Heterophylly and plastitycity in plant; | U,An |
| CLO 4 | apply skills on different techniques in cytology and chemical research to identify and classify plant species. | Ap |

R-Remember; U-Understanding; An-Analyze; Ap-Apply

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 2 | 2 | 3 | 3 | 1 | 2 |
| CLO 2 | 3 | 1 | 2 | 3 | 2 | 1 | 2 |
| CLO 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 |
| CLO 4 | 2 | 3 | 2 | 3 | 3 | 2 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Cytotaxonomy and Cell** | **12** | |
| 1.1 | Definition, History, principle of cytotaxonomy, significance of cytotaxonomy | 2 | 1 |

| | | | |
|---|---|---|---|
| 1.2 | Differences between Cytotaxonomy, Classical taxonomy and Chemotaxonomy | 2 | 1,2 |
| 1.3 | Definition of plant cell, origin and evolution of prokaryotic cell and eukaryotic cell | 2 | 1,2 |
| 1.4 | Illustration of Liliopsida and Magnoliopsida plant cell | 3 | 1 |
| 1.5 | Origin and evolution of mitochondria and plastid, chromosome | 3 | 2 |
| **2.0** | **Cytomorphological characters used in taxonomy** | **9** | |
| 2.1 | Root Cytomorphological characters | 2 | 1,4 |
| 2.2 | Stem and leaf Cytomorphological characters | 3 | 1,4 |
| 2.3 | Flower and pollen Cytomorphological characters | 4 | 1,4 |
| **3.0** | **Apomixis in evolution of plant species** | **5** | |
| 3.1 | Concept, categories and example for new plant species | 3 | 1,2 |
| 3.2 | Importance of apomixes studies in evolution of plant species | 2 | 1,3 |
| **4.0** | **Heterophylly and plastitycity within plants** | **9** | |
| 4.1 | Concept, and Definition Heterophylly and plastitycity in plants | 3 | 2 |
| 4.2 | Significance and Evolution of Heterophylly and plastitycity | 3 | 2,3 |
| 4.3 | Cytological basis of Heterophylly and plastitycity | 3 | 3 |
| **5.0** | **Chromosome characteristics used in taxonomy** | **14** | |
| 5.1 | Chromosome morphology and behaviour | 4 | 2,3 |
| 5.2 | Karyotype**,** karyotyping analysis in evolution and phylogeny of plant species | 5 | 2,3,4 |
| 5.3 | Preparation of ideogram and phylogenetic tree | 4 | 3,4 |
| **6.0** | **Chemotaxonomy** | **10** | |
| 6.1 | Introduction, definition, origin of chemotaxonomy | 1 | 1,2 |
| 6.2 | Chemotaxonomical classification of plants | 2 | 1 |
| 6.3 | Chemical characters and their use in chemotaxonomy | 3 | 3,4 |
| 6.4 | Principles and procedures of chemotaxonomy | 2 | 3 |
| 6.5 | Stages in chemotaxonomic investigations | 2 | 3 |
| **7.0** | **Chemotaxonomical study of flowing group of plants** | **8** | |
| **7.1** | Medicinal plant | 2 | 1,3 |
| 7.2 | Toxic plant | 2 | 1,3 |
| 7.3 | Aromatic plant | 2 | 1,3 |
| 7.4 | Spices plant | 2 | 1,3 |
| **8.0** | **Serotaxonomy** | **7** | |
| 8.1 | History, Definition and serological classification of plants | 2 | 1,2 |
| 8.2 | Methods Used in Serotaxonomy | 2 | 3 |
| 8.3 | Important of serology in taxonomical study | 1 | 2 |
| 8.4 | Role of serology in solving taxonomic problems | 2 | 2,3 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**

1. Ghani, A. 2003. Medicinal Plants of Bangladesh with Chemical Constituents and Uses (2nd ed.) Asiatic Society of Bangladesh.
2. Gibbs, R. D.1974. Chemotaxonomy of flowering plants. Volume1 and 2. McGill-Queen's University Press.
3. Gupta, P.K. 1999. Cytogenetics. Rastogi Publications, India.
4. Shukla, R.S. and Chandel, P.S. 2001. Cytogenetics, Evolution and Plant Breeding. S. Chand and Co., India.
5. Singh, R. 2017. Practical Manual on Plant Cytogenetics. Singh, R., 1993. Plant Cytogenetics. CRC Press.
6. Subrahmanyam, N.S. 2004. Modern Plant Taxonomy. Vikas Publishing House Pvt Ltd. New Delhi, India.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3101 | | |
| **Course Title** | : General viva-voce | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : MS Examination Committee | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

## Practical Courses

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3102 | | |
| **Course Title** | : Plant Systematics | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Plant Systematics** |
|---|---|
| 1.1 | Identify the following inflorescence and fruits with reference to their morphological specialities: (a) Inflorescence – simple raceme, spike, corymb, head, simple cyme (b) cyathium, capitulum, verticillaster and hypanthodium |
| 1.2 | Root and stems: different types of modified root and stems |
| 1.3 | Different types of leaf structure |
| 1.4 | Fruits–simple–(fleshy)–berry drupe, pepo, hespiridium. Dry indehiscent – nut. Drydehiscent–legume, capsule (loculicidal), Aggregate |
| 1.5 | Preparation of floral formula and floral diagram from floral description (of families studied) |
| 1.6 | Identify the families mentioned in the syllabus by noting their vegetative and floral characters |
| 1.7 | Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family |
| 1.8 | Prepare herbarium of 50 plants with field notes |
| 1.9 | Field work: local excursion and field reports |
| 1.10 | Study of museum specimens |
| 1.11 | Preparation of dichotomous key |
| 1.12 | Study and identification of unknown angiosperm plants with the help of key |
| 1.13 | Study of capitula and flowers of asclepiads |
| 1.14 | Using numerical tools to rank plants into different groups |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3103 | | |
| **Course Title** | : Physiology of Higher Plants | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Physiology of Higher Plants** |
|---|---|
| 1.1 | Determination of water potential of *Rhoeo* leaf by the plasmolytic method. |
| 1.2 | Determination of osmotic potential of potato by the gravimetic method |
| 1.3 | Determination of rate of transpiration (per unit time and per unit leaf area) by potometer |
| 1.4 | Separation of photosynthetic pigments |
| 1.5 | Qualitative test for carbohydrate, lipid and protein |
| 1.6 | Demonstration of catalase activity |
| 1.7 | Demonstration of amylase activity |
| 1.8 | Quantitative estimation of sugar |
| 1.9 | Estimation of proline |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3104 | | |
| **Course Title** | : Applied Mycology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Applied Mycology** |
|---|---|
| 1.1 | To acquaint with the techniques for preparing temporary slides of fungal specimens for microscopic examinations |
| 1.2 | Detailed morphological studies non-mycelial and mycelial vegetative bodies of the fungi; fungal tissue (Prosenchyma and Pseudoparenchyma); special somatic structures (selerotia, rhizomorphs, stroma, haustoria); asexual spores (arthrospores, blastospores, chlamydospores, sporangiospores, and conidiospores); sexual spores (oospores, zygospores, ascospores and basidiospores) |
| 1.3 | Preparation of different culture media, autoclaving and sterilization |
| 1.4 | Collection, isolation, identification and culture of fungi/mushrooms from various sources and their preservation |
| 1.5 | Procedure of mushroom cultivations commercially used agriculture and industrial |
| 1.6 | Practical note book contain description, labelled diagrams and identifying characters of the studied fungal genera |
| 1.7 | Local excursion |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3105 | | |
| **Course Title** | : Fern Biology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Fern Biology** |
|---|---|
| 1.1 | Local excursion and submit their reports |
| 1.2 | Collection and herbarium preparation of fern from various habitats |
| 1.3 | Collection and preservation of fern spores from various sources |
| 1.4 | Studies on external and internal features of different organs in Eusporangiate and Leptosporangiate fern |
| 1.5 | Practical note book contain description with collection method of spores, preparation method of herbarium, labeled diagrams and identifying characters of the given samples of specific fern |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3106 | | |
| **Course Title** | : Plant Histology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Plant Histology** |
|---|---|
| 1.1 | Study of different types of cells maceration technique (Schultz's Method) |
| 1.2 | Study of internal structures of different types of leaves (especially dorsiventral and isobilateral type) |
| 1.3 | Study of different types of stomata (Dicot and Monocot) from leaves |
| 1.4 | Preparation of permanent slide (free hand section) by using double stain - Safranin and Fast green |
| 1.5 | Study of shoot apex- Dissection of shoot with the help of fine blade by removing the young leaf primordia and exposing the apical meristem |
| 1.6 | Microtomy:<br>a) Types of Microtome machine<br>b) Collection, killing and fixing materials in a fixative<br>c) Preparation of paraffin blocks of the fixed materials<br>d) Section cutting (both T.S. and L.S.) of the paraffin blocks with the help of Microtome machine and mounting ribbons on slides<br>e) Staining the paraffin slides with suitable stain and preparation of permanent slide |
| 1.7 | Spotting: Study of prepared slides for identification |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3107 | | |
| **Course Title** | : Plant Pathology and Plant Protection | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Plant Pathology and Plant Protection** |
|---|---|
| 1.1 | Preparation and sterilization of culture media and |
| 1.2 | Isolation, purification and study of fungal growth |
| 1.3 | Single spore isolation technique |
| 1.4 | Counting of spores in haemocytometer and colorimeter |
| 1.5 | Measurement of micropropagules by Ocular micrometer |
| 1.6 | Preparation, estimation and application of suitable fungicide for a particular diseased plot |
| 1.7 | Study of locally available diseased plants |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3108 | | |
| **Course Title** | : Seed Science and Technology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Seed Science and Technology** |
|---|---|
| 1.1 | Seed quality test |
| 1.2 | Seed health test through blotter method |
| 1.3 | Comment on the supplied dried seed (Sample A) whether the seeds are healthy or infected |
| 1.4 | Count the number of spores from the supplied materials (Sample B) using Haemocytometer |
| 1.5 | Students should visit local market to acquaint with different types of seeds |
| 1.6 | Seed treatment with fungicides |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3109 | | |
| **Course Title** | : Cytotaxonomy and Chemotaxonomy | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Cytotaxonomy and Chemotaxonomy** |
|---|---|
| 1.1 | Study of chromosome compliment from root of monocot and dicot plant |
| 1.2 | Study of pollen morphology of dicot and monocot plant species |
| 1.3 | Prepare karyotype and ideogram from supplied data |
| 1.4 | Study of chemical nature of plant pigment, uses and from supplied specimens |
| 1.5 | Collection and herbarium preparation of locally available aromatic, toxic, medicinal plants |
| 1.6 | Spotting: Study of locally available aromatic, toxic, medicinal, spices plants |
| 1.7 | Field work: local excursion and field reports |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3110 | | |
| **Course Title** | : Research Project | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

Each non-thesis student will conduct a project work under the supervision of a teacher and submit the project paper at the end of the academic year.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3111 | | |
| **Course Title** | : Thesis | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 8 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 200 | | |

Each thesis student will conduct a research work under the supervision of a teacher and submit the thesis paper at the end of the academic year.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3112 | | |
| **Course Title** | : Thesis presentation and defense | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

## Specialization 2: Plant Biotechnology

The aim of this group is to impart basic and advanced technical knowledge needed to understand the subject and carry out higher education and /or research on any level of Biotechnology. It also prepares students to undertake employment in plant biotechnology.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1201 | | |
| **Course Title** | : Cytogenetics and Crop Improvement | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Md. Mamunur Rashid Sarkar | | |
| **Credit Value** | : 4 | **Credit hours/week:** 5 | **Total credit hour:** 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The Cytogenetics and Crop Improvement course explores the role of chromosomal changes in enhancing crop traits. It covers polyploidy, chromosomal variations, and molecular cytogenetics, linking these to evolution and gene mapping. Students learn to apply concepts like genetic recombination, alien gene transfer, and haploid techniques to improve crops, develop resistance, and boost nutritional value, driving agricultural innovation.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive level |
|---|---|---|
| CLO 1 | know the fundamental principles and methods of cytogenetics special emphasis on molecular level along with in-depth knowledge; | R |
| CLO 2 | describe the banding patterns, abnormalities and karyotyping of plant chromosomes as well as effect of chromosomal alteration in crop; | R, U,E, An |
| CLO 3 | demonstrate knowledge of plant genetics and crop improvement; | Ap |
| CLO 4 | modify and use variations in chromosomal number and structure in the development and synthesis of new species and varieties; | An, Ap |
| CLO 5 | apply skills on different techniques in cytogenetic research at advance level for crop improvement. | Ap |

R-Remember; U-Understanding; An- Analyze; E-Evalute, Ap-Apply

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| CLO 1 | 3 | 3 | 2 | 1 | 3 | 3 | 3 |
| CLO 2 | 2 | 3 | 3 | 1 | 3 | 2 | 3 |
| CLO 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CLO4 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CLO5 | 1 | 2 | 3 | 2 | 3 | 3 | 3 |

Note: 3 - High, 2 - Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Autopolyploid** | **3** | |
| 1.1 | Occurrence and phenotypic effects | 1 | 1 |
| 1.2 | Meiotic and breeding behavior | 1 | 1 |
| 1.3 | Genetics | 1 | 1 |
| | | | |
| **2.0** | **Allopolypiolds and genome analysis** | **3** | |
| 2.1 | Distinction between auto and allopolyploids | 1 | 1 |
| 2.2 | Genome analysis in allopolyploids | 1 | 1 |
| 2.3 | Synthesis of new genera and species using allopolyploids *(Primula kewensis, Agrotrichum, Triticale)* | 1 | 2 |
| | | | |
| **3.0** | **Hyperploids** | **4** | |
| 3.1 | Transmission of extra chromosome and breeding behaviour of trisomics | 1 | 3 |
| 3.2 | Use of trisomics in chromosome mapping | 1 | 3 |
| 3.3 | Trisomics in human | 1 | 1 |
| 3.4 | Tetrasomics in plants | 1 | 1 |
| | | | |
| **4.0** | **Hypoploid** | **4** | |
| 4.1 | Meiotic and breeding behaviour of monosomics | 1 | 3 |
| 4.2 | Locating genes on chromosome arms | 1 | 4 |
| 4.3 | Meiotic and breeding behaviour of nullisomics | 1 | 4 |
| 4.4 | Use of nullisomics in locating genes on chromosomes | 1 | 4 |
| | | | |
| **5.0** | **Intra- and Inter - Chromosomal Changes** | **10** | |
| 5.1 | Detection of duplication | 1 | 1 |
| 5.2 | Duplication in plant breeding and evolution | 1 | 2 |
| 5.3 | Use of deficiency for chromosome mapping in plant | 1 | 2 |
| 5.4 | Effect of duplication and deficiency on crossing over | 1 | 2 |

| | | | |
|---|---|---|---|
| 5.5 | Behaviour of bridge and fragment in inversion heterozygote | 1 | 2 |
| 5.6 | Included and overlapping inversion | 1 | 2 |
| 5.7 | Role of inversion in evolution | 1 | 2 |
| 5.8 | Orientation of interchange quadrivalents | 1 | 2 |
| 5.9 | Breeding behaviour of interchange heterozygotes | 1 | 2 |
| 5.10 | Cytogenetic localization of genes using interchanges | 1 | 3 |
| | | | |
| **6.0** | **Molecular Cytogenetics** | **4** | |
| 6.1 | Chromosomal DNA vs Chromosome length/area/volume | 1 | 2 |
| 6.2 | Chromosomal DNA and evolution | 1 | 1 |
| 6.3 | Detection of repetitive DNA; Repetitive DNA vs Satellite DNA | 1 | 2 |
| 6.4 | Detection and localization of gene on chromosome | 1 | 2,3 |
| | | | |
| **7.0** | **Evolution of Karyotype** | **5** | |
| 7.1 | Prokaryotype to eukaryotype | 1 | 2 |
| 7.2 | Selective regulation of karyotype | 1 | 2 |
| 7.3 | Amount of DNA per genome | 1 | 2 |
| 7.4 | Evolution of individual chromosome | 1 | 2 |
| 7.5 | Karyotypic changes within taxa | 1 | 2 |
| | | | |
| **8.0** | **Alien Genetic Resources in Crop Improvement** | **4** | |
| 8.1 | Alien additive and values | 1 | 1 |
| 8.2 | Transfer of genes from an alien chromosome | 1 | 4 |
| 8.3 | Possibilities and limitation | 1 | 4 |
| 8.4 | Production of substitution lines | 1 | 5 |
| | | | |
| **9.0** | **Genetic Recombination in Crop Improvement** | **4** | |
| 9.1 | Recombinant DNA; application for conversation of cereal crops in to nitrogen fixing plants | 1 | 4 |
| 9.2 | Application for resistance to viruses and other pathogen | 1 | 5 |
| 9.3 | Application for improving nutritional quality of pulse | 1 | 5 |
| 9.4 | Application for construction of male sterile lines | 1 | 5 |
| | | | |
| **10.0** | **Haploid in Crop Improvement** | **4** | |
| 10.1 | Classification, meiosis and production system | 1 | 1 |
| 10.2 | Parthenogenesis and apogynus | 1 | 1 |
| 10.3 | Chromosome elimination and somatic reduction | 1 | 1 |
| 10.4 | Anther and microspore culture; Ovule culture; Breeding application | 1 | 5 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

## Books Recommended

1. Garber, E.D. 1974. Cytogenetics. Tata McGraw-Hill Publishing Co. Ltd., India.
2. Gupta, P.K. 1999. Cytogenetics. Rastogi Publications, India.
3. Kato, Takamisu, A. Wilson and Paul F. 2019. Radiation Cytogenetics, Methods and Protocols. Springer.
4. Sharma, A.K. 1980. Chromosome Techniques. Elsevier.
5. Shukla, R.S. and Chandel, P.S. 2001. Cytogenetics, Evolution and Plant Breeding. S. Chand and Co., India.
6. Singh, R. 2017. Practical Manual on Plant Cytogenetics. Singh, R., 1993. Plant Cytogenetics. CRC Press.
7. Swanson, C.P., Merz, T. and Young, W.J. 1973. Cytogenetics. Prentice Hall of India.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1202 | | |
| **Course Title** | : Applied Plant Breeding | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : M. Nasiruddin | | |
| **Credit Value** | : 4 | **Credit hours/week:** 5 | **Total credit hour:** 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The purpose of the Applied Plant Breeding course is to provide students with practical skills and knowledge in plant breeding methodologies. It addresses problems including food security, crop enhancement, and sustainable agriculture by instructing students to apply genetic concepts and contemporary breeding techniques to improve plant characteristics. It emphasizes developing resilient crop varieties that can withstand climate change and contribute to global food security. Also, highlight development of high-yielding and disease-resistant varieties. Furthermore, it equips students for careers in research, agriculture, and associated domains.

**Course Learning Outcome (CO)**

| **CLO No.** | **Expected Course Learning Outcomes**<br>Upon completion of this course, the students will be able to: | **Cognitive Level** |
|---|---|---|
| CLO 1 | explain how theories of plant breeding are used to characterize genotypic and phenotypic variation; | U |
| CLO 2 | identify sources of variation in plants and compare methods for generating additional variation; | An |
| CLO 3 | describe methods select to improved plants for future use as inbred varieties, inbred lines for hybrid productions, and hybrid cultivars; | U |
| CLO 4 | propose breeding methods for different breeding objectives such as yield improvement, stress resistance, or end-use quality; | C |
| CLO 5 | describe how plant breeders use product development pipelines to manage parents, populations, and individual breeding lines to release pure-line cultivars or F1 hybrids; | U |
| CLO 6 | examine the challenges related to and the importance of ethics and intellectual property in plant breeding. | Ap |

An-Analyze; U-Understanding; Ap-Apply; C-Create

**Mapping CLOs with PLOs**

| **CLOs** | **Program Learning Outcomes (PLOs)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| CLO 1 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| CLO 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CLO 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| CLO 4 | 2 | 3 | 2 | 2 | 3 | 1 | 2 |
| CLO 5 | 3 | 2 | 1 | 3 | 2 | 1 | 2 |
| CLO 6 | 2 | 1 | 3 | 2 | 3 | 3 | 2 |

Note: 3 - High, 2 – Medium, 1 – Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Principals of plant breeding** | **5** | |
| 1.1 | Basic principle of plant breeding | 1 | 1 |
| 1.2 | Sources of variation, the genetic basis of selection based on breeding behavior, different methods of induction of variations | 2 | 1 |
| 1.3 | Problems of Plant Breeding: Breeding methods, gene pattern of the traits, factors limiting genetic improvement of crop plants | 2 | 1 |
| | | | |
| **2.0** | **Distant hybridization and hybrid development** | **4** | |
| 2.1 | Definition, importance and scope of distant hybridization | 1 | 1, 2, 4 |
| 2.2 | Methods of distant hybridization | 1 | 1, 2, 4 |
| 2.3 | Development, evaluation and maintenance of parental lines; Purification and improvement of parental lines | 2 | 1, 2, 4 |
| | | | |
| **3.0** | **Development of Hybrid Varieties of Crop Plants** | **6** | |
| 3.1 | Production technologies of hybrids varieties in important field crops; hybrid seed production of rice, maize, and vegetables | 3 | 1, 2,4 |
| 3.2 | Use of various breeding techniques: CMS, GMS, Self-incompatibility, heterosis, apomixes and chemicals | 3 | 1, 2, 4 |
| | | | |
| **4.0** | **Stress Breeding** | **10** | |
| 4.1 | The scope and practical dimension of stress factors of crop plants; Types of stress, importance and breeding crop varieties tolerant to stresses | 2 | 1 |
| 4.2 | Techniques and methodology of breeding for the development of drought and heat tolerant crop varieties | 3 | 3, 4 |
| 4.3 | Breeding strategy for development of salt tolerant crop variety, | 3 | 3, 4 |
| 4.4 | Mechanism and genetic basis of disease resistance | 1 | 1 |
| 4.5 | Methods of breeding for disease resistance | 1 | 3 |
| | | | |
| **5.0** | **Molecular Plant Breeding** | **10** | |
| 5.1 | Molecular plant breeding tools: markers and maps | 2 | 1 |
| 5.2 | Quantitative trait loci (QTL): requisites for QTL mapping, molecular linkage maps, data for QTL mapping (marker data and phenotype data) | 3 | 1, 2 |
| 5.3 | Molecular marker-assisted breeding: Marker-assisted selection (MAS), marker-assisted gene introgression, gene pyramiding and selection for QTL; opportunities and challenges | 3 | 2, 3, 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5<br>CLO 6 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Acquaah, G. 2012. Principles of Plant Genetics and Breeding. Blackwell Publishing.
2. Allard, R.W. 1960. Principle of Plant Breeding. John Willey and Sons, New York.
3. Chahal, G.S. and Gosal, S.S. 2003. Principle and Procedure of Plant Breeding. Narosa Publishing. New Delhi, Kolkata.
4. Chaudhuri, H.K. 1966. Elementary Principles of Plant Breeding.Oxford&IBH Publishing Co. New Delhi, India.
5. Chaudhury, R.C. 1993. Introduction to Plant Breeding. Oxford & IBH Publishing Co. New Delhi, India.
6. Singh, B.D. 1983. Plant Breeding. Kalyani Publishers, New Delhi, India.
7. Sleper, D.A. and Poehlman, J.M. 2006. Breeding Field Crops. 1st ed. Blackwell Publishing.
8. C Neal Stewart JR. 2008. Plant Biotechnology and Genetics. A John wiley& sons, Inc., publication, New Jersey, Canada.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1203 | | |
| **Course Title** | : Biometrical Genetics | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : F. M. Ali Haydar | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course:**
The course on Biometrical Genetics focuses on understanding how genes influence traits using statistical methods. It helps students analyze genetic patterns, predict outcomes in breeding, and improve plants, animals, or humans. By studying this, learners can apply genetics to solve real-world problems, like increasing crop yields, enhancing livestock, or understanding inherited any biological traits.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to | Cognitive Level |
|---|---|---|
| CLO 1 | understand quantitative genetic theory and principles as they apply to biometrical genetics | U |
| CLO 2 | read, understand and evaluate literature involving biometrical genetics as it relates to plant breeding | An |
| CLO 3 | design, execute, analyze, and interpret results of experiments involving polygenically controlled characters of interest in a biometrical genetics. | Ap |

U-Understanding; Ap-Apply; An-Analyze

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 2 | 1 | 2 | 2 | 2 | 3 | 2 |
| CLO 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 |
| CLO 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course Contents | Credit hours | CLOs |
|---|---|---|---|
| **1.0** | **Hierachichal analysis of variance** | **12** | |
| 1.1 | Fixed and Random effects | 4 | 1 |
| 1.2 | Biological basis of interaction | 6 | 1 |
| 1.3 | Weighted least squares | 2 | 1 |
| | | | |
| **2.0** | **Biometry and genetics** | **8** | |
| 2.1 | Linear and multiple regression | 2 | 1,2 |
| 2.2 | Discriminant function and selection index | 3 | 2 |
| 2.3 | Pure lines and multiple factor hypothesis | 3 | 2 |
| | | | |
| **3.0** | **Scales** | **4** | |

| | | | |
|---|---|---|---|
| 3.1 | Scaling tests and transformation of the scales | 4 | 3 |
| **4.0** | **Components of means and model fitting** | **6** | |
| 4.1 | Additive-dominance model | 3 | 1,2 |
| 4.2 | Non-allelic interaction model | 3 | 1,2 |
| **5.0** | **Genotype × environment interaction** | **6** | |
| 5.1 | Specification and detection | 3 | 3 |
| 5.2 | Segregating generations | 3 | 3 |
| **6.0** | **Components of variation** | **5** | |
| 6.1 | Variation in $F_2$ and back-crosses | 2 | 1 |
| 6.2 | Generations derived from $F_2$ | 3 | 1 |
| **7.0** | **Random breeding population** | **6** | |
| 7.1 | BIP's | 3 | 3 |
| 7.2 | Triple test cross | 3 | 3 |
| **8.0** | **Diallels** | **6** | |
| 8.1 | Analysis of Hayman's diallel table | 3 | 3 |
| 8.2 | Combining ability, Line × tester analysis | 3 | 3 |
| **9.0** | **Heridity analysis** | **7** | |
| 9.1 | Dominance selection and Heterosis | 4 | 1,2 |
| 9.2 | Heritability and selection | 3 | 3 |

## Mapping CLOs with the Teaching Learning and Assessment Strategies

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Gomez, K.A and Gomez, A.A. 1976. Statistical Procedure for Agricultural research. International Rice Research Institute. John Wiley & Sons. New York.
2. Mather, K. and Jinks, J.L. 1982. Biometrical Genetics. Chapman and Hall. London, New York.
3. Sharma. J.R. 2014. Statistical and biometrical Techniques in Plant Breeding. New AGE International Ltd. Publishers. Puna. India.
4. Singh, P. and Narayanan, S.S. 2013. Biometrical Techniques in Plant Breeding, Kalyani Publishers, Kolkata.
5. Singh, R.K. and Chaudhary, B.D. 1977. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers New Delhi.
6. Singh, S. 2010. Theory and Application of Biometrical Genetics, CBS publishers & Distributors. CBS Publishers & Distributors Pvt Ltd, India.
7. Zaman, S.M., Rahman, H.K. and Howlader, M. 1982. Simple Lessons from Biometry. Bangladesh Rice Research Institute, Joydebpur, Dhaka.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1204 | | |
| **Course Title** | : Plant Tissue Culture and Somatic Cell Technology | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Mustafa Abul Kalam Azad | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The rationale for a course on plant tissue culture and somatic cell technology is to teach students about the principles, techniques, and applications of plant tissue and cell culture. The course can help students understand how to manipulate plant life for research and conservation, and how to develop improved crops. It can also help students prepare for careers in plant biotechnology research and industry.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | Provide theoretical information and practicum experience in plant tissue culture; | U |
| CLO 2 | Determining the problems of *in vitro* plantlet production and they can solve these difficulties; | An |
| CLO 3 | Apply skills to establish *in vitro* culture techniques in agriculture, food and pharmaceutical industry; | Ap |
| CLO 4 | Predict social and ethical issues, and concentration calculations appropriate for this field will be introduced as an integral part of this program. | C |

U-Understanding; Ap-Apply; An-Analyze; C-Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CLO 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CLO 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CLO 4 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Concept and historical background** | **4** | |
| 1.1 | Cell theory, cellular aphorism, cellular totipotency and plant tissue culture | 2 | 1 |
| 1.2 | Milestone observations and experimentations towards the development of tissue culture techniques | 2 | 1 |

| | | | |
|---|---|---|---|
| **2.0** | **Definition and dimension** | **2** | |
| 2.1 | Plant tissue culture, cell culture, callus culture, organ culture, quiescent cell, permanent cell and dividing cell | 2 | 1 |
| | | | |
| **3.0** | **Tissue culture medium** | **2** | |
| 3.1 | Components and different types | 1 | 1 |
| 3.2 | Importance of inorganic, organic, and undefined components; roles of growth regulators and additives | 1 | 1 |
| | | | |
| **4.0** | ***In Vitro* developmental processes** | **4** | |
| 4.1 | Dedifferentiation vs redifferentiation processes; cytodifferentiation, callogenesis, rhizogenesis and hormonal regulation of organogenesis in callus culture | 1 | 2 |
| 4.2 | Difference between organogenic and embryogenic developments | 1 | 2,3 |
| 4.3 | Different pathways / routes of plantlet development in tissue culture | 2 | 2,3 |
| **5.0** | **Micropropagation** | **4** | |
| | | | |
| 5.1 | Terminologies and techniques; objectives and requirements of different operational steps. Gradient of juvenility and maturity along the plant body | 1 | 1 |
| 5.2 | Factors affecting success in different steps; effects of topophysis, plagiotropic and orthotropic on micropropagation | 2 | 2 |
| 5.3 | Commercial application with special reference to cloning of tropical fruit and ornamental plants | 1 | 3,4 |
| | | | |
| **6.0** | **Somatic embryogenesis** | **4** | |
| 6.1 | Types of embryogeny in higher plants**,** nomenclatures of somatic cells before initial embryogenesis | 1 | 2,3 |
| 6.2 | Stages of somatic embryo development *in vitro,* factors affecting somatic embryogenesis | 2 | 2,3 |
| 6.3 | Encapsulation of somatic embryos and importance of somatic embryos | 1 | 2,3 |
| | | | |
| **7.0** | **Somaclonal variation** | **4** | |
| 7.1 | Nomenclature and terminology | 1 | 1 |
| 7.2 | Origin / source and causes of variation | 2 | 1 |
| 7.3 | Use and importance of Somaclonal variants in important crop plants | 1 | 3 |
| | | | |
| **8.0** | **Meristem culture** | **4** | |

| | | | |
|---|---|---|---|
| 8.1 | Shoot tip vs meristem tip cultures, reasons of considering meristem as a virus free organ | 2 | 2,3 |
| 8.2 | Techniques of isolation and culture of meristem, and production of pathogen-free plants through meristem culture | 2 | 2,3 |
| | | | |
| **9.0** | **Cell culture** | **4** | |
| 9.1 | Techniques of establishment and culture of cells | 2 | 2 |
| 9.2 | Growth pattern of cells in suspension culture and types of cell suspension culture systems | 1 | 2,3 |
| 9.3 | Applications of single cell and mass suspension cultures | 1 | 3 |
| | | | |
| **10.0** | **Anther / pollen culture** | **4** | |
| 10.1 | Techniques of anther and pollen cultures | 1 | 2 |
| 10.2 | Pathways of *in vitro* pollen embryogenesis and plantlet development | 1 | 2 |
| 10.3 | Factors affecting, rogenesis and production of haploids | 1 | 2 |
| 10.4 | Utilization of haploids in plant breeding and genetics | 1 | 3 |
| | | | |
| **11.0** | **Zygotic embryo culture** | **3** | |
| 11.1 | Reasons behind and technique of zygotic embryo culture | 1 | 1 |
| 11.2 | Application of the embryo rescue technique in eliminating the incompatibility barrier of conventional cross breeding | 2 | 3,4 |
| | | | |
| **12.0** | **Somatic hybridization and cybridization** | **5** | |
| 12.1 | Techniques of isolation, purification, fusion and culture of protoplasts | 2 | 2 |
| 12.2 | Somatic hybridization vs cybridization and their importance | 1 | 2,3 |
| 12.3 | Stages of plantlet development from the fused/hybridized protoplast | 1 | 1,2 |
| 12.4 | Applications and limitations of somatic hybridization for raising distant hybrids | 1 | 3,4 |
| | | | |
| **13.0** | **Selection of stress tolerant genotypes** | **4** | |
| 13.1 | Types of stress, biological vs environmental stresses, stress tolerance vs stress resistance | 1 | 2 |
| 13.2 | Selection and regeneration of stress (drought and salt) tolerant genotypes through cell /callus culture | 3 | 3 |
| | | | |
| **14.0** | **Cryopreservation** | **4** | |
| 14.1 | Definition, scope, different steps and factors affecting the cryopreservation process | 2 | 1 |
| 14.2 | Merits, demerits and impact on germplasm conservation of | 2 | 1 |

| | | | |
|---|---|---|---|
| | endangered plants | | |
| | | | |
| **15.0** | **Production of secondary metabolites** | **4** | |
| 15.1 | Terminology, types and distribution of secondary metabolites in plant body | 1 | 1 |
| 15.2 | Mass production of secondary metabolites using suspension culture | 2 | 3 |
| 15.3 | Commercial application of *in vitro* secondary metabolites production | 1 | 3,4 |
| | | | |
| **16.0** | **Utilization and scope** | **4** | |
| 16.1 | Roles and impacts of plant cell and tissue culture techniques in other areas of plant sciences and biotechnology | 4 | 3,4 |

## Mapping CLOs with the Teaching Learning and Assessment Strategies

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Bhojwani, S.S. and Razdan, M.K. 1983. Plant Tissue Culture: Theory and Practice. Elsevier Sci. Publ., Amsterdam, The Netherlands.
2. Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and limitations. Elsevier Sci. Publ. Amsterdam, The Netherlands.
3. Debergh, P.C. and Zimmerman, R.H. 1990. Micropropagation: Technology and Application. Kluwer Academic Publ. Dordecht. The Netherlands.
4. George, E.F., Hall, M.A. and De Klerk, G. 2008. Plant Propagation by Tissue Culture, 3rd Ed, Vol 1, Agritech Publications, New York, USA.
5. Jain, S.M. and Saxena, P.K. 2009. Protocols for *In Vitro* Cultures and Secondary Metabolite Analysis of Aromatic and Medicinal Plants, Agritech Publications, New York, USA.
6. Kirakosyan, A. and Peter B. 2009. Recent Advances in Plant Biotechnology. Agritech Publications, New York, USA.
7. Razdan, M.K. 1993. An Introduction to Plant Tissue Culture. Oxford & IBH Publ. Co. Pvt. Ltd. New Delhi, India.

1.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1205 | | |
| **Course Title** | : Cell Biology and Omics Sciences | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Uthpal Krishna Roy | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Cell Biology and Omics Sciences are foundational disciplines in modern biology. Cell biology provides insights into cellular structures and processes, while omics sciences deliver comprehensive molecular data (genes, proteins, metabolites) to explain how these structures and processes are regulated. Combining cell biology with omics sciences enhances our understanding of how molecular-level changes translate into cellular functions and organismal phenotypes. The integration of cell biology and omics sciences provides a comprehensive understanding of biological systems, and together, they drive innovations in agriculture, health, environmental science, and biotechnology.

**Course Learning Outcomes (CLOs)**

| CLO No. | **Expected Course Outcomes**<br>Upon completion of this course, the students will be able to: | **Cognitive level** |
|---|---|---|
| CLO 1 | know the history and fundamentals of cell biological research, basic properties of cellular metabolism, cellular regulation, and cellular stress responses; | R |
| CLO 2 | describe the interaction between cells and their environments, cellular function, movements of cells, cell cycle, and cell signaling process; | U |
| CLO 3 | analyze the molecular basis of cell regulation and responses of cells with different stresses, the molecular basis of cell death and cell renewal; | An |
| CLO 4 | develop and utilize the basic skills in various Omics techniques and techniques of cell biological research. | C, Ap |

R-Remember; U-Understanding; An-Analyze; C- Create; Ap-Apply

**Mapping CLOs with PLOs**

| **CLOs** | **Program Learning Outcomes (PLOs)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| CLO 1 | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| CLO 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 |
| CLO 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 |
| CLO 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 – Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction to the study of cell biology** | **4** | |
| 1.1 | An overview of cells and cell Research | 2 | 1 |
| 1.2 | Nature and Types of Biological Molecules | 1 | 1,2 |
| 1.3 | Formation of Complex Macromolecular Structures | 1 | 1,2 |
| | | | |
| **2.0** | **Cell Metabolism and Cellular Functions** | **10** | |
| 2.1 | An overview of Metabolism; Oxidation and Reduction; Metabolic Regulation, and Redox Biology | 3 | 1,2 |
| 2.2 | Metabolic energy; Capture and Utilization of energy; Central role of enzymes as biological catalysts | 2 | 1,2 |
| 2.3 | The Nuclear envelop and traffic between the Nucleus and the Cytoplasm | 1 | 1,2 |
| 2.4 | Protein sorting and transport: Endoplasmic reticulum, Golgi apparatus and Lysosomes | 2 | 1,2 |
| 2.5 | Bioenergetics and Metabolism: Mitochondria, Chloroplast and Peroxisomes | 2 | 1,2 |
| | | | |
| **3.0** | **Interaction between Cells and their Environment** | **5** | |
| 3.1 | Cell-Cell and Cell-Matrix Adhesion: An Overview | 1 | 1 |
| 3.2 | Extracellular Matrix | 1 | 1,2 |
| 3.3 | Cell-Cell and Cell-ECM Junction, and their Adhesion Molecules | 2 | 1,2 |
| 3.4 | Adhesive Interaction in Motile and Non-motile Cells | 1 | 1,2 |
| | | | |
| **4.0** | **Molecular Cell Regulation** | **8** | |
| 4.1 | Signaling Molecules and their Receptors, Functions of Cell surface Receptors | 1 | 1,2 |
| 4.2 | Signal transduction and Signaling Network, Pathways of intracellular Signal transduction | 2 | 2,3 |
| 4.3 | Regulation of the Cell cycle, Regulators of Cell cycle Progression; Entry into Mitosis, Completion of Mitosis, Meiosis and Fertilization | 3 | 2,3 |
| 4.4 | Necrosis and Programmed Cell Death (Apoptosis), Central regulators of Apoptosis, Signaling Pathways that regulate Apoptosis | 2 | 2,3 |
| | | | |
| **5.0** | **Cellular stress response** | **9** | |
| 5.1 | Stress, Stressors, and Stress Response | 1 | 1 |
| 5.2 | Expression of stress-inducible genes; Transcription factor and | 3 | 2,3 |

| | | | |
|---|---|---|---|
| | their regulation; Regulation of translation during stress | | |
| 5.3 | Cell signaling and stress responses; Age-dependent changes in the stress response; Hijacking of cellular stress responses | 3 | 2,3 |
| 5.4 | Epigenetic regulation of stress responses in plants; Enzymatic and Hormonal regulation of stress | 2 | 2,3 |
| | | | |
| **6.0** | **System Biology and Omics technologies** | **8** | |
| 6.1 | Introduction to Omics, Opportunities and Challenges in Omics, Overview of System Biology and Omics tools, Omics in Crop Improvement | 3 | 1,2 |
| 6.2 | Building bridges from "omics" to Cell biology, Omics approaches to cell signaling | 2 | 2,3 |
| 6.3 | Integrated omics approaches in plant system Biology, Opportunities and Challenges in multi-omics approaches | 2 | 3,4 |
| 6.4 | Organellar omics, Metallomics and Spatial omics | 1 | 3,4 |
| | | | |
| **7.0** | **Single-cell omics** | **6** | |
| 7.1 | Introduction, Concepts and methods for single cell isolation and profiling, advances and application of single-cell omics technologies | 2 | 1,2 |
| 7.2 | Single-cell genomics, single-cellepigenomics, single-celltranscriptomics, and single-cell metabolomics | 2 | 3,4 |
| 7.3 | Single-cell and multimodal omics, single-cell multi-omics strategies and application, multi-omics profiling of single cells | 2 | 3,4 |
| | | | |
| **8.0** | **Advancement of Omics Sciences** | **10** | |
| 8.1 | Genomic Technologies : Microarrays; Quantitative PCR; Next generation Sequencing | 2 | 4 |
| 8.2 | Metabolomics Technologies: NMR spectroscopy-based metabolomics; Mass spectrometry, GC-MS & LC-MS based Metabolomics | 2 | 4 |
| 8.3 | Proteomics Technologies: Protein microarray; Gel- based approaches; ICAT labelling; X-ray crystallography; NMR spectroscopy | 3 | 4 |
| 8.4 | Transcriptomics Technologies: Expressed sequence tag (EST), SAGE; NGS-based RNA sequencing (RNA-seq) | 3 | 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Alberts B., Johnson A., Lewis J., Raff M., Roberts K. and Walter P. 2008. Molecular Biology of the Cell, 5th Edition. Publisher: Garland Science, USA.
2. Ashwani K. RAI and Teruhiro Takabe, 2006. Abiotic Stress Tolerance in Plants: Toward the Improvement of Global Environment and Food. Springer, Netherlands.
3. Gaur R.K. and Sharma P. 2014. Approaches to Plant Stress and their Management.Springer, India.
4. Geoffrey M. Cooper and Hausman R.E. 2007. The Cell: A Molecular Approach. 4th edition. ASM Press, USA.
5. Gerald Karp, 2013. Cell and Molecular Biology: Concepts and Experiments. 7th edition. John Wiley & Sons, USA.
6. Harvey L., Arnold B., Kaiser, C. A., Monty K., Anthony B., Hidde. P., Angelika A. and Scott, M.P. 2012. Molecular Cell Biology: International Edition (7th). Macmillan Press LTD, UK.
7. Verma D.P.S and Hong Z., 2007. Plant Cell Monographs: Cell Division Control in Plants. Springer, Germany.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2201 | | |
| **Course Title** | : Agricultural Biotechnology | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : M. Sarwar Parvez | | |
| **Credit Value** | **:** 4 | **Credit hours/week:** 5 | **Total credit hours:** 60 |
| **Total Marks** | **:** 100 | | |

**Rationale of the course**

The course teaches modern methods to improve crops, reduce losses, and make farming more efficient. It covers topics like tissue culture, genetic engineering, and creating GM crops to overcome traditional breeding limits. Students learn about smart farming, hydroponics, and ways to increase shelf life. The course focuses on using technology to solve farming challenges and ensure food security.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | demonstrate the ability to use molecular, genetic, and cellular tools to improve crop yield, pest resistance, and nutritional quality in agricultural systems; | R, U, Ap |
| CLO 2 | develop sustainable solutions using hydroponic systems, indoor agriculture, and biotechnological innovations to maximize resource efficiency and environmental sustainability; | U, Ap |
| CLO 3 | apply biotechnological strategies to reduce post-harvest losses, enhance product quality, and extend shelf life, contributing to improved food security. | Ap, E,C |

R-Remember; U-Understanding; Ap-Apply; E-Evaluate; C-Create

## Mapping CLOs with PLOs

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| CLO 1 | 3 | 1 | 2 | 3 | 1 | 1 | 3 |
| CLO 2 | 3 | 2 | 2 | 3 | 2 | 3 | 1 |
| CLO 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 |

Note: 3 - High, 2 – Medium, 1 – Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction to Agricultural Biotechnology** | **9** | |
| 1.1 | Definition, some important agricultural research centre | 2 | 1, 2 |
| 1.2 | Different types of crops: cereals, pulses, vegetables, tubers and fruits | 1 | 1,2 |
| 1.3 | Limitations of conventional plant breeding for crop improvement | 2 | 2, 3 |
| 1.4 | Necessity of biotechnology for crop improvement | 2 | 2 |

| | | | |
|---|---|---|---|
| 1.5 | Use of biotechnological tools to overcome the limitation of conventional plant breeding | 2 | 1,3 |
| **2.0** | **Various Tissue Culture Approaches to Crop Improvement** | **12** | |
| 2.1 | Introduction to plant tissue culture, totipotency, various approaches to crop improvement | 4 | 2, |
| 2.2 | Somaclonal variation: concept, principle, factors and causes, importance and applications along with examples | 2 | 1,3 |
| 2.3 | Wide hybridization: *in vitro* fertilization, embryo culture, protoplast fusion | 3 | 1,3 |
| 2.4 | Meristem culture: pathogen elimination and production of virus free plant | 1 | 1,3 |
| 2.5 | Haploid production: androgenesis, gynogenesis and development of homozygous lines | 2 | 1,3 |
| **3.0** | **Genetic Engineering or Recombinant Technology for Crop Improvement** | **9** | |
| 3.1 | General terminology used in genetic engineering: gene, restriction enzymes, ligases, recombinant DNA, gene isolation, cloning, RNA and DNA polymerases, vectors, complementary DNA (cDNA),marker aided selection (MAS), antibiotic resistance marker genes,oncogenes, gene library, transposons/transposable elements | 4 | 1, 2 |
| 3.2 | Different types of gene transfer systems in plant: direct and indirect | 3 | 2 |
| 3.3 | Direct system: Biolistics (particle or gene gun) | 1 | 1,3 |
| 3.4 | Indirect system: *Agrobacterium* – mediated gene transformation | 1 | 1,3 |
| **4.0** | **Genetically Modified (GM) Crops** | **12** | |
| 4.1 | Defination, purpose of GM crop | 2 | 2 |
| 4.2 | Types of modifications: transgenic, cisgenic, subgenic | 1 | 2 |
| 4.3 | Advantages and disadvantages of GMO | 1 | 2,3 |
| 4.4 | Some important gene (trait) used to develop GM crop: herbicide resistant, insect resistant, stress tolerance, nitrogen fixing, fruit processing, genes for nutritional aspects | 3 | 2 |
| 4.5 | Biofuel production by GMO | 3 | 1,3 |
| 4.6 | Biosafety resolutions | 2 | 2 |
| **5.0** | **Hydroponic System of Indoor Agriculture** | **9** | |
| 5.1 | Introduction, basic principles and history | 2 | 1,2 |
| 5.2 | Basic components of a hydroponic system | 2 | 1, 3 |
| 5.3 | Different types of hydroponic system: wick, deep water culture, aeroponics, drip, nutrient film technique | 4 | 1,3 |
| 5.4 | Advantages and disadvantages of hydroponic system | 1 | 2 |

| | | | |
|---|---|---|---|
| **6.0** | **Post- Harvest Management** | **9** | |
| 6.1 | Post-harvest losses: causes and impact | 2 | 2, 3 |
| 6.2 | Technologies for minimizing post-harvest losses | 2 | 1,3 |
| 6.3 | Biotechnological approaches for post-harvest management | 3 | 1,3 |
| 6.4 | Shelf life: biotechnological approaches for increasing shelf life of crop | 2 | 1,3 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**

1. Ahindra, N. 2008. Textbook of Agricultural Biotechnology. 1st edition, PHI Learning Pvt. Ltd., New Delhi, Delhi, India.
2. Kumar, A. 2008. Agricultural Biotechnology Discovery Publishing Pvt. Ltd., New Delhi, Delhi, India.
3. Kumar, H.D. 2005. Agricultural Biotechnology. Daya Publishing House, New Delhi, Delhi, India.
4. Rajmohan, J. 2006.Agricultural Biotechnology. Gyan BooksPvt. Ltd., New Delhi, Delhi, India.
5. Srivastava, D.K., Ajay, K.T. and Pankaj, K. 2021. Agricultural Biotechnology: Latest Research and Trends. Springer, Singapore.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2202 | | |
| **Course Title** | : Applied Microbiology | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Most. Ferdousi Begum | | |
| **Credit Value** | **:** 4 | **Credit hours/week:** 5 | **Total credit hours:** 60 |
| **Total Marks** | **:** 100 | | |

**Rationale of the course**

This course is design to know the analytical procedure of water and food for public health and community services and to develop idea and expertise in operation of bioreactor, scale up and product recovery and as well as expertise on clinical diagnosis of pathogen. It also focuses on mechanism of bioremediation for pollution abatement, bio-energy generation and microorganisms-mediated-nanoparticles with noble approaches.

**Course Learning Outcomes (CLOs)**

| CO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive level |
|---|---|---|
| CLO1 | Acquire basic knowledge on applied microbiology and its implications to produce beneficiary products and community services; | U |
| CLO2 | Analyze microbial quality and significance of air and water; | An |
| CLO3 | Explain food safety, quality assurance and HACCP to a food production process and regulatory authorities; | E |
| CLO4 | Apply the knowledge of mass scale production of industrial microbial products, and biological energy generation; | Ap |
| CLO5 | Develop skill for clinical diagnosis, pollution abatement and different aspects of microbial nanotechnology. | C |

U-Understanding, An-Analyze, E-Evaluate, Ap- Apply, C-create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| CLO 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CLO 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 |
| CLO 4 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| CLO 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 - Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction** | **4** | |
| 1.1 | Definition, areas and scope of applied microbiology. | 2 | 1 |
| 1.2 | Advances of applied microbiology in 21st century | 2 | 1 |
| **2.0** | **Control of microorganisms** | **5** | |
| 2.1 | Terminology- microbicidal, microbiostatic, sterilization, disinfection, antiseptic, germicide and sanitizer | 1 | 1 |
| 2.2 | Physical agents and methods: Heat, Filtration, Radiation | 2 | |
| 2.3 | Chemical agents and methods: Major disinfectants and antiseptics, Chemical sterilants and gaseous sterilants | 2 | 1 |

| | | | |
|---|---|---|---|
| **3.0** | **Microbiology of air** | **6** | |
| 3.1 | Introduction, microorganisms in outdoor and indoor environment- sources, characteristics and consequences | 2 | 2 |
| 3.2 | Bioaerosol: nature and health effects | 1 | 2 |
| 3.3 | Aeroallergens and allergic disorders | 1 | 2 |
| 3.4 | Method of estimation of airborne microorganisms. Method of air purification | 2 | 2 |
| **4.0** | **Microbiology of water** | **7** | |
| 4.1 | Introduction, sources of water Fresh water and marine water microbiology: characteristics, distribution of microflora and their contributions | 3 | 2 |
| 4.2 | Indicator microorganisms, Bacteriological water analysis: MPN test- presumptive test, confirmed and completed test; Membrane filtration, P-A test, Enzyme substrate test, PCR test | 2 | 2 |
| 4.3 | Purification of drinking water and waste water treatment system | 2 | 2 |
| **5.0** | **Microbiology of food** | **7** | |
| 5.1 | Sources of microbial contamination; Food spoilage; food poisoning and infection; and method of food preservation | 3 | 3 |
| 5.2 | Indices of food sanitary quality, Microbial testing of foods-traditional methodology and new approaches | 2 | 3 |
| 5.3 | Principles and guidelines of HACCP; Regulatory and enforcement agencies: WHO and FAO, ISO, FDA, EU the codex alimentarius, applications of codex standard in international trade; BSTI and BFSA | 2 | 3 |
| **6.0** | **Industrial microbiology** | **7** | |
| 6.1 | Basic concept, structure of bioreactor | 1 | 4 |
| 6.2 | fermentation technique, scale up, upstream process and downstream process | 2 | 4 |
| 6.3 | Production of citric acid- substrate preparation, inoculums preparation, inoculation, fermentation, product recovery and strain improvement | 2 | 4 |
| 6.4 | Penicillin production and strain improvement | 2 | |
| **7.0** | **Diagnostic microbiology** | **6** | |
| 7.1 | Serological tests: antigen, antibody, antigen and antibody reactions- agglutination, precipitation and Enzyme-linked immunosorbent assay (ELISA) | 3 | |
| 7.2 | Molecular test : PCR | 2 | |
| 7.3 | Antimicrobial susceptibility test: Disc diffusion method | 1 | |
| **8.0** | **Bioremediation** | **7** | |
| 8.1 | Basic concept, microbial degradation of petroleum hydrocarbon and some common pesticides- PCB, DDT, | 2 | 5 |

| | | | |
|---|---|---|---|
| | BHC, PCPS and chlorobenzoates | | |
| 8.2 | Biodegradation pathway of xenobiotics- enzymatic conversion, orthro-cleavage pathway and meta-cleavage pathway | 3 | 5 |
| 8.3 | Detoxification and accumulation of heavy metals- adsorption-adsorption to cell wall or other compounds, cellular metabolism and extracellular precipitation | 2 | 5 |
| **9.0** | **Bioenergy generation** | **6** | |
| 9.1 | Microbial fuel cells (MFCs)and its application, Biosynthesis of hydrogen: potential substrates and digestion process | **3** | 4 |
| 9.2 | Biogas- substrates and microorganisms, structure of biogas plant, biogas production, anaerobic digestion and application. | **3** | 4 |
| **10.0** | **Microbial nanotechnology** | **5** | |
| 10.1 | Introduction into nanotechnology and microbiology, Principles and applications of basics tools used in nanotechnology | **3** | 5 |
| 10..2 | Biosynthesis of microorganisms mediated nano-particle. Application of microbial nanotechnology in clinical microbiology, food science, agriculture and waste water treatment | **2** | 5 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Dubey, R.C. 1998. A text book of biotechnology. S. Chand and Company LTD, India.
2. Jay, J.M. 1987. Modern Food Microbiology. 3rd edition, CBS Publishers & Distributors, India.
3. Markendey, D.K. and Markendey, N.R. 2002. Microorganisms in bioremediation. Capital publishing company, India.
4. Pelzer, M.J., Chan, E.C.S. and Krieg, N.R. 1993. Microbiology: Concepts and Applications. McGraw-Hill, Inc.
5. Prescott, S.O. and Dunn, C.G. 1959. Industrial Microbiology (Third edition). McGraw-Hill, Inc.
6. Purohit, S.S and Mathur, S.K. 1996. Biotechnology: Fundamental and Applications. Agro Botanical Publishers, India.
7. Purohit, S.S., Saluza, A.K. and Kakrani, H. N. 2008. Pharmaceutical microbiology. Agrobios publishing company, India.
8. Sahai, V.N. 1990. Fundamentals of soil. Kalyani Publishers, New Delhi.
9. Sen, S.P. and Palit, P. 1988. Biofertilizers: Potentialities and Problems. NayaProkash, Calcutta.
10. Tortora, G.J., Funke, B.R. and Case, C.L. 2004. Microbiology an Introduction (Eighth edition). Pearson Education. Ltd. India.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2203 | | |
| **Course Title** | : Wood Science and Technology | | |
| **Semester** | : 2nd | | |
| **Course teacher** | : Rubaiyat Sharmin Sultana | | |
| **Credits** | : 4 | Credit hours/week = 5 | Total credit hours=60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Wood Sciences and Molecular Technology course covers theoretical and practical aspects of genetically wood modification and utilization for wood industries. This course defines molecular genetic tools for the identification of the origin of wood and DNA isolation from wood, wood modification by molecular breeding, modern and future forestry-based biotechnology. Wood sciences and molecular technology is designed to prepare students for meeting the challenges of a wood products industry career.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected course outcomes<br>Upon completion of this course, the students will be able to: | Cognitive level |
|---|---|---|
| CLO 1 | understand wood, types, industrial utilization, wood products, wood quality, wood producing tree, physical and mechanical characteristics of wood; | U |
| CLO 2 | learn about basic microscopic features of wood at different surfaces, cell wall layer and xylem development; | E |
| CLO 3 | develop knowledge on mechanism of wood formation, Chemical constituents of wood, reaction wood, wood defects, wood preservation,and degradation of wood; | E |
| CLO 4 | apply the knowledge of wood biotechnology like genetic variation in wood properties, genes related to the formation of wood; improvement of wood properties by molecular breeding and conventional breeding methods. | Ap |

U-Understanding; E-Evaluate; Ap- Apply

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 2 | 2 | 3 | 2 | 2 | 3 | 3 |
| CLO 2 | 3 | 2 | 2 | 3 | 2 | 1 | 3 |
| CLO 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| CLO 4 | 3 | 3 | 2 | 2 | 3 | 3 | 2 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction** | **7** | |
| 1.1 | Wood definition, different kinds of wood, characteristics of | 4 | 1 |

| | | | |
|---|---|---|---|
| | diagnostics feature used in wood identification.Wood quality, genetic correlations between wood quality traits, wood producing tree. | | |
| 1.2 | Biotechnology in wood industry | 1 | 1 |
| 1.3 | New biological methods in assessment of wood and wood products | 2 | 1 |
| | | | |
| **2.0** | **Wood Formation** | **11** | |
| 2.1 | Recent advances in the molecular biology of wood formation. | 1 | 3 |
| 2.2 | Development of genomics for wood biology.Genetic control in wood lignification; Genetic controls of microfibril angle (MFA) in the secondary cell wall | 6 | 3 |
| 2.3 | Genes related to the formation of wood, hormonal and enzymatic activities in the formation of wood | 4 | 3 |
| | | | |
| **3.0** | **Molecular Biotechnology in Wood** | **19** | **4** |
| 3.1 | Applications of biotechnology and molecular genetics to tree improvement | 1 | 2,4 |
| 3.2 | Micropropagation techniques for timber trees, somaclonal variation use for selection good traits of timber clones; Germplasm conservation techniques of woody tree species | 4 | 2,4 |
| 3.3 | Genome Analysis and Gene Mapping in Woody plants, Restriction fragment length polymorphism (RFLP), Random amplified polymorphic DNA (RAPD) Strategies for applications of molecular markers to tree improvement programs. Molecular tools for breeding program. Improvement of wood properties by molecular breeding and conventional breeding methods, Traits of interest for tree improvement | 5 | 4 |
| 3.4 | Modifications in lignin content and composition<br>Hormonal control of xylem differentiation | 4 | 4 |
| 3.5 | Molecular genetic tools for the identification of the origin of wood and DNA isolation from wood | 3 | 4 |
| 3.6 | Molecular detection of fungi in wood | 1 | 4 |
| 3.7 | Modern and future forestry-based biotechnology | 1 | 4 |
| | | | |
| **4.0** | **Chemical Constituents of Wood** | **7** | |
| 4.1 | Chemical constituents of hard and soft wood | 2 | 3 |
| 4.2 | Biosynthesis of wood biomass: cellulose, hemi-cellulose and lignin | 2 | 3 |
| 4.3 | Wood as renewable energy source comparison of the different producers of biomass processes for conversion of biomass into energy and chemicals | 2 | 3 |

| | | | |
|---|---|---|---|
| 4.4 | Genes involved in the biosynthesis of lignin, cellulose and hemi-cellulose in wood | 1 | 4 |
| | | | |
| **5.0** | **Timber Seasoning** | **4** | |
| 5.1 | Definition, types of seasoning of timber, Kiln vs Air-dried firewood seasoning, objectives, improved ability by seasoning of timber, significance of timber seasoning, advantages and disadvantages of natural seasoning and artificial seasoning | 2 | 3 |
| 5.2 | Advances in wood drying and its development | 2 | 3 |
| | | | |
| **6.0** | **Wood Preservation and Processing** | **4** | |
| 6.1 | Definition, types, Preservatives, importance for tropical countries, methods. Impact on some particular fields. Disposal of treated wood waste | 2 | 3 |
| 6.2 | Improvement of preservative penetration in wood | 1 | 3 |
| 6.2 | Waste wood management and energy production | 1 | 3 |
| 6.3 | Biological control of timber in service | 1 | 3 |
| | | | |
| **7.0** | **The Biology of Reaction Wood Introduction** | **3** | |
| 7.1 | Definition, structure, types, formation of rection wood, advantages and disadvantagesof reaction wood | 2 | 3 |
| 7.2 | Characteristics of compression and tension wood and comparative study between these two types wood | 1 | 3 |
| | | | |
| **8.0** | **Wood Defects** | **3** | |
| 8.1 | Natural defects, seasoning defects, defects due to conversion; Common lumber defects | 1 | 3 |
| 8.2 | Fungal defects, defects due to insects and other animal | 1 | 3 |
| 8.3 | Tree defect identification | 1 | 3 |
| | | | |
| **9.0** | **Degradation of Wood** | **2** | |
| 9.1 | Bacterial wood degradation, fungal wood degradation | 1 | 3 |
| 9.2 | Wood degradation with insects and other reasons for wood degradation | 1 | 3 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books recommended**

1. Baas, P. 2014. New Perspective in Wood Anatomy. Springer, Berlin-Heidelberg-New York.
2. Carlquist, S. 1975. Ecological Strategies of Xylem Evolution. Berkeley, University of California Press, USA.
3. Carlquist, S. 1998. Comparative Wood Anatomy Systematic, Ecological and Evolutionary aspects of Dicotyledon Wood. Springer, Berlin-Heidelberg-New York.
4. Dickison, W.C. 2000. Integrative Plant Anatomy. Academic Press USA.
5. Engel, D.H. and Phummai, S.A. 2002. Field Guide to Tropical Plants of Asia. Timber Press, Japan.
6. Ogata, K, Fujii, T., Abe. H. and Baas, P. 2008. Identification of the Timbers of Southest Asia and the Western Pacific. Holzforschung, Netherland.
7. Schweingruber. F. H. 2007. Wood Structure and Environment Springer, Berlin-Heidelberg, New York.
8. Siau, J.F. 1984. Transport Process in Wood. Springer Verlag, New York.
9. Ursula Kües Ed. 2007 Wood Production, Wood Technology, and Biotechnological Impacts Erschienenim Universitätsverlag Gottingen.
10. Zimmermann, M.H. 2002. Xylem Structure and the Ascent of Sap. Springer Verlag, New York.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2204 | | |
| **Course Title** | : Developmental Genetics | | |
| **Year/Semester** | : 2nd | | |
| **Course Teacher** | : Umme Qulsum | | |
| **Credit Value** | : 4 | **Credit hours/week**: 4 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

This course is an introduction to Plant Developmental Biology. It offers a dynamic approach to the study of plant structure and development by integrating recent advances in Genetics and Molecular Biology. To expand students' knowledge about plant development, molecular mechanisms of its genetic control and the impact of the environment on plant development.

**Course Learning Outcomes (CLO)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive level |
|---|---|---|
| CLO 1 | define different terminologies relevant to leaf, shoot and root development, fruit and seed development, embryogenesis, photomorphogenesis, vascular system, etc. | R |
| CLO 2 | describe the internal structures of the various plant organs, how the organs are formed, and the genes involved in organ formation; | U |
| CLO 3 | understand the mechanism behind the transition from vegetative to reproductive development, and the interplay between genes and environment; | U |
| CLO 4 | gain various skills through hands-on experience on techniques such as tissue culture, histology, web tools in bioinformatics; and conduct different experiments relevant to plant development including DNA, RNA and protein isolation at different stages of plant development and gene expression. | Ap |

R-Remember; U-Understanding; Ap-Apply

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CLO 2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 |
| CLO 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| CLO 4 | 3 | 2 | 2 | 3 | 3 | 1 | 3 |

Note: 3 - High, 2 – Medium, 1 – Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction- An approach to Plant Development** | **7** | |
| 1.1 | Pattern formation in plant development | 1 | 1 |
| 1.2 | Difference between plant and animal development, germ | 2 | 1 |

| | | | |
|---|---|---|---|
| | line development, post embryonic development, regeneration and totipotency | | |
| 1.3 | Variety of plant organs, and cell types | 1 | 1 |
| 1.4 | Intercellular communication, model plant system | 1 | 1 |
| 1.5 | Cloning genes relevant to plant development | 1 | 4 |
| 1.6 | Gene families and their role in plant development, and virtual plants | 1 | 4 |
| | | | |
| **2.0** | **Cell lineage and Positional Formation** | **6** | |
| 2.1 | Founder cell and developmental compartments | 2 | 2 |
| 2.2 | Positional information in plant development | 2 | 2,3 |
| 2.3 | Cell layers and chimeras, transmission of information between layers | 1 | 3 |
| 2.4 | Knotted gene and floricaula gene | 1 | 2,3,4 |
| | | | |
| **3.0** | **Embryogenesis** | **8** | |
| 3.1 | Genetics of embryogenesis | 1 | 1 |
| 3.2 | Embryo lethal mutant in *Arabidopsis* and maize | 2 | 2 |
| 3.3 | Cell fate map in embryo development | 2 | 3 |
| 3.4 | *In vitro* fertilization and embryo development | 1 | 1 |
| 3.5 | Photomorphogenesis, different light sensitive photomorphogenic mutants in *Arabidopsis* Downstream in photomorphogenesis | 2 | 1,2 |
| | | | |
| **4.0** | **Shoot Development** | **5** | |
| 4.1 | Shoot apical meristem (SAM), organization layers and zones, SAM mutants | 3 | 1,2,3 |
| 4.2 | Cell differentiation in SAM and SAM molecular biology | 2 | 2,3 |
| | | | |
| **5.0** | **Leaf Development** | **4** | |
| 5.1 | Genetics of leaf development in monocot and dicot | 2 | 1,2 |
| 5.2 | Stomatal patterning and spacing | 2 | 3 |
| | | | |
| **6.0** | **Transition to flowering** | **2** | |
| 6.1 | Transition to vegetative to inflorescence, and inflorescence to floral development in *Arabidopsis* | 2 | 3 |
| | | | |
| **7.0** | **Flower Development** | **8** | |
| 7.1 | Molecular genetics of flowering- ABC model | 2 | 1,2 |
| 7.2 | Identification of floral Homeotic genes and MADS box genes | 2 | 4 |
| 7.3 | Sex determination- monoecious and dioecious | 2 | 1,4 |
| 7.4 | Development of floral Reproductive Organ and Gametophytes | 2 | 1,2 |
| | | | |

| | | | |
|---|---|---|---|
| **8.0** | **Pollination and Apomixis** | **4** | |
| 8.1 | Pollen germination, tube growth and guidance | 2 | 1 |
| 8.2 | Self-incompatibility | 1 | 2 |
| 8.3 | apomixes | 1 | 1,2 |
| | | | |
| **9.0** | **Seed and Fruit Development** | **6** | |
| 9.1 | Different stages in seed development | 2 | 1 |
| 9.2 | Dormancy and the control of germination | 2 | 1 |
| 9.3 | Molecular mechanism of fruit growth and ripening | 2 | 2,4 |
| | | | |
| **10.0** | **Root Development** | **4** | |
| 10.1 | Root apical meristem and promeristem, origin of primary root during embryogenesis | 2 | 1 |
| 10.2 | Molecular genetics of root development | 2 | 2,4 |
| | | | |
| **11.0** | **Vascular Development** | **6** | |
| 11.1 | Development of stem and leaf vascularae | 2 | 1 |
| 11.2 | Differentiation of xylem, phloem, and programmed cell death | 2 | 1 |
| 11.3 | Gene expression during vascular development | 2 | 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books recommended**


2. Beck, C.B. 2010. An introduction to plant structure and development: plant anatomy for the twenty-first century. Cambridge University Press, UK.
3. Cronk, Q.C., Bateman, R.M., and Hawkins, J. A. 2004. Developmental genetics and plant evolution. CRC Press, USA.
4. Howell, S.H., and Howell, S.H. 1998. Molecular genetics of plant development. Cambridge University Press, UK.
5. Leyser, O., and Day, S. 2009. Mechanisms in plant development. John Wiley & Sons Inc. USA
6. Soltis, D., Soltis, P., and Leebens-Mack, J. 2006. Developmental Genetics of the Flower: Advances in Botanical Research. Elsevier, Netherland.
7. Soltis, P., and Doyle, J.J. 2012. Molecular systematics of plants II: DNA sequencing. Springer Science & Business Media.
8. Turnbull, C.G. 2005. Plant architecture and its manipulation. Blackwell Publishing, USA.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3201 | | |
| **Course Title** | : General viva-voce | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : MS Examination Committee | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

## Practical Curses

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3202 | | |
| **Course Title** | : Cytogenetics and Crop Improvement | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Cytogenetics and Crop Improvement** |
|---|---|
| 1.1 | Study of chromosome compliment from root meristem |
| 1.2 | Pollen grain mitosis to study gross morphology of chromosomes and to determine the chromosome number |
| 1.3 | Interphase nuclear and interphase chromosome volume in different plant species |
| 1.4 | Observation and calculation of chiasma frequency from pollen mother cells and presentation of data |
| 1.5 | Karyotype analysis up to preparation of ideogram |
| 1.6 | Genome analysis in crop plants |
| 1.7 | Induction of polyploidy |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3203 | | |
| **Course Title** | : Applied Plant Breeding | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Applied Plant Breeding** |
|---|---|
| 1.1 | Demonstration of hybridization program of different field crops |
| 1.2 | Demonstration of observational yield trial and preliminary yield trials |
| 1.3 | Visiting seed certification agency to discuss with plant variety release procedure |
| 1.4 | Visiting crop germplasm collection centers in Bangladesh |
| 1.5 | Report preparation and submission on all research visits |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3204 | | |
| **Course Title** | : Biometrical Genetics | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Biometrical Genetics** |
|---|---|
| 1.1 | Revision of analysis of variance and regression. |
| 1.2 | Regression |
| 1.3 | Weighted least squares |
| 1.4 | Scaling test; Joint scaling test |
| 1.5 | Non –allelic interaction; Generation means; GXE (Parents and $F_1$); GXE (Multiple lines) |
| 1.6 | Deviation of expected mean squares; Components of $F_2$ and lines derived from it |
| 1.7 | Predicted response to selection (BIP); Triple test cross |
| 1.8 | Diallel; Heterosis; Analysis of variance (hierarchical) |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3205 | | |
| **Course Title** | : Plant Tissue Culture and Somatic Cell Technology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Plant Tissue Culture and Somatic Cell Technology** |
|---|---|
| 1.1 | Preparation of stock solution, plant growth regulators, and nutrient media |
| 1.2 | Collection, surface sterilization, preparation, and inoculation of explants |
| 1.3 | Establishment of callus and induction of somatic embryogenesis and organogenesis |
| 1.4 | Microscopic analysis of callus for cyto-differentiation, embryogenesis and organogenesis |
| 1.5 | Determination of appropriate stages of anther and pollen for culture initiation and induction of haploid plants |
| 1.6 | Determination of growth index by callus culture and bioassay system for auxin and cytokinin (Demonstration only) |
| 1.7 | Estimation of different growth parameters for evaluation of suitable media composition using proliferating shoot cultures |
| 1.8 | Evaluation and interpretation of experimental data |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3206 | | |
| **Course Title** | : Cell Biology and Omics Sciences | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Cell Biology and Omics Sciences** |
|---|---|
| 1.1 | Extraction and estimation of proline from salt-stress and unstressed seedlings |
| 1.2 | Extraction, estimation and comparative analysis of the enzyme Catalase from different plant samples |
| 1.3 | Extraction and estimation of Thiobarbituric acid reactive substances (TBARS) |
| 1.4 | Extraction and estimation of Pro-oxidant ($H_2O_2$) |
| 1.5 | *In situ* localization of $H_2O_2$ through DAB staining |
| 1.6 | Assessment of RCV (Relative cell viability) |
| 1.7 | Determining the concentration of $Na^+$/ $k^+$ ion using flame photometry |
| 1.8 | Assessment of antioxidative pigment (chlorophyll a and b, anthocyanin and carotenoids) |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3207 | | |
| **Course Title** | : Agricultural Biotechnology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Agricultural Biotechnology** |
|---|---|
| 1.1 | Techniques of preparation of plant tissue culture media. |
| 1.2 | Techniques of preparation of bacterial culture media for culture of bacteria |
| 1.3 | Molecular techniques of analysing transgenic plants |
| 1.4 | GUS assay |
| 1.5 | Bioassay of transformed tissues and plants |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3208 | | |
| **Course Title** | : Applied Microbiology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Applied Microbiology** |
|---|---|
| 1.1 | Differential staining of bacteria: Acid fast staining |
| 1.2 | Biochemical test for bacteria: Catalase, Starch , indole and MR-VP test |
| 1.3 | Estimation of indoor and outdoor airborne fungi/bacteria |
| 1.4 | Assessment of coliforms standard in water samples |
| 1.5 | Study of antibiosis through microbial sensitivity test |
| 1.6 | Agglutination and precipitation test to determine antigen/antibody |
| 1.7 | Measurements of bacterial growth |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3209 | | |
| **Course Title** | : Wood Science and Technology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Wood Science and Technology** |
|---|---|
| 1.1 | Hand lens features of soft wood and hardwood, sapwood and heart wood specimens. |
| 1.2 | Wood specimen collection and preservation. |
| 1.3 | Section preparation by rotary and sliding microtome |
| 1.4 | Preparation of permanent slide after double staining with safranin and fast green |
| 1.5 | Microscopic features identification in transverse section (TS), longitudinal section (LS) and radial section (RS) in permanent slide by inspection of some soft wood and hardwood species |
| 1.6 | Identify different types of cells after using maceration technique (Schultz,s method) |
| 1.7 | Measurement of dimensions of woody tissues in macerated cells and in stained section in the permanent slides (preparates) |
| 1.8 | Measurement of microfibril angle and tissue proportions |
| 1.9 | Measurement of growth increment in reaction wood. Observation of compression and tension wood characteristics. Compare normal and reaction wood features |
| 1.10 | Spotting: Identification of wood by hand lens. Identification of wood features in TS, LS and RS under light microscope from the permanent slide |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3210 | | |
| **Course Title** | : Developmental Genetics | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Developmental Genetics** |
|---|---|
| 1.1 | Isolation of DNA from plant tissue/cells at different developmental stages |
| 1.2 | Isolation of RNA from plant tissue/cells at different developmental stages |
| 1.3 | Polymerase chain reaction |
| 1.4 | Gene expression analysis |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3211 | | |
| **Course Title** | : Research Project | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

Each non-thesis student will conduct a project work under the supervision of a teacher and submit the project paper at the end of the academic year.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3212 | | |
| **Course Title** | : Thesis | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 8 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 200 | | |

Each thesis student will conduct a research work under the supervision of a teacher and submit the thesis paper at the end of the academic year.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3213 | | |
| **Course Title** | : Thesis presentation and defense | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : MS Examination Committee | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

## Specialization 3: Environmental Botany

Courses offered under this group aims to provide the students with in depth and most recent understanding of local and global ecosystems emphasizing plants and plant-environment interactions, management, conservation and sustainable utilization of biodiversity and plant resources. They will enrich their expertise to undertake higher research /education and specialized jobs.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1301 | | |
| **Course Title** | : Plant Ecology and Ecosystem Management | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Saika Kabir Nitu | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The study of plant ecology and ecosystem management is crucial for understanding and maintaining the healthy and functional of ecosystems. It provides a scientific foundation for addressing the complex environmental challenges faced by our planet, such as habitat degradation, climate change, biodiversity loss, and the sustainable use of natural resources. By fostering an integrated approach to managing ecosystems, this field of study provides the tools and knowledge needed to promote biodiversity conservation, combat climate change, restore degraded lands, and ensure the sustainable use of natural resources.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive level |
|---|---|---|
| CLO 1 | understand the basic ecological principles and familiarize it and the causes of climate change and global warming | U |
| CLO 2 | analyze different ecological processes and functions, interactions within plants and environments | An |
| CLO 3 | describe environmental hazards and risk; application of the intrinsic values of environmental issues with exploration of plant communities | E |
| CLO 4 | create awareness on various ecological acts associated with human welfare | C |

U-Understanding; An- Analyze, E- Evaluate; C- Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 2 | 3 | 1 | 2 | 2 | 2 | 3 |
| CLO 2 | 1 | 3 | 2 | 1 | 2 | 1 | 2 |
| CLO 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| CLO 4 | 2 | 2 | 3 | 3 | 2 | 2 | 2 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Ecology** | **3** | |
| 1.1 | Introduction, Principles of ecology, Scope, Application of plant ecology | 2 | 1 |
| 1.2 | Economic development and impacts | 1 | 1 |
| | | | |
| **2.0** | **Plants and environment** | **8** | |
| 2.1 | Biosphere, composition of air | 1 | 1 |
| 2.2 | Temperature, rainfall, relative humidity and their fluctuations in Bangladesh | 3 | 1 |
| | | | |
| **3.0** | **The ecosystem** | **5** | |
| 3.1 | Concept of ecosystem, ecosystem structure and function | 1 | 2 |
| 3.2 | Ecosystem modeling | 1 | 2 |
| 3.3 | Study of major ecosystems of the world (seas, estuaries, river, ponds, deserts, forests etc) | 2 | 2 |
| 3.4 | Ecosystem services and valuation | 5 | 3 |
| | | | |
| **4.0** | **Productivity in ecosystem** | **6** | |
| 4.1 | Primary and secondary productivity | 1 | 2 |
| 4.2 | Measurement of primary productivity | 1 | 2 |
| 4.3 | Productivity in different ecosystems | 2 | 2 |
| 4.4 | Factors affecting primary productivity | 2 | 2 |
| | | | |
| **5.0** | **Pollution ecology** | **7** | |
| 5.1 | Types, causes, effects and control of pollution | 2 | 3 |
| 5.2 | Surface water and ground water pollution | 1 | 3 |
| 5.3 | Air pollution: primary air pollution, indoor air pollution | 1 | 3 |
| 5.4 | Soil pollution | 1 | 3 |
| 5.5 | Noise pollution | 1 | 3 |
| 5.6 | Bio-magnification of non-biodegradable insecticides | 1 | 3 |
| | | | |
| **6.0** | **Population ecology** | **5** | |
| 6.1 | Population attributes | 1 | 1 |
| 6.2 | Population growth form | 2 | 1 |
| 6.3 | Interactions among populations | 2 | 1 |
| | | | |
| **7.0** | **Natural resources, bionomics and ecosystem** | **8** | |

| | **management** | | |
|---|---|---|---|
| 7.1 | Bioremediation of contaminated soil and water | 2 | 4 |
| 7.2 | Biological control of insects, pests | 1 | 4 |
| 7.3 | Environmental ethics | 1 | 4 |
| 7.4 | Sustainable earth ethics: shallow and deep ecology; | 1 | 4 |
| 7.5 | Environmental awareness human impact on the earth; Ecocidal activities with restraints | 1 | 4 |
| 7.6 | Environmental protection act | 1 | 4 |
| 7.7 | Future sustainable development and Bangladesh perspective | 1 | 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Ashby, M. 1969. An Introduction to Plant Ecology. 2nd edition, Macmillan, New-Delhi, India.
2. Chandel, P.S. and Shukla, R.S. 2005. Ecology and Environments. Publisher: S Chand & company Ltd. New- Delhi, India.
3. Cormondy, E.J. 1985. Concepts of Ecology. Prentice Hall of India, New Delhi.
4. Daubenmire, R.F. 1974. Plants and Environment. 3rd edition, John Wiley &Son's Inc.
5. Jadhav, H. and Bhosale V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, New Delhi, India.
6. Rahman M. S. 2005. Paribesh Bijnan O Udvid Vugol. Absor Prakashani, Dhaka.
7. Shukla, R.S. and Chandel P.S. 2001. Plant Ecology. Publisher: S Chand & company Ltd. New-Delhi, India.
8. Shukla, R.S. and Chandel P.S. 2003. Plant Ecology and Soil Science. Publisher: S Chand & company Ltd. New-Delhi, India.
9. Trivedi, P.R. and Raj, G. 1995. Environmental Ecology, Akash Publishing House New-Delhi, India.
10. Weaver, J.E. and Clements, F.E. 1938. Plant Ecology 2nd edition, McGraw-Hill Book Company.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1302 | | |
| **Course Title** | : Biodiversity and Plant Resource Management | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Md. Hasanur Rahman | | |
| **Credit Value** | : 4 | **Credit Hrs/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The rationale for studying biodiversity and plant resources management is essential for understanding and addressing the complex relationships between ecosystems, species, and human societies. The study of biodiversity and the sustainable management of plant resources have both practical and ethical significance. A comprehensive study of biodiversity and plant resource management is vital for maintaining ecological balance, ensuring food and water security, combating climate change, and fostering sustainable economic growth. It also addresses cultural and ethical considerations, ensuring that plant resources are managed responsibly for the benefit of both current and future generations.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | understand the diverse source of plant resources and its utility; | U |
| CLO 2 | analyze different management of plant resources and conservation; | An |
| CLO 3 | apply knowledge to find out the present and future situation in terms of plant biodiversity resources and their utilization in Bangladesh; | A |
| CLO 4 | create awareness or motivation on various plant biodiversity issues related to sustainable environment development for human welbeing.. | C |

U= Understand, An = Analysis, A= Apply, C= Creative

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 2 | 2 | 2 | 1 | 2 | 2 |
| CLO 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| CLO 3 | 1 | 2 | 2 | 1 | 2 | 2 | 2 |
| CLO 4 | 3 | 3 | 1 | 1 | 2 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course Contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Plant biodiversity** | **12** | |
| 1.1 | **Introduction:** Definition**,** Measurement of plant biodiversity, Hot spots of biodiversity; Value of biodiversity; Biodiversity and sustainable development | 6 | 1 |
| 1.2 | **Threats to plant biodiversity:** Major threats; Habitat degradation, loss and fragmentation; Overexploitation, Species invasions | 6 | 1 |
| | | | |
| **2.0** | **Plant biodiversity Conservation** | **9** | |
| 2.1 | **Conservation:** Concept; *In-situ* and *Ex-situ* conservation; Importance of conservation; Biodiversity conservation in | 5 | 2,3 |

| | | | |
|---|---|---|---|
| | Bangladesh | | |
| 2.2 | Ecosystem-based adaptation metods for conservation | 4 | 4 |
| **3.0** | **Plant resources** | **12** | |
| 3.1 | Concept, Types and Necessities | 3 | 2 |
| 3.2 | **Forest resources**: Major forest products and their uses – Timber, fuel and paper; Minor forest products and their uses – Gum, resin, tannin, dyes and pigments | 4 | 2,3,4 |
| 3.3 | **Sea-weed resources** – Food, fodder and fertilizer applications | 3 | 2,3,4 |
| 3.4 | **Renewable and non-renewable plant resources**: concept, differences, uses and balance | 2 | 2,3 |
| **4.0** | **Plant resources management (PRM)** | **8** | 2 |
| 4.1 | Concepts and basic features of PRM | 2 | 3 |
| 4.2 | Management practices - need , methods | 4 | 3 |
| 4.3 | Importance and forms of community participation in PRM | 2 | 3 |
| **5.0** | **Convention, rights and acts** | **6** | |
| 5.1 | Convention on biological diversity (CBD); Bio-safety; Biodiversity Act; Biosafety regulation | 4 | 4 |
| 5.2 | National biodiversity strategy action plan of Bangladesh; | 2 | 4 |
| **6.0** | **Remote sensing tools for vegetation study** | **13** | |
| 6.1 | Basic concepts of Remote sensing and Image Interpretation | 5 | 1 |
| 6.2 | Digital Image Processing (DIP) | 4 | 2 |
| 6.3 | Remote sensing in Forestry and Land Evaluation Studies | 3 | 3 |
| 6.4 | Terminology | 1 | 1 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Recommended Books**


1 Ansari, A., S. Singh, Z. Gill, K. Abbas**,** M. Naeem**,** (Eds.) 2016. Plant Biodiversity: Monitoring, Assessment and Conservation. CABI Publications (cabi.org), India.
2 Campbell, J.B. 2002. Introduction to Remote Sensing. Taylor Publications.
3. Chowdhury Q. I. (Ed.), 2001.Bangladesh State of Biodiversity. Published by Forum of Environmental Journalists of Bangladesh.
4. Dahiya M.P.2006. Biodiversity Conservation. Pragon Publications, New Delhi, India.
5. Gangopadhyay, A. 2007. Plant Biodiversity. Gene-Tech Publishers, India.
6. Jason-Hendon, J. (Ed.). 2017. Textbook of Biodiversity. Syrawood Publishing House, India.
7. Joseph G., 2003: Fundamentals of Remote Sensing. University Press.
8. Krishnamurthy K.V. 2018. An Advanced Textbook On Biodiversity: Principles And Practice. Oxford & IBH Publishing Co Pvt.Ltd, New Dehi.
9. Martha. J. Groom, Gary K. Meffe, C. Ronald Carrall (Third Edition), 2006. Principles of Conservation Biology. SinauerAssocites, Inc. Publishers, USA.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1303 | | |
| **Course Title** | : Applied Ethnobotany | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Gour Pada Ghosh | | |
| **Credit Value** | : 4 | **Credit Hrs/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Ethnobotany deals with the relationship of local people with their ambient vegetation. It reaches across natural sciences and plants have always been of central significance to human welfare as they provide food, medicines, fuel, construction materials and many other services. The main focus of this discipline is to justify the application of ethnobotanical knowledge into the development interface. As it addresses the local people's knowledge about their ecosystems, it has great value in order to conserve ecosystems meaningfully. Thus, it possesses the strength to achieve 'locally based global conservation system'. After attaining the course, the graduates will be equipped themselves as conservation biologists and development practitioners in socioeconomic and environmental sectors.

**Course Learning Outcomes (CLOs)**

| CLOs | **Expected Course Outcomes**<br>Upon completion of this course, the students will be able to: | **Cognitive level** |
|---|---|---|
| CLO 1 | define ethnobotany is and recognize the terminologies of ethnobotany; conceptualize the development phases of ethnobotany and its area of conduct; | R,U |
| CLO 2 | examine the contribution of ethnobotanical knowledge in rural livelihood; | Ap |
| CLO 3 | explain the traditional management practices of ecosystem; | E |
| CLO 4 | formulate the pathway of the application of this knowledge into the sustainable rural development. | E,C |

R-Remember; 2. U-Understanding; 3. Ap-Apply; 4. E-Evaluate; 5. C-Create

**Mapping CLOs with PLOs**

| CLOs | **Program Learning Outcomes (PLOs)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** |
| CLO 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CLO 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 |
| CLO 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CLO 4 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Ethnobotany as a discipline** | **9** | |
| 1.1 | Introduction to the course | 1 | 1 |
| 1.2 | Ethnobtany in the new world (modern concept of ethnobotany) | 4 | 2 |
| 1.3 | Nature of ethnobotany and its significance | 2 | 2 |

| | | | |
|---|---|---|---|
| 1.4 | Nature of ethnobotanical knowledge and its importance | 2 | 3 |
| **2.0** | **Ethno-plant taxonomy and perceived environment** | **8** | |
| 2.1 | Understanding the perceived environment and ethnotaxonomy | 2 | 1, 2 |
| 2.2 | Basis of ethno-plant taxonomy, principles and categories of ethno-plant taxonomy | 2 | 2 |
| 2.3 | Comparison with conventional taxonomy, importance of ethno-plant taxonomy | 4 | 2,3 |
| **3.0** | **Medicinal plants and ethno-medicine** | **10** | |
| 3.1 | Traditional uses of plants as medicine and Chemical composition of medicinal plants | 3 | 2 |
| 3.3 | Contribution of medicinal plants to modern medicine | 2 | 3,5 |
| 3.4 | Medicinal plants cultivation, marketing of medicinal plants at national and international levels. | 3 | 3,5 |
| 3.5 | Economic importance of medicinal plants and potentiality of medicinal plants in Bangladesh, conservation of medicinal plants | 2 | 3,5 |
| **4.0** | **Ethno-ecology and subsistence** | **10** | |
| 4.1 | Introduction to Ethno-ecology | 1 | |
| 4.2 | Paleo-ethnobotany: Definition, origin of agriculture, places of domestication of plants in ancient times, levels of plant domestication, domestication of important crop plants (e.g. wheat, rice, etc.) | 4 | 2,3,4 |
| 4.3 | Wild resources: components of natural ecosystem and importance for human life and sustenance | 3 | 1,3 |
| 4.4 | Home-garden: Traditional home-garden, plant diversity and traditional home-garden, nature of home-garden in rural Bangladesh and its importance | 2 | 3,4 |
| **5.0** | **Ethnobotany and environmental change** | **4** | |
| 5.1 | Dynamic nature of ecosystem, services of ecosystem, climate change and ecosystem based approach to adaptation. | 2 | 3,5 |
| 5.2 | Role of Ethnobotanical knowledge in conservation of ecosystem | 2 | 3,4 |
| **6.0** | **Local ecosystem and its economic and ecological dimensions** | **4** | |
| 6.1 | Local ecosystem and resource utilization pattern of the inhabitant and cultural values | 1 | 2,4 |
| 6.2 | Externalities and changing pattern of local resource utilization and its impact, local resource users and their rights | 2 | 3,4 |
| 6.3 | Integration of ethnobotanical knowledge and scientific knowledge to achieve sustainable development | 1 | 5 |

| | | | |
|---|---|---|---|
| **7.0** | **Bio-prospecting** | **4** | |
| 7.1 | Meaning of bio-prospecting, ethno-botanical knowledge and its scope on searching bio-products | 1 | 1,3,4 |
| 7.2 | Agreements to collect ethnobotanical knowledge for drug development, using ethnobotanical knowledge for modern biotechnological and pharmaceutical research and development | 3 | 2,4,5 |
| | | | |
| **8.0** | **Plants, people and Rights** | **8** | |
| 8.1 | Intellectual Property Rights (IPRs) and ethnobotanical knowledge | 2 | 2 |
| 8.2 | Patentability and application of IPRs on ethnobotanical knowledge | 2 | 3,5 |
| 8.3 | TRIPS and status of intellectual property laws in Bangladesh | 2 | 3 |
| 8.5 | CBD, its background and relation with ethnobotany | 2 | 3 |
| | | | |
| **9.0** | **Biopiracy** | **2** | 3,4 |
| 9.1 | Concept and occurrence,<br>examples of bio-piracy occurred on neem and turmeric | 2 | 3,5 |
| | | | |
| **10.0** | Over all discussion about the course | 1 | |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**


1. Balick, M. and Cox, P.A. 1997. Plant, People and Culture: The Science of Ethnobotany. Scientific American
2. Brush, S.B. and Stabinsky, D. (eds.) 1996. Valuing Local Knowledge: Indigenous People and Intellectual Property Rights. Island Press, Washington DC.
3. Cotton, C.M. 1996. Ethnobotany: Principles and Applications. John Willey and Sons; Chichester, UK.
4. Cunninigham, A.B. 2001. Applied Ethnobotany: People, Wild Plant Uses and Conservation. Earthscan Publication Ltd., USA.
5. Ghani, A. 2003. Medicinal Plants of Bangladesh with Chemical Constituents and Uses (2nd ed.) Asiatic Society of Bangladesh.
6. Martin, G.J. 1995. Ethnobotany: A Conservation Manual. Chapman and Hall, London.
7. Reid, W.V., Laird, S.A., Meyer, C.A., Gomej, R., Sittenfeld, A., Janzen, D.H., Gollin, M.A. and Juma, C. (Eds.). 1993. Biodiversity Prospecting: Using Genetic Resources for Sustainable Development. World Resources Institute (WRI), USA.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 1304 | | |
| **Course Title** | : Limnology and Aquaculture | | |
| **Semester** | : 1st | | |
| **Course Teacher** | : Sabrina Naz | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Limnology is important for understanding aquatic ecosystems, its biotic, abiotic components and used in water management, wildlife habitat protection. Aquaculture deals with production technology required for economically important plants, animals and fishes. Here are some reasons why a course in limnology and aquaculture is relevant to Botany. The course will enable the students understand the relationships between the conditions of within an aquatic ecosystem, identify, human impacts on ecosystems and will learn to protect and restore ecosystems.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to : | Cognitive Level |
|---|---|---|
| CLO 1 | to know the lentic and lotic environments; | U |
| CLO 2 | Able to analyze interaction between biotic and abiotic components of different freshwater ecosystem; | An |
| CLO 3 | develop the skills to perform experiments to elucidate mechanisms associated with freshwater environment; | Ap |
| CLO 4 | Able to explain and create production system involved in aquaculture in Bangladesh. | Ap,An,C |

U-understanding, Ap-apply, An-Analyze, C-create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| CLO 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| CLO 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| CLO 4 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course Contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Wetlands** | **6** | |
| 1.1 | Wetland definition; Importance of wetlands | 2 | 1,,3 |
| 1.2 | Classifícation of wetlands, Flood plain wetlands and water bodies | 2 | 1,3 |
| 1.3 | Bangladesh: Chalan beel, a case study | 2 | 1,3,4 |

| | | | |
|---|---|---|---|
| **2.0** | **Lake energetics** | **6** | |
| 2.1 | Source, type, utilization, underwater light climate; water movement | 1 | 2,3 |
| 2.2 | photosynthetic behavior of natural photosynthesis (Neoblackman model) | 2 | 2,3 |
| 2.3 | periodicity, and vertical productivity distribution | 3 | 2,3,4 |
| **3.0** | **Carbon dynamics** | **2** | |
| 3.1 | Carbon dynamics in eutrophic lakes | 1 | 1,2 |
| 3.2 | location of DOC in aquatic ecosystem; pelagic carbon cycling (phytoplankton EOCn release) | 1 | 2,3,4 |
| **4.0** | **Plankton** | **2** | |
| 4.1 | Zooplankton, phytoplankton, fish and benthic community interactions | 2 | 2,3 |
| **5.0** | **Applied limnology** | **8** | |
| 5.1 | a) Pollution; sources and types of pollution | 2 | 3 |
| 5.2 | b) Sewage & its treatment, origin & composition, mechanical, biological treatment | 2 | 4 |
| 5.3 | c) Contaminated waters: self purification process; indicator organism, rehabilitation of water | 2 | 3,4 |
| 5.4 | biomanipulation; bioaccumilation and effects of persistent pollutants | 2 | 3,4 |
| **6.0** | **Trace elements** | **6** | |
| 6.1 | Trace elements of water; impact on ecosystem health | 2 | 2,3,4 |
| 6.2 | Role of agrochemicals and heavy metal in water pollution | 2 | 2,3 |
| 6.3 | Impact of trace elément on écosystem health | 2 | 4 |
| **7.0** | **Arsenic pollution** | **4** | |
| 7.1 | Arsenic pollution in Bangladesh | 2 | 2,3 |
| 7.2 | Accumulation in water bodies and food chain; impacts | 2 | 3,4 |
| **8.0** | **Aquaculture** | **11** | |
| 8.1 | Definition and history; trends of Aquaculture in Bangladesh | 2 | 1,2 |
| 8.2 | Culture types: Monoculture, Polyculture; definition, pattern and techniques of composite culture | 2 | 2 |
| 8.3 | mixed and integrated fish farming in Bangladesh | 2 | 3 |
| 8.4 | Duckweed culture, Azolla culture,Spirulina Culture usage and importance | 5 | 3,4 |
| **9.0** | **Pond fertilization** | **6** | |
| 9.1 | Definition of fertili\zer, manure, organic and inorganic fertilizers in fish ponds | 2 | 1,2 |
| 9.2 | water quality and fertilizers | 2 | 2,3 |
| 9.3 | drying of ponds, liming of ponds, impact on aquatic ecosystem; sustainability | 2 | 3,4 |
| **10.0** | **Aquatic vegetation** | **6** | |
| 10.1 | Types, role of aquatic plants in fish culture | 2 | 2,3,4 |

| | | | |
|---|---|---|---|
| 10.2 | Conservation of aquatic biodiversity | 2 | 4 |
| 10.3 | Invasive aquatic plants. IPBES | 2 | 4 |
| **11.0** | **Blue Economy** | **2** | |
| 11.1 | Blue economy concept, scope;Application of' Blue economy in Bangladesh | 2 | 2,4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books recommended**

1. Cole, G.A. 1979. Text Book of Limnology. The Mosby Co. London,
2. Goldman, C.R. and Home, A.J. 1983. Limnology. McGraw-Hill. Book Co.
3. Khan, M.S. and Khatun, M. 1987. Aquatic Angiosperms of Bangladesh. Publ. by: Bangladesh National Herbarium & Bangladesh Agricultural Research Council.
4. Khondker, M. 1995. Limnology, Dhaka Univ. Publ.
5. Ruttner, R. 1963. Fundamentals of Limnology (Translated). Toronto Univ. Press. Canada.
6. Wetzel and Robert. G. 2001. Limnology; Academic Press, New York.
7. Zaman, M. and Naz, S. 2000. Shybal Bichitra. Srijon Publ. Rajshahi. Bangladesh.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2301 | | |
| **Course Title** | : Environmental Microbiology | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Farzana Ashrafi Neela | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Environmental microbiology, as a discipline began as a somewhat marginal branch of Life Sciences which then transformed into one of the most vibrant and visible areas of contemporary research. The intent of the course is to introduce many facets of microbial life on this planet and to show that Earth's ecosystems and microbes are closely related. There is the enormous diversity of microorganisms in the environment, their cell–cell communication strategies and the adaptive behavior plays a crucial role in the development of new generation of information-based research.

**Course Learning Outcomes (CLOs)**

| CLOs | Expected course outcomes<br>Upon completion of this course, the student will able to | Cognitive level |
|---|---|---|
| CLO 1 | learn the major principles of environmental microbiology and functional diversity of microorganisms in the environment in relation to ecosystems; | U |
| CLO 2 | explain the adaptive strategies of microbes in extreme environments; | U |
| CLO 3 | describe the significant of microbial activities in the environments and with plants; | E |
| CLO 4 | capable of applying fundamental principles of microbiology of potable water and public health; | Ap |
| CLO 5 | develop skill to analysis microorganisms from various ecosystem in research institutes and public health sector. | C |

U-understanding, Ap-apply, E-Evaluate, C-create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CLO 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| CLO 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| CLO 4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CLO 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course Contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Microbes and environments** | **15** | **1** |
| 1.1 | Populations and community: definition: ecosystem, community, population and individual; Microbial population in a pond ecosystem; Microbial environments and microenvironments | 3 | |
| 1.2 | Biofilm: Definition, stages of biofilm formation, Quorum sensing, advantages of biofilm formation of bacteria, disadvantages, control | 3 | |
| 1.3 | Soil microbiome: Definition, soil profile, soil pathogenic and beneficial microbiome, and importance | 3 | |
| 1.4 | Freshwater environments: Definition, types, microbial distribution, importance and role of freshwater microbes, microbial loop | 3 | |
| 1.5 | Marine environments**:** Definition, types, microbial distribution, deep sea microbiology: microbial distribution in hydrothermal vent | 3 | |
| **2.0** | **Environmental effect on microbial growth** | **10** | **2** |
| 2.1 | Temperature and pH: low and high | 4 | |
| 2.2 | Extremophiles: | | |
| | Introduction, Occurrence, classification and characteristics, adaptations and their applications in biotechnological processes | 6 | |
| **3.0** | **Significance of microbial activities in the environment** | **10** | **3** |
| 3.1 | Biogeochemical cycles: definition, Carbon and nitrogen cycle | 4 | |
| 3.2 | Microbial bioremediation: Concept, principal of bioremediation, biostimulation, bioaugmentation, Biodegradation and biotransformation of Xenobiotics including pesticides and petroleum biodegradation | 6 | |
| **4.0** | **Microbial interactions with plants** | **5** | **3** |
| 4.1 | Lichens and michorrhizae, *Agrobacterium* and crown gall disease, root nodule bacteria and symbiosis with legumes | | |
| **5.0** | **Microbial contamination in environment** | **8** | **3** |
| 5.1 | Antibiotic resistance: definition, mode of action, sources of contamination, role of antibiotic resistance in agriculture and aquaculture, transfer of antibiotic resistance by horizontal gene transfer | 5 | |
| 5.2 | Microbial aspect of water pollution: Introduction to indicator organisms: characteristics, significance; coliform bacteria, | 3 | |

| | | | |
|---|---|---|---|
| **6.0** | **Sanitation and public health microbiology with special reference to Bangladesh** | **2** | **4** |
| 6.1 | Water supply, the use of safe water, public tube well coverage, sanitation, disposal of human excreta and refuse | | |
| **7.0** | **Methods in microbial ecology** | **10** | **5** |
| 7.1 | Culture independent analysis: Metagenomics; Viable but non-culturable (VBNC) microbial communities: VBNC microbes in environments, methods for detection of VBNC microbes; implication and significance of VBNC in environment and health | 5 | |
| 7.2 | Cultural dependent analysis: DNA extraction from environmental samples, PCR and sequencing for 16S rRNA analysis | 5 | |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books recommended**


1. Atlas and Bartha. 1998. Microbial ecology: Fundamentals and Applications (4th ed.). Benjamin Cummings.
2. Hawker, L.E. and Linton, A.H. 1971. Micro-organisms function, form and environment. Edward Arnold Ltd.
3. Madigan, M.T. and Martinko, J.M . 2006. Biology of Microorganisms (11th ed.) Pearson Prentice Hall.
4. Neela F.A. and Mane R.S. 2022. Environmental Microbiology (1st ed.). IP Innovative Publication Pvt. Ltd. A-2, Gulab Bagh, Nawada, Uttam Nagar, New Delhi - 110059, India.
5. Pelzer, M., Chan, E.C.S. and Krieg, N.R. 1993. Microbiology (5th ed.) Tata Mcgraw-Hill edition.
6. Slonczewski and Foster. 2011. Microbiology: An Evolving Science (2nd ed.). Norton Publishing.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2302 | | |
| **Course Title** | : Molecular Stress Physiology | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Md. Mostafizur Rahman | | |
| **Credit Value** | : 4 | **Credit hours/week**: 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

The course is designed to provide an in-depth understanding of how plants respond to various environmental stresses at the molecular, biochemical, and physiological levels. As environmental challenges such as climate change, soil degradation, and pollution increasingly affect crop production worldwide, this course becomes crucial for developing effective strategies to mitigate these stresses and improve crop resilience.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to : | Cognitive Level |
|---|---|---|
| CLO 1 | understanding the interaction of plants with biotic and abiotic environments; | U |
| CLO 2 | explore the mechanistic basis of stress tolerance from cellular to molecular level in plants; | An |
| CLO 3 | develop the skills to perform experiments to elucidate mechanisms associated with plant stress; | Ap |
| CLO 4 | create awareness on various agronomic strategies to rescue plants from stresses. | C |

U-understanding, Ap-apply, An-Analyze, C-create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| CLO 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| CLO 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 |
| CLO 4 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 - Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course Contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction** | **6** | |
| 1.1 | Stress: Definition; types; factors; stress induced phases; Strategies to face the stress conditions | 1 | 1 |
| 1.2 | Plant cell organelles: Functions under stress; Chelators; Phytochelatins | 1 | 2 |
| 1.3 | Biotic stress: Types of attacker; Symptoms exhibited by plants attack; Effects of attacker on plant growth, development and yield | 2 | 1,2 |
| 1.4 | Abiotic stress: Major crops affected by abiotic stress; stress responses in plants. | 1 | 1,2 |
| 1.5 | Crops tolerance against abiotic stress: Morphological, Physiological, Biochemical, and Molecular changes | 1 | 2 |

| | | | |
|---|---|---|---|
| **2.0** | **Mycorrhizal symbiosis** | **6** | |
| 2.1 | Types of mycorrhizae | 1 | 1 |
| 2.2 | Benefits to plants and environment | 1 | 2 |
| 2.3 | Symbiotic association of Arbucular Mycorrhizal Fungi (AMF) with host plants | 1 | 3 |
| 2.4 | Role of AMF: Nutrient uptake strategies | 1 | 3 |
| 2.5 | Role of AMF: Heavy metal detoxification strategies; As Biofertlizers | 2 | 3,4 |
| **3.0** | **Mineral uptake in plants** | **7** | |
| 3.1 | Mineral nutrition: Classification; Deficiency symptoms | 1 | 1,2 |
| 3.2 | Method of identifying the nutritional requirements of plants | 1 | 3 |
| 3.3 | Molecular aspects of uptake and long-distance transport of iron and zinc under deficiency | 3 | 3,4 |
| 3.4 | Biofortification of staple crops: Strategies and Applications | 1 | 3,4 |
| 3.5 | Hydroponic system and principles of plant nutrition | 1 | 4 |
| **4.0** | **Heavy metal stress in plants** | **6** | |
| 4.1 | Factors influencing metals uptake by plants in soil | 1 | 1 |
| 4.2 | Plants responses to heavy metal exposure | 1 | 2 |
| 4.3 | Effects of different heavy metals on plants | 1 | 2 |
| 4.4 | Molecular Mechanisms of Heavy metal tolerance and toxicity | 2 | 3,4 |
| 4.5 | Signal Transduction in Response to Heavy Metals | 1 | 4 |
| **5.0** | **Phytoremediation** | **6** | |
| 5.1 | Hyper-accumulating plants and non-accumulating plants | 1 | 1 |
| 5.2 | Strategies for alleviation of heavy metal toxicity | 1 | 3 |
| 5.3 | Mechanism of heavy metal remediation by microorganisms | 2 | 4 |
| 5.4 | Alleviation of heavy metal toxicity though exogenous compounds (silicon, salicylic acid glutathione) | 2 | 4 |
| **6.0** | **Salinity stress in plants** | **6** | |
| 6.1 | Types of salinity; Soil Salinity Levels; Major symptoms; Source and causes of soil salinity | 2 | 1 |
| 6.2 | Effects of salinity on plants; Na and K balance under salinity | 1 | 3,4 |
| 6.3 | Tolerance mechanisms to salt stress in Glycophytes | 2 | 4 |
| 6.4 | Salinity problem in Bangladesh and its effect on crop yield | 1 | 3 |
| **7.0** | **Drought stress in plants** | **5** | |
| 7.1 | Causes of drought stress in plants | 1 | 1 |
| 7.2 | Effects of drought on plants | 1 | 2 |
| 7.3 | Morphological, physiological and molecular mechanisms associated with drought tolerance in plants | 3 | 2,3 |
| **8.0** | **Role of phytohormones in abiotic stress tolerance** | **6** | |
| 8.1 | Key mediators of plant responses to abiotic stresses; functions in stress responses; | 2 | 1 |
| 8.2 | Regulatory role of phytohormones in abiotic stress tolerance | 2 | 2 |
| 8.3 | Engineering phytohormones for producing abiotic stress tolerant crops | 2 | 3,4 |
| **9.0** | **Antioxidant system and its role on stress tolerance** | **6** | |

| | | | |
|---|---|---|---|
| 9.1 | Reactive oxygen species (ROS): Sources of ROS in Plant Cells, $H_2O_2$ induction, ROS scavenging | 2 | 1 |
| 9.2 | Types of antioxidants, role antioxidant activities in detoxifying ROS | 2 | 2 |
| 9.3 | Antioxidant genes and biomolecules and their roles in stress tolerance | 2 | 3,4 |
| **10.0** | **Advance techniques of Molecular Plant Physiology** | **6** | |
| 10.1 | RNAi and CRISPR/Cas9 system for gene knockout | 2 | 4 |
| 10.2 | Chlorophyll fluorescence technology | 1 | 4 |
| 10.3 | Metabolome and metabolomics | 1 | 3 |
| 10.4 | Database searching for metabolic pathways and genes | 1 | 4 |
| 10.5 | Analytical techniques for metabolomics analysis with advantage and disadvantages | 1 | 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books recommended**


1. Claverie, J.M. and Notredame, C. 2006. Bioinformatics for Dummes (2nd edition). John Wiley & Sons, United States.
2. Dennis, D.T. and Turpin, D.H. 1990. Plant Physiology, Biochemistry and Molecular Biology. Longman Scientific & Technical, New York, United States.
3. Meena, V. S. (edit) 2018. Role of Rhizospheric Microbes in Soil: Volume 1 and 2. 1st ed. Springer.
4. Rao, K.V.M., Raghavendra, A.S. and Reddy, K.J. 2006. Physiology and Molecular Biology of Stress Tolerance in Plants. Springer, Berlin, Germany.
5. Rout, G.R. and Das, A.B. (edts) 2013. Molecular Stress Physiology of Plants. Springer Dordrecht Heidelberg New York London.
6. Shabala, S. (edt) 2017. Plant Stress Physiology. 2nd Edition. CABI.
7. Smith, S.E. and Read, D. 2008. Mycorrhizal Symbiosis. 3rd Edition. Academic Press is an imprint of Elsevier, 360 Park Avenue South, New York, NY 10010-1710.
8. Wu, Q.S. (edt). 2017. Arbuscular Mycorrhizas and Stress Tolerance of Plants. Springer Nature Singapore Pte Ltd.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 2303 | | |
| **Course Title** | : Agronomy and Crop Management | | |
| **Semester** | : 2nd | | |
| **Course Teacher** | : Md. Omar Faruq | | |
| **Credit Value** | : 4 | **Credit hours/ Week** : 5 | **Total credit hours**: 60 |
| **Total Marks** | : 100 | | |

**Rationale of the course**

Agronomy and crop management are critical disciplines in agriculture that address the sustainable and efficient production of food, fiber, and other agricultural products. This course is designed to equip learners with the knowledge and skills required to optimize crop production while ensuring environmental sustainability. By addressing these critical areas, the course empowers students and professionals to make informed decisions that benefit the agricultural sector, society, and the environment.

**Course Learning Outcomes (CLOs)**

| CLO No. | Expected Course Outcomes<br>Upon completion of this course, the students will be able to: | Cognitive Level |
|---|---|---|
| CLO 1 | know the concept of agronomy, its principles and importance, and their relationship with allied disciplines; | R |
| CLO 2 | Understand the fundamental principles of farming system and types of Farming; | U |
| CLO 3 | Evaluate the application and importance of agronomic principles in field crop management; | E |
| CLO 4 | Analyze and apply field practices for crop production, use of fertilizer, soil conservation, water, nutrient and weed management, crop protection, and post-harvest technology; | An, Ap |
| CLO 5 | apply the knowledge to interpret the different practices of agronomic crop production and create human resources to apply and develop science and technology in the field of agronomy. | Ap, C |

R- Remember; U- Understanding, Ap- Apply; An- Analyze; E- Evaluate; C- Create

**Mapping CLOs with PLOs**

| CLOs | Program Learning Outcomes (PLOs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 |
| CLO 1 | 3 | 3 | 2 | 1 | 1 | 2 | 1 |
| CLO 2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 |
| CLO 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 |
| CLO 4 | 2 | 2 | 3 | 3 | 3 | 2 | 2 |
| CLO 5 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

Note: 3 - High, 2 – Medium, 1 – Low

**Course Content, Teaching and Assessment Strategy**

| Module | Course contents | Credit hrs | CLOs |
|---|---|---|---|
| **1.0** | **Introduction** | **3** | |
| 1.1 | Concept and history of Agronomy | 1 | 1 |

| | | | |
|---|---|---|---|
| 1.2 | Basic principles and importance of agronomy | 1 | 1 |
| 1.3 | Potential productivity and constraints in crop production | 1 | 1 |
| | | | |
| **2.0** | **Cropping and Farming Systems** | **5** | |
| 2.1 | Definition, Agronomic classification of crops | 1 | 2 |
| 2.2 | Types of cropping systems | 1 | 2 |
| 2.3 | Dryland Agriculture | 1 | 2 |
| 2.4 | Watershed Management | 1 | 2 |
| 2.5 | Wasteland Management | 1 | 2 |
| | | | |
| **3.0** | **Agrometeorology** | **3** | |
| 3.1 | Concept and its application | 1 | 1 |
| 3.2 | Climatology and agroclimatic normal | 1 | 3 |
| 3.3 | Climate change and variability | 1 | 3 |
| | | | |
| **4.0** | **Resource Management** | **7** | |
| 4.1 | Soil environment and soil conservation | 1 | 4,5 |
| 4.2 | Irrigation system and water management | 1 | 4,5 |
| 4.3 | Manures and fertilizers | 1 | 4,5 |
| 4.4 | Nutrients management | 1 | 4,5 |
| 4.5 | Weed management | 1 | 4,5 |
| 4.6 | Growth analysis and crop protection | 1 | 4,5 |
| | | | |
| **5.0** | **Field Crops, Farm Machinery and Seed Technology** | **5** | |
| 5.1 | General description of important crops | 1 | 1,2 |
| 5.2 | Cropping systems- cereals, oil seed, pulses, fibre crops | 1 | 5 |
| 5.3 | Crop establishment and after cultivation | 1 | 4 |
| 5.4 | Farm machinery and tillage operations | 1 | 4 |
| 5.5 | Seed technology | 1 | 5 |
| | | | |
| **6.0** | **Modern Agriculture** | **4** | |
| **6.1** | Sustainable agriculture- organic and eco-friendly agriculture | 1 | 5 |
| **6.2** | Integrated Farming System | 1 | 5 |
| **6.3** | Agricultural Technology | 1 | 5 |
| **6.4** | Modern Agricultural Farming - Hydroponics | 1 | 5 |
| | | | |
| **7.0** | **Harvesting and Post-Harvest Technology** | **3** | |
| 7.1 | Concept, symptoms, types and methods of harvesting, | 1 | 1,4 |
| 7.2 | Post-harvest processing and methods | 1 | 4 |
| 7.3 | Types and methods of crop storage | 1 | 4 |

**Mapping CLOs with the Teaching Learning and Assessment Strategies**

| CLOs | Teaching-Learning approach | Assessment strategy | Reinforcement assignment/Tasks |
|---|---|---|---|
| CLO 1<br>CLO 2<br>CLO 3<br>CLO 4<br>CLO 5 | Lectures, Multimedia projector, Participatory question-answer, Text books, Lecture notes, Group discussion, Online resources and Video documentation | Quiz, Assignment, Class test, Presentation, and Final exam | Feedback, Individual/Group discussion and Counseling |

**Books Recommended**

1. Balasubrananiyan, P. and Palaniappan, S.P. 2001. Principles and Practice of Agronomy. Agrobios, India.
2. Chandrasekaran B, Annadurai K and Somasundaram E. 2010. A text book of Agronomy. . New age international publisher, India
3. Chatterjee, B.N. and Maiti, S. 1984. Cropping system: Theory and practice. Oxford & IBH Publishing Company. New delhi, India.
4. De, G.C. 2013. Fundamentals of Agronomy. Oxford & IBH Publishing Company. New delhi, India.
5. Jayanta, D., Mahendra, P. and Rai, R.K. 1996. Fundamentals of Cereal Crop Production. Tata McGraw-Hill Publishing Company. New Delhi, India.
6. Kumar, P. and Rekha, N.K. 2021. Rural Management Agronomy. Mahatma Gandhi National Council of Rural Education (MGNCRE), Hyderabad, India.
7. Reddy, T.Y. and Reddy, G.H.S. 2015. Principles of Agronomy. Kalyani Publishers. New delhi, India.
8. Singh, C. 1983. Modern Techniques of Raising Field Crops. Oxford & IBH Publishing Company. New delhi, India.
9. Singh, S.S. 2013. Principles and Practices of Agronomy. Kalyani Publishers. New delhi, India.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3301 | | |
| **Course Title** | : General viva-voce | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : MS Examination Committee | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

## Practical Courses

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3302 | | |
| **Course Title** | : Plant Ecology and Ecosystem Management | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Plant Ecology and Ecosystem Management** |
|---|---|
| 1.1 | Ecological adaptations in xerophytes, hydrophytes, epiphytes, halophytes with comments and their niches |
| 1.2 | Survey of plant communities by a) list, b) count and c) point quadrates, d) line and e) belt transects |
| 1.3 | Calculation of some quantitative characters (both analytic and synthetic) of species /communities from the collected data |
| 1.4 | Preparation of a) frequency histogram, b) valence histogram, c) phytograph with ecological comments |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3303 | | |
| **Course Title** | : Biodiversity and Plant Resource Management | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Biodiversity and Plant Resource Management** |
|---|---|
| 1.1 | Visits, survey, collection, description and materials; Field assignments: Submit herbariums of a specified number of species of flora |
| 1.2 | Description of species within the flora; include diagrams; photographs, maps, distribution, lists, relative abundance; time of flowering, pollution details; fruit and seed production |
| 1.3 | Preparation of Keys to identify the collected species |
| 1.4 | Methods of conservation of seeds, seed banks. Study of *ex situ*, *in situ* and cryopreservation |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3304 | | |
| **Course Title** | : Applied Ethnobotany | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Applied Ethnobotany** |
|---|---|
| 1.1 | Conduct fieldwork to understand the extent of uses of plants by the local people, collection and submission of those plants/ plant products during examination and submit field report |
| 1.2 | Identify and describe the ethnobotanical uses of the items collected during fieldwork |
| 1.3 | Collection of folk formularies of some common diseases (Skin disease, diabetes, dysentery, jaundice, etc.) from the people of assigned areas |
| 1.4 | Qualitative test of phytochemicals of medicinal plants (e.g. Carbohydrates, Flavonoids, Glycosides etc.) |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3305 | | |
| **Course Title** | : Limnology and Aquaculture | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Limnology and Aquaculture** |
|---|---|
| 1.1 | Study of Lake Morphometry |
| 1.2 | Collection and preservation of natural phytoplankton and zooplankton population and their quantitative and qualitative study using standard technique |
| 1.3 | Determination of alkalinities and total hardness of water |
| 1.4 | Determination of relation between pH and water temperature |
| 1.5 | Determination of net productivity, gross primary productivity and rate of respiration of a fresh water habitat |
| 1.6 | Piloting aquaculture of an economically important plant |
| 1.7 | Practical notebook to contain description, labeled diagrams and identifying characters of the studied plankton genera |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3306 | | |
| **Course Title** | : Environmental Microbiology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Environmental Microbiology** |
|---|---|
| 1.1 | Biosafety Practices and Procedures for the Microbiology Laboratory |
| 1.2 | National policy and guidelines on biosafety |
| 1.3 | Laws and regulations relevant to biosafety |
| 1.4 | To learn the uses of UV spectrophotometer, laminar air flow and centrifuge and PCR mechine |
| 1.5 | Techniques for the study of environmental microbes: Sample collection, sample processing and Determination of microbial numbers and sample preservation |
| 1.6 | Antibiotic sensitivity tests by disc diffusion method |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3307 | | |
| **Course Title** | : Molecular Stress Physiology | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Molecular Stress Physiology** |
|---|---|
| 1.1 | Preparation of a hydroponics system for plant cultivation |
| 1.2 | Preparation of stock and working solution as well as the establishment of hydroponic culture |
| 1.3 | Calculate the annealing temperature and demonstrate the PCR program for RT-PCR analysis |
| 1.4 | Isolation of plant RNA and checking RNA integrity through gel electrophoresis method |
| 1.5 | Collection of xylem sap through root pressure method |
| 1.6 | Determination of iron chelate reductase activity in roots |
| 1.7 | Methodological overview and demonstration of high-performance liquid chromatography (HPLC) for analyzing plant metabolites |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3308 | | |
| **Course Title** | : Agronomy and Crop Management | | |
| **Course Type** | : Practical | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Relevant Course Teachers | | |
| **Credit Value** | : | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 33.33 | | |

| **1.0** | **Agronomy and Crop Management** |
|---|---|
| 1.1 | Identification of seeds of field crop |
| 1.2 | Identification of sand, silt, and clay by finger method |
| 1.3 | Identification of manures and fertilizers |
| 1.4 | Preparation & preservation of farmyard manure & compost |
| 1.5 | Testing seed for moisture, purity, germination, viability & vigor |
| 1.6 | Study of life cycle & morphology of major weed with emphasis on the identification of propagating organs |

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3309 | | |
| **Course Title** | : Research Project | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

Each non-thesis student will conduct a project work under the supervision of a teacher and submit the project paper at the end of the academic year.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3310 | | |
| **Course Title** | : Thesis | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : Respective Supervisor | | |
| **Credit Value** | : 8 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 200 | | |

Each thesis student will conduct a research work under the supervision of a teacher and submit the thesis paper at the end of the academic year.

| | | | |
|---|---|---|---|
| **Course Code** | : MBOT 3311 | | |
| **Course Title** | : Thesis presentation and defense | | |
| **Course Type** | : Research work | | |
| **Semester** | : 3rd | | |
| **Course Teacher** | : MS Examination Committee | | |
| **Credit Value** | : 2 | **Credit hours/week**: | **Total credit hours**: |
| **Total Marks** | : 50 | | |

# Faculty of Biological Sciences
# University of Rajshahi

## Academic Ordinance for the Award of Master of Science (MS) Degree

The Faculty or Biological Sciences shall be constituted according to the Statutes, Ordinances and Regulations of the University governing by the constitution of the Faculties.

**1. Degree Awarding Departments**

The Faculty consists of the following Degree Awarding Departments:

| | | | |
|---|---|---|---|
| a) | Psychology | d) | Genetic Engineering and Biotechnology |
| b) | Botany | e) | Clinical Psychology |
| c) | Zoology | f) | Microbiology |

and such other department(s) that may be established by the University from time to time and as assigned to the Faculty by the Academic Council.

**2.** There shall be a course of study of Master of Science (MS) degree.

**3. Degrees Offered**

The Postgraduate degrees to be offered under this ordinance are:

**Master of Science** in-

3.1 Psychology
3.2 Botany
3.3 Zoology
3.4 Genetic Engineering and Biotechnology
3.5 Clinical Psychology
3.6 Microbiology

**4. Subject code**

4.1 Psychology (PSY)
4.2 Botany (BOT)
4.3 Zoology (ZOOL)
4.4 Genetic Engineering and Biotechnology (GEB)
4.5 Clinical Psychology (CPSY)
4.6 Microbiology (MIC)

**5. Duration of Course and Course Structure**

5.1 The MS course consisting of general and thesis groups and minimum duration of the MS programme shall be three semesters of 6 (six) months each. A candidate for the Master degree must complete all requirements for the degree within three academic years from the date of his/her first admission.

5.2 The Committee of Courses shall review the curricula at least once in every Academic Year and recommend changes/revision (if any) and send it to the Faculty, and then the Faculty will recommend it to the Academic Council for approval.

5.3 Teaching for the courses will be deemed reckoned in terms of credits within the following guidelines:

| Nature of course | Contact hour (for I credit) |
|---|---|
| Theoretical | : I hour a week |
| Laboratory/sessional | : 2 - 3 hours a week |
| Project | : 2 - 3 hours a week |
| Field work/Internship training | : 4 days of field work |
| Thesis | : 3 hours a week |

For other fractions of credit, proportionality shall be applied.

5.4 Total Hours/Weeks: The total teaching hours including lecture, tutorial and laboratory shall be between 24-42 hours per week

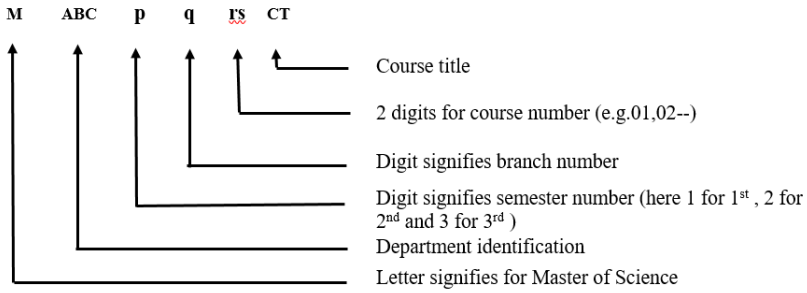
5.5 Course Designation: Each course is designated by a single letter identifying the course offering department followed by **M** for **Master's** programme and other letter(s)/number(s) with the following criteria without any space between letters and numerals:

(a) The following three letters correspond to the Department identification.

(b) Next three digits correspond to the course number.

(c) Next digit signifies Semester number.

(d) The last two digits will be reserved for departmental use for the identification of different areas within a department (e.g. course title).




## 6. Distribution of Course credits

The Master's programme shall have a total of **36** credits and the distribution of courses and credits are as follows:

### 6.1. General Group

| Course type for MS | Credits |
|---|---|
| Theoretical | 20 - 26 |
| Board Viva-voce | 2 |
| Practical | 4 - 10 |
| Project+ /Field Work +/Internship | 2-10 |
| **Total** | **36** |

### 6.2. Thesis Group

| Course type for MS | Credits |
|---|---|
| Theoretical | 20-26 |
| Board Viva-voce | 2 |
| Thesis | 6-12 |
| Viva-voce on Research work/internship | 2-8 |
| **Total** | **36** |

## 7. Academic Calendar for MS programme

7.1 The minimum duration of the MS programmes shall be three semesters; duration of each semester shall be not less than 12 teaching weeks.

7.2 There shall be final examination at the end of each semester conducted by the Examination Committee, which shall be formed by the academic committee of the respective department.

7.3 Academic schedule for general notification shall be published before starting of the 1st semester, on approval of the Departmental Academic Committee. The schedule may be prepared according to the following guidelines:

| **1st Semester (19 weeks)** | **Number of weeks** |
|---|---|
| Teaching | 12 |
| Preparatory Leave | 2 |
| Examination Period | 3 |
| Result Publication | 2-4 |
| **Total:** | **19-21** |

| | |
|---|---|
| Vacation including Inter-Semester Recess | 1 week |

| **2nd Semester (20 weeks)** | **Number of weeks** |
|---|---|
| Teaching | 12 |
| Preparatory Leave | 2 |
| Examination Period | 3 |
| Result Publication | 2-4 |
| **Total:** | **19-21** |

| | |
|---|---|
| Vacation (Summer, Ramadan, and Others) including Inter-Session Break | 9 weeks |
| **(1st Semester + 2nd Semester) Total:** | **52 weeks** |

| **3rd Semester (26 weeks)** | **Number of weeks** |
|---|---|
| Practical/Thesis/Project +Internship / Thesis + Internship | 12-16 |
| Project* | 2-4 |
| Viva-voce | 4 |
| Thesis presentation result publication | 6 |
| **Total:** | **26** |

| | |
|---|---|
| **(1st Semester + 2nd Semester + 3rd Semester) Total:** | **78 weeks** |

## 8. Admission Requirements

8.1 For admission into the master's programmes in any Department in the Faculty, a candidate must have a B.Sc. (Honors) or an equivalent degree in the relevant/related subject with good academic records from any recognized Institute/University. The admission criteria for students other than Rajshahi University will be defined by the academic committee of the relevant department.

8.2 Maximum 10 (ten) years break of study after passing B.Sc. (Honors) or an equivalent degree can be allowed for admission.

8.3 To be eligible for admission to MS programme, a student must have to obtain at least 2.75 CGPA in the B.Sc. (Honors) Examination.

8.4 Eligibility of a thesis student must have to obtain 3.25 CGPA in B.Sc. (Honors) or equivalent examination.

8.5 The number of seats will be determined by the relevant entity.

8.6 Candidate appearing at the Bachelor of Science (Houors) Final Semester from this University may be admitted provisionally to the M.S. class pending publication of their examination results. The confirmation of their admission being subjected to the passing the Examination when the results of examination are published.

8.7 If a student obtain or fails to obtain or improve the MS Degree within a maximum 3 (Three) academic years from the date of first admission, shall not be allowed for admission or readmission.

8.8 Foreign Students: Eligibility for the admission of foreign students in the aforementioned postgraduate programme shall be followed by the 'Ordinance for admission of foreign students'.

**9. Attendance:** As per the Ordinance of the University of Rajshahi

**10.** Striking off the Names and Readmission: As per the Ordinance of the University of Rajshahi.

## 11. Grading

11.1 The letter grade system for assessing the performance of the student shall be as follows:

| Numerical Grade | Letter Grade (LG) | Grade Point (GP) |
|---|---|---|
| 80% or above | A+ | 4.0 |
| 75% to less than 80% | A | 3.75 |
| 70% to less than 75% | A- | 3.5 |
| 65 to less than 70% | B+ | 3.25 |
| 60% to less than 65% | B | 3.0 |
| 55% to less than 60% | B- | 2.75 |
| 50 to less than 55% | C+ | 2.5 |
| 45% to less than 50% | C | 2.25 |
| 40 to less than 45% | D | 2.0 |
| less than 40% | F | 0.0 |
| Incomplete | I | 0.0 |

A letter grade 'I' (incomplete) shall be awarded for courses that could not be completed in one semester, which will continue through to the next semester.

11.2 A Semester wise Grade Point Average (SGPA) shall be computed for each semester. The SGPA will be calculated as:

$$SGPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

where. n is the number of courses offered during the semester, C, is the number of credits allotted to a i'th course and G, is the i'th grade point corresponding to the grade awarded for that course.

11.3 A Cumulative Grade Point Average (CGPA) shall also be computed at the end of second and 3rd Semester in the following way:

$$CGPA = \frac{\sum_{i=1}^{m} C_i S_i}{\sum_{i=1}^{m} C_i}$$

where. m is the total number of semesters being considered, S, is the SGPA of a i'th semester, C, is the total number of credits in i'th semester.

11.4 Both SGPA and CGPA will be rounded off as per the Ordinance of the University.

11.5 Earned Credit: As per rules of the University Ordinance.

## 12. Marks and Credit Distribution

12.1 Distribution of Marks (as per course types)

| | | | | | |
|---|---|---|---|---|---|
| 12.1.1 | Theoretical Courses | Continuous Assessment (CA) | Class Participation and Attendance | 10% | 30% |
| | | | Quizzes/Class Test/Assignment | 20% | |
| | | Semester Final Examination | | | 70% |
| 12.1.2 | Laboratory | Laboratory Assessment (LA) | Class Participation and Attendance | 10% | 40% |
| | | | Quizzes and Viva-Voce | 30% | |
| | | Practical/Design Work/Report | | | 60% |
| 12.1.3 | Project /Field Work /Internship | Internal Examiner/Supervisor<br>External Examiner(Any teacher from the panel of examiners other than the supervisor)<br>Presentation and Oral Examination (will be conducted by the respective examination committee) Supervisor/Internal Examiner | | | 70%<br><br>30% |
| 12.1.4 | General viva Voce | General viva voce will be conducted by the respective examination committee | | | 100% |

<table>
<tr><td>12.1.5</td><td>Thesis</td><td colspan="2">Supervisor and one external examiner (Any teacher from the panel of examiners other than the supervisor)<br>(Based on quality of analysis, design, organization, writing style, etc.)<br>Defense and Viva voce of the thesis (will be conducted by the respective examination committee)</td><td>75%<br><br>25%</td></tr>
<tr><td rowspan="11">12.1.6</td><td colspan="3">Basis for awarding marks for class participation and attendance</td><td rowspan="11"></td></tr>
<tr><td rowspan="10"></td><td>Attendance</td><td>Marks</td></tr>
<tr><td>90% to above</td><td>10%</td></tr>
<tr><td>85% to below 90%</td><td>9%</td></tr>
<tr><td>80% to below 85%</td><td>8%</td></tr>
<tr><td>75% to below 80%</td><td>7%</td></tr>
<tr><td>70% to below 75%</td><td>6%</td></tr>
<tr><td>65% to below 70%</td><td>5%</td></tr>
<tr><td>60% to below 65%</td><td>4%</td></tr>
<tr><td>Less than 60%</td><td>0%</td></tr>
</table>

12.2 Credits Distribution

12.2.1 General Group (Non-thesis MS programme)

| Semester | Nature of course | Credit |
|---|---|---|
| **1st semester** | Theoretical | 10-12 |
| | **Total** | **10-12** |
| | | |
| **2nd semester** | Theoretical | 10-12 |
| | **Total** | **10-12** |
| | | |
| **3rd semester** | Practical | 6-8 |
| | Project / Field work etc.* | 2-8 |
| | Internship | 0-6 |
| | Board Viva-voce | 2 |
| | **Total** | **12-18** |
| **(1st semester + 2nd semester + 3rd semester) Total** | | **36** |
| ***Internship, Field work, and Project:** The Chairman of the Department through Academic Committee shall allocate the projects to the students and shall arrange for holding Internship training and field works for the students. | | |

12.2.2 Thesis group (MS programme)

| Semester | Nature of course | Credit |
|---|---|---|
| 1st semester | Theoretical | 10-12 |
| | Total | 10-12 |
| 2nd semester | Theoretical | 10-12 |
| | Total | 10-12 |
| 3rd semester | General Viva-voce | 2 |
| | Thesis | 6-8 |
| | Internship | 0-6 |
| | Thesis Viva-voce | 2 |
| | Total | 12-16 |
| **(1st semester + 2nd semester + 3rd semester) Total** | | **36** |

12.3 Duration of Examination

Duration of Theoretical examination of different courses shall be as follows:

| | |
|---|---|
| Courses of 2 credits or less than 2 Credits | 2 Hours/3 Hours |
| Courses of more than 2 credits | 3 Hours/4Hours |

**13. Conduct of Examination and Rules for Promotion**

13.1 There shall be final examinations at the end of each semester conducted by the Examination Committee of the Departments.

13.2 1st and 2nd Semester results must be published by the Controller of Examinations. The results shall be finalized at the end of the 3rd semester of the programme.

13.3 Minimum passing grade: The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory/project/field work/in-plant training, thesis and viva-voce course will be C.

I 3.4 Promotion to higher semester: A student who has a grade point average 2.0 or higher, is not more than 4 credit points and at least C grade in the laboratory/field work/in-plant training of the 1st and 2nd semester shall be promoted to the 2nd and 3rd semester, respectively.

13.5 There shall be no improvement in laboratory/field work/in-plant training/project/ thesis and viva voce courses. A student failing to secure a minimum C grade in any of these courses in any semester shall fail the semester.

13.6 Grade Point Improvement:

13.6.1 A promoted student who obtains less than B grade in theoretical courses in any semester, may appear in the upcoming regular examination of that semester to improve the grade points.

13.6.2 Clause 13.6.1 is not valid for a candidate who cannot improve his/her course grade; in that case the previous grade shall remain valid.

14. **Administration:**

Academic Committee of the respective Department shall design curriculum, allocate courses for teaching, constitute Examination Committee and the panel of examiners as per rules of the University.

**15. Class Test**

15.1 For theoretical courses of less than or equal to 2 credits, there shall be at least two class tests and at least three class tests for greater than 2 credits in a semester.

15.2 Previous class test marks will remain valid for the reported/course improvement student if he/she is unable to appear at regular class test.

15.3 The course teacher(s) must submit the average marks of class tests to the chairman of the examination committee.

**16. Publication of Results**

16.1 A student must successfully complete the courses of all the semesters within maximum three and half academic years as outlined by the Committee of Courses with all its pre-requisites in order to be eligible for the award of MS degree. The student must earn 36 credit points (i.e. no 'F' grade) and the CGPA for the student must be 2.25 or higher.

16.2 The final merit position will be based on the basis of earned CGPA.

16.3 Recording of Result: The overall results of a successful student shall be declared on the basis of CGPA with the corresponding letter grade (LG). The Transcripts in English will show the course designation, course title, credit, letter grade and grade point of individual courses. SGPA of each semester. CGPA and corresponding LG for the over-all result.

**17. Examination Committee:** As per the ordinance of Rajshahi University.

**18. Question Setter and Examiners:** For MS examination there shall be two question-setters (First and second setters) in each of the theory course and also two script examiners (First and Second Examiners) in each theory course, Project/field work/Internship Report and Thesis/Dissertation. In case, the marks awarded by the two examiners differ by 20% or more, the examination committee shall recommend that the answer scripts/thesis be re-examined by the third examiner and the arithmetic mean of the two nearest marks will be counted. If 50% or more answer scripts differ by 20% or more, all scripts of that paper will be reexamined by the 3rd examiner as per the University Ordinance.

**19. Medium and Nature of Questions and Answers:**

Question shall be made in English and /or a translated version in Bangla. The medium of answers in the examination of all courses shall be either English or Bangla. However, a mixing of English and Bangla shall never be allowed in answer-script.

**20. Theoretical Examination and Board of Viva -voce**

20.1 A candidate absenting himself/herself in a course in an examination, in which he/she ought to have been present, will be considered 'F' grade in that course.

20.2 Members of the concerned Examination Committee shall be the members of the Board and conduct Viva-voce.

**21. Laboratory Examination**

21.1 Laboratory work will be implied for non-thesis students (General Group)

21.2 The concerned Lab teacher(s) will conduct Lab Viva-voce.

21.3 The departmental Academic Committee will assign a teacher or a group of teachers to conduct a particular laboratory class or all the laboratory classes of a particular semester, as well as to conduct the laboratory assessment examination of that class during the scheduled course periods.

21.4 One copy of the marks of the laboratory assessment/examination will be sent to the Chairman of the concerned Examination Committee.

**22. Thesis/Dissertation**

22.1 Research work for a thesis must be carried out under the supervision of a full time teacher who is a member of Academic Committee to the relevant department. A co-supervisor may be appointed within or outside the department if needed.

22.2 Every student shall submit the required number (3) of type written or word processed bound copies of thesis to the Chairman or the Examination Committee through his/her supervisor.

22.3 The student shall certify that the research work was done by the candidate himself/herself and that the same work has not been submitted elsewhere for any degree (except for publication).

22.4 Every thesis student must appear at an oral presentation/examination, on a date or dates fixed by the Chairman of the Examination Committee where he/she will present the results of his/her research work in front of the Examination Committee.

22.5 Examination Committee will send two copies of the thesis to one copy to supervisor and one copy to the external examiner for the evaluation of the thesis via the Controller of Examinations. The arithmetic mean of the marks awarded by the two examiners in each course shall be taken.

22.6 If an examiner is unwilling to evaluate the thesis, with the consent of Examination Committee the chairman of the committee may send the thesis to another panel examiner via the Controller of Examinations.

22.7 One copy of the thesis approved for MS degree shall be sent by the Chairman of the respective Examination Committee, to the Departmental Seminar/University Library for future reference.

**23. Eligibility for Examination:** As per the ordinance of the University of Rajshahi.

**24. Duration of Examination**

**24.1.** The duration of examination of theory course shall be 3 (three) hours for 0.50 and 4 (four) hours for 0.75 to 1.00 unit courses.

**24.2.** The duration of practical examination shall be 24 (twenty our) hours [6 (six) hours per day].

**25. Examination Ethics**

25.1 Everyone involved in the process of examination has to ensure the security of examination and follow the examination rules of the University.

25.2 An examinee never be asked any question that hurt his/her religious or ethnic background.

25.3 If someone (teacher or employee) is involved in examination process has the following relatives as examinee(s) he/she should inform the Chairman of concerned Examination Committee or the Controller of Examinations immediately: (i) husband/wife, (ii) son/daughter, (iii) brother/sister (iv) brother-in law/sister -in-law, (v) son in- law/daughter-in-law, (vi) nephew/niece. (vii) first cousins, (viii) father/mother (ix) Uncle/aunt and (x ) father-in-law/ mother-in-law.

**26. Enforcement of the Ordinance**

This Ordinance shall come in force from the academic session 2020-2021 (examination- 2021) or session 2021-2022 (examination-2022) onwards. Students under the previous ordinance shall have to complete their programme as implied Ordinance. Special consideration may be taken if such students remain in the programme after the due date.

**27. Amendment**

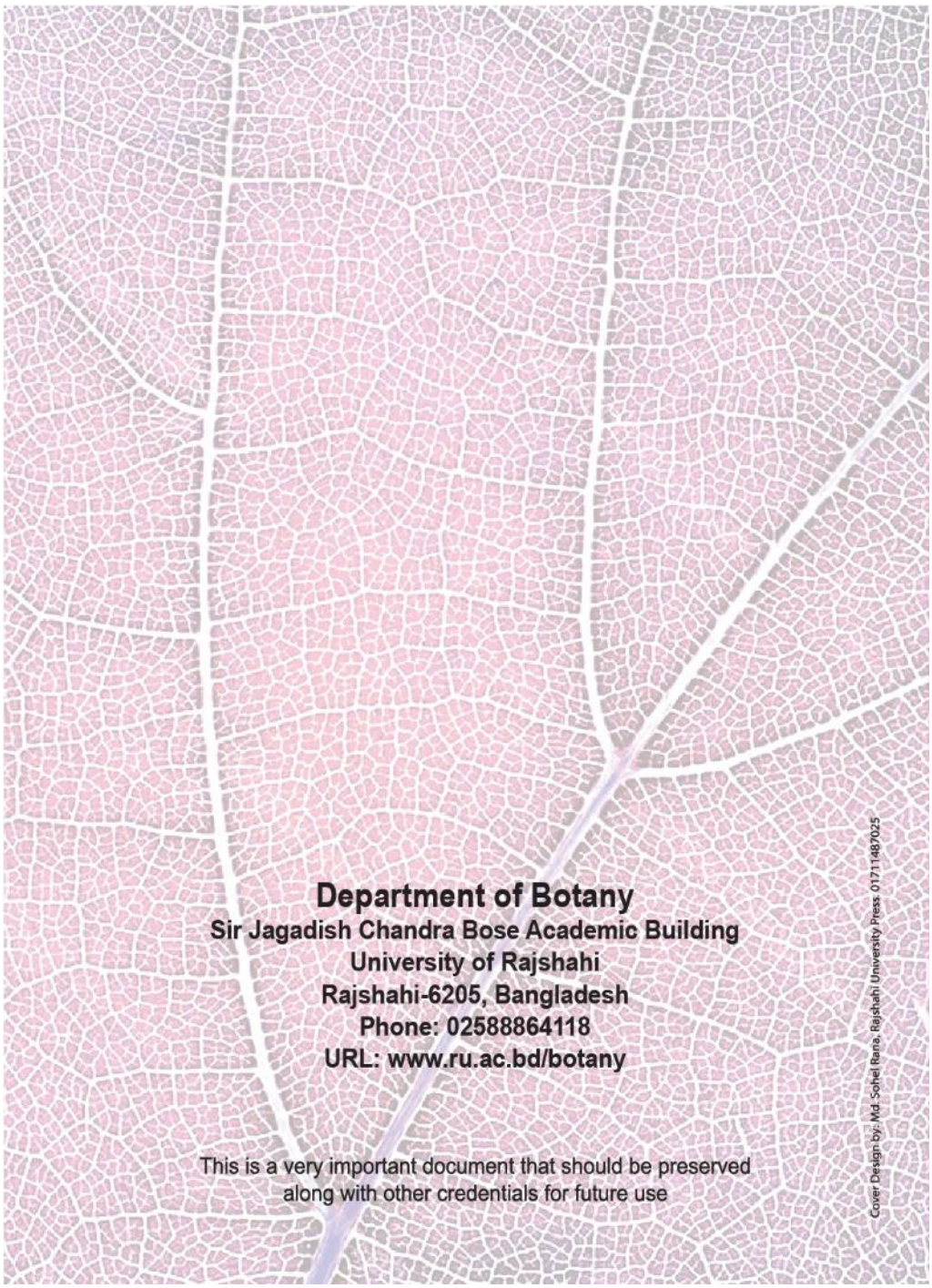
Any proposal to amend this ordinance shall be processed through the Faculty of Biological Sciences and shall have to be passed by the Academic Council of the Rajshahi University.

## CURRICULUM COMMITTEE

Department of Botany, University of Rajshahi, Rajshahi-6205

| | | |
|---|---|---|
| **Convener** | **:** | Professor Dr. Gour Pada Ghosh |
| **Members** | **:** | Professor Dr. Most. Ferdousi Begum |
| | | Professor Dr. A. H. M. Mahabubur Rahman |
| | | Professor Dr. Md. Sarwar Parvez |
| | | Dr. Md. Mostafizur Rahman |
| **Coordinator** | **:** | Professor Dr. Mohammad Shahidul Alam, Chairman, Department of Botany, University of Rajshahi |
| **Course Contributors** | **:** | All Faculty Members |
| **Expert Members** | **:** | Professor Dr. Shaikh Bokhtear Uddin<br>Department of Botany, University of Chittagong |
| | | Professor Dr. Saleh Ahammad Khan<br>Department of Botany, Jahangirnagar University |
| | | Professor Dr. M. Firoz Alam<br>House no.114, Kadirgong Darikharbona, Boalia, Rajshahi-6202 |

*[The Curriculum was approved by the Committee of Curriculum Meeting No. 3rd; Dated: 05.05.2025]*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URL: www.ru.ac.bd/botany
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