# FACULTY OF AGRICULTURE

## Curriculum for Bachelor of Science in Agriculture (Honours)


# Sher-e-Bangla Agricultural University

**Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh**

**February, 2018**

**Courtesy: IQAC-SAU; QAU-HEQEP; UGC; Ministry of Education and World Bank**

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**Disclaimer**
Every effort has been made to make this curriculum enriched with accurate information and correct entries as recommended by the 69th Academic Council meeting of SAU. However, we apologize for any typographical errors. The SAU reserves the right to alter/cancel course(s) and their contents, admission requirements, etc.

**Funded by:**
QAU- HEQEP, UGC, Ministry of Education and World Bank.

# Vice-Chancellor's Message

It is a great privilege for me to introduce the Sher-e-Bangla Agricultural University (SAU) located in the heart of Dhaka city on a beautiful green campus inherited from the then Bengal Agricultural Institute (BAI) which was converted into Sher-e-Bangla Agricultural University in 2001 by the Honorable Prime Minister, Sheikh Hasina. It started with the Faculty of Agriculture in 2001. The other three faculties namely, Agribusiness Management, Animal Science, Veterinary Medicine & Fisheries and Aquaculture were established in the year-2007, 2012 and 2016 respectively.

The mission of Sher-e-Bangla Agricultural University is based upon the firm belief that agricultural education particularly higher education provides a critical pathway to leadership development in academic and research fields as well as in achieving sustainable agricultural development, socio-economic progress of the country.

Presently, SAU is offering undergraduate and postgraduate programs (MS and Ph.D) under a course credit system with the aim to producing researchers, academicians and field level extension specialists in the field of Agriculture to deal with the issues like food production, technology generation and dissemination, marketing system improvement, poverty and hunger alleviation, food security, protein energy malnutrition (PEM), micro-nutrient deficiency (MND) etc. Nearly 234 highly qualified faculty members are shouldering the academic responsibilities plus running research activities of the university. New technologies are being developed by potential research through Sher-e-Bangla Agricultural University Research System (SAURES) while the Outreach program is set to transfer the newly developed technologies to the farmer's field for raising agricultural productivity.

The present edition of the outcome based curriculum of B. Sc. Ag. (Hons.) contains the updated courses and their contents, intended learning outcomes as taught in the undergraduate program of the Faculty of Agriculture. I believe that the information provided in this book will be of much helpful to all concern including the students

Appreciation goes to IQAC-HEQEP project, UGC, Ministry of Education and the World Bank for their financial support in the preparation of this Curriculum. I congratulate the IQAC management team, self-assessment committee members and teachers of this University with special thanks to Prof. Mohammed Ali, Head Self-Assessment Committee, Agriculture Faculty and Director, IQAC, Prof. Dr. Md. Asaduzzaman Khan whose tremendous efforts and dedication have made it possible to bring out this important academic document to light.

**(Prof. Dr. Kamal Uddin Ahamed)**
Vice-Chancellor

# Dean's Words

We are living in an age of globalization where every day we face new challenges particularly in the field of agriculture. With the advancements of science and technology, traditional agriculture is rapidly transforming into smart Agriculture involving ICTs. So in this age, it is extremely essential to keep updating and re-adjusting course curricula as per the demand of the time.

I sincerely appreciate Prof. Dr. Md. Asaduzzaman Khan, who took the initiative to compile an outcome based curriculum of the undergraduate program of the Faculty of Agriculture as part of this IQAC project.

I am feeling great to present this volume containing course details of the Faculty of Agriculture. I am confident that this publication will help our students and others to learn about our academic programs and related matters. It would also serve as a ready reference for those who wish to suggest improvement/addition/deletion of our courses.

I would like to extend my sincere appreciation to the IQAC management team, Self-Assessment committee members of Agriculture Faculty and all those involved, including Vice Chancellor, Pro-Vice Chancellor, the HEQEP sub project team, UGC, Ministry of Education and the World Bank in the compilation and publication of this important curriculum handbook.

**(Prof. Md. Ruhul Amin)**
Dean
Faculty of Agriculture

# IQAC Director's Words

The SAU's Institutional Quality Assurance Cell (IQAC) has been working to ensuring the standards of higher education at SAU. The IQAC of SAU is involved in the enhancement of teaching-learning processes, curriculum development, programs for self-assessment and future academic improvement. The Ministry of Education (MoE) with the assistance of the World Bank and UGC has undertaken a Higher Education Quality Enhancement Project (HEQEP) to improve the quality of teaching-learning of the tertiary educational institutions of the country. The updated outcome based curriculum of undergraduate level will allow students to become better graduates to face the challenges ahead to increase the crop productivity in order to ensure food security of the country. The Sher-e-Bangla Agricultural University has started its academic activities afresh with a course credit system with new course curricula at the B. Sc. Ag. (Hons.) level in 2002 and M.S. in 2003. It has now become essential to update and modernize the curriculum to meet the immediate and long term demand of the country. At this point of view we took the initiative to rearrange, update and upgrade the syllabus of B.Sc.Ag. (Hons.) to outcome based curriculum under the HEQEP-IQAC project. Initially, it was not an easy task to update the whole syllabus of B. Sc. Ag. (Hons.) within the short period, but the difficult task became easy when the chairmen, self-assessment committee members, curriculum committee members of IQAC and teachers of the departments extended their fullest concentration towards developing the outcome based curriculum.

I express my gratitude to the Vice-Chancellor and Pro-Vice Chancellor of the University, Dean, Faculty of Agriculture, all academic and members of curricula committee, members of the IQAC-project management team, members of self-assessment committee and academic council.

I like to take this opportunity of conveying my deep sense of gratitude to UGC, HEQEP, MoE and the World Bank for their cooperation and financial support in the preparation of this volume. I am sure that this undergraduate curriculum shall serve as a reference not only to the student of SAU but to all those actively engaged with Agricultural Education system in Bangladesh.

**(Dr. Md. Asaduzzaman Khan)**
Director, IQAC and Professor
Department of Soil Science, SAU

# Foreword

It is indeed an honor and privilege for me to be a part of curriculum development process. It makes me happy to publish this outcome based curriculum of B.Sc.Ag. (Hons.) Conducted by self-assessment committee of Agriculture Faculty and Institutional Quality Assurance Cell (IQAC), SAU. This undergraduate curriculum has been developed in a standard format which contains vision, mission, programme objectives, programme learning outcomes (PLO), course objectives, intended learning outcomes, teaching and assessment strategies.

Self- Assessment Committee gratefully acknowledges and appreciates the devotion of the faculty members for their significant contribution to prepare the curriculum handbook.

I am confident that this academic document will greatly help our students and others to know about our academic programs and related matters. I would like to extend my sincere appreciation to the IQAC management team, self-assessment committee members, HEQEP, UGC, Ministry of Education and the World Bank for their assistance to accomplishing this assignment.

**(Prof. Dr. Mohammed Ali)**
Head, Self-Assessment Committee
Faculty of Agriculture
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207.

# Contents

## Overview of Sher-e-Bangla Agricultural University

Sher-e-Bangla Agricultural University (SAU) is situated in the center of the capital city, Dhaka with excellent communication facilities to reach the University. The SAU campus stands on 86.97 acres (35.21 ha) of picturesque land covered by green plantations.

The "Sher-e-Bangla Agricultural University Act 2001" was passed in the National Parliament of Bangladesh on 09 July 2001 through the transformation of the then Bangladesh Agricultural Institute (BAI) into Sher-e-Bangla Agricultural University. The foundation stone of the University was laid by the then Honorable Prime Minister Shiekh Hasina on 15 July 2001. Earlier this Institute was established on December 11, 1938 by Sher-e-Bangla A.K. Fazlul Huq, the then Chief Minister of undivided Bengal as the Bengal Agricultural Institute (BAI). BAI was the oldest and the pioneer agricultural institution in Bangladesh. The figure of this establishment was renamed as the "East Pakistan Agricultural Institute" in 1947. After the independence of Bangladesh in 1971, the name of the institute was accordingly changed to the Bangladesh Agricultural Institute (BAI). Since its inception in 1938, the BAI had been functioning as a "Faculty of Agriculture" under Dhaka University. Meanwhile, with the establishment of Bangladesh Agricultural University (BAU) at Mymensingh in 1961 its academic affiliation was transferred to BAU in 1964 till it's up gradation to Sher-e-Bangla Agricultural University in 2001.

The Sher-e-Bangla Agricultural University was set up with a mission to extend the higher agricultural education and committed to promote sustainable research in diverse areas of agricultural sciences and to offer extension services for the welfare of the farming communities of Bangladesh.

Since its inception the SAU was functioning as a mono faculty university; The Faculty of Agriculture. Later on Faculty of Agribusiness Management in 2007, Animal Science & Veterinary Medicine in 2012 and Fisheries and Aquaculture Faculty in 2016 were established and started functioning.

## Overview of the Agriculture Faculty

Since its establishment in 1938 the Bengal Agricultural Institute (BAI) has started functioning as a "Faculty of Agriculture" under Dhaka University. Meanwhile, with the formation of Bangladesh Agricultural University (BAU) at Mymensingh in 1961 its academic function was transferred to BAU in 1964 till it's up gradation to Sher-e-Bangla Agricultural University in 2001. The Faculty of Agriculture (FA) of SAU is one of the important faculties of the university engaged in offering Bachelor of Science in Agriculture B. Sc. Ag. (Hons.) at undergraduate level. Among the fourteen

departments, twelve departments (12) of this Faculty are offering MS in different disciplines and 9 departments are offering PhD degree.

## 1. Vision of Agriculture Faculty

To be a leading center of excellence in agricultural education, research and innovative technological services to the agricultural community of the country with global recognition.

## 2. Mission of Agriculture Faculty

- Provision of innovative character education with the intention of producing educated and skilled human resources, in several areas of agricultural sciences.
- Conduct problem oriented research and technology transfer in the field of husbandry to help in sustainable growth.
- Run into the challenges that Agri-graduates are likely to confront throughout their professional calling.

## 3. Program Educational Objectives (PEO):

- To offer a tolerant, innovative and quality teaching in all fields of farming
- To identify agricultural problems and their sustainable solution
- To enable graduates to acquire knowledge of the subject areas as per international standard for their career growth
- To develop creative and management skills and good communication skills of the graduate
- To work with collaborative and creative approach in the target oriented goals

## 4. Program Learning Outcomes (PLO)

1) Acquire and apply knowledge of agricultural sciences to prepare themselves for a better future;
2) Develop intellectual skills needed for critical thinking, problem solving and creativity;
3) Identify, develop and provide creative, advanced and efficacious solution to agricultural problems;
4) Develop analytical skill for enhancing decision making ability through learning numeracy, statistical and computing sciences;

5) Enhance entrepreneurship and innovation skills for career growth;
6) Communicate effectively in both written and oral forms. Communicate effectively with a diverse group of people using appropriate traditional and emerging IT media;
7) Acquire interpersonal skills to become valued individual and team contributors. Realize and demonstrate effective leadership responsibility. Understand and commit professionally, ethically and with human responsibility as per with the agriculturist's code of behavior;
8) Function independently and learn responsibility for personal activities. Acknowledge the need for and to engage in lifelong learning and professional growth;
9) Raise awareness and commitment towards effective citizenship and societal duty.

## 5. **Generic Skills**

Education is all about to gain a set of skills. Such skills will prepare the graduates competent enough to confront the realities of life, to develop the attitude of lifelong learning and to lead to the socioeconomic growth of the nation.

The curriculum of agriculture faculty will provide the following generic skills to the graduates:

| Generic skills | Skill development mechanism |
|---|---|
| i. Intellectual skills matching with program of study | Accumulate up to date literature, participate actively in seminar, discussion, group activities |
| ii. Practical & problem solving skills | Handling lab equipment, demonstrate practical skills, field problem identification and resolution |
| iii. Numeracy and analytical skills | Group work, case management |
| iv. Entrepreneurship and invention skills | Assignment, industrial visit |
| v. Communication & IT skills | Assignment, literature search, presentation |
| vi. Interpersonal, teamwork & leadership skills | Group work, attachment with students' organizations |
| vii. Self-management and personal development skills | Class attendance, punctuality, cooperativeness, sincerity, conduct, time management |
| viii. Commitment to community, country & humanity | Involvement with extra-curricular and social activities |

## 5. Curriculum Alignment / Skill Mapping

Curriculum must be aligned with program objectives, program learning outcome and intended learning outcomes through proper skill mapping

**Format for skill mapping**

| Courses | Program Learning Outcome | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 |
| ABOT 103& 104 | x | x | x | x | | x | | x | |
| ABOT 257 & 258 | x | x | x | x | | x | | x | |
| ABOT 405 & 406 | x | x | x | x | | x | | x | |
| ABOT 483 | x | x | x | x | | | | | |
| AGCH 107&108 | x | x | x | x | x | x | | | |
| AGCH 357 & 358 | x | x | x | x | | x | | | |
| AGCH 361 | x | x | x | x | | x | | | |
| AEIS 207 & 208 | x | x | | | x | x | x | x | x |
| AEIS 355 & 356 | x | x | | | x | x | x | x | x |
| AEIS 407 & 408 | x | x | | | x | x | x | x | x |
| AEIS 409 & 410 | x | x | | | x | x | x | x | x |
| AEIS 383 | x | x | | x | | | | x | |
| AGEN 159 &160 | x | x | x | x | x | | | x | |
| AFES 259 & 260 | x | x | x | x | | x | | x | x |
| AFES 335 | x | x | x | x | | x | | | x |
| AGRO 101 & 102 | x | x | x | x | | x | | x | |
| AGRO 251 & 252 | x | x | x | x | | x | | x | |
| AGRO 351 & 352 | x | x | x | x | | x | | x | |
| AGRO 401 & 402 | x | x | x | x | | x | | x | |
| AGRO 451 & 452 | x | x | x | x | | x | | x | |
| AGRO 231 | x | x | x | x | | x | | | |
| BIOC 155 & 156 | x | x | | x | | x | | | |
| BIOC 209 & 210 | x | x | | x | | x | | | |
| BIOT 359 & 360 | x | x | | x | x | x | | | |
| BIOT 433 | x | x | | | x | x | | | |
| ENTO 253 & 254 | x | x | x | x | | x | | x | |
| ENTO 307 & 308 | x | x | x | x | x | x | | x | |
| ENTO 459 & 460 | x | x | x | x | x | x | | x | x |
| ENTO 333 | x | x | x | x | x | x | | x | x |
| GEPB 203 & 204 | x | x | x | x | | x | | x | |
| GEPB 305 & 306 | x | x | x | x | | x | | x | |
| GEPB 455 & 456 | x | x | x | x | | x | | x | |
| GEPB 381 | x | x | x | x | | x | | | |
| HORT 151 & 152 | x | x | x | x | x | x | | x | |
| HORT 201& 202 | x | x | x | x | x | x | | x | |
| HORT 301 & 302 | x | x | x | x | x | x | | x | |
| HORT 453 & 454 | x | x | x | x | x | x | | x | |
| HORT 281 | x | x | x | x | x | x | | x | |
| ENGL 131 | x | | | | | x | | x | |
| PLPA 205 & 206 | x | x | x | x | | x | | x | |
| PLPA 353 & 354 | x | x | x | x | | x | | x | |
| PLPA 457 & 358 | x | x | x | x | | x | | x | |
| PLPA 431 | x | x | x | x | | x | | x | |
| SOIL 105 & 106 | x | x | x | x | | x | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SOIL 255 & 256 | x | x | x | x | | x | | | |
| SOIL 303 & 304 | x | x | x | x | | x | | | |
| SOIL 403 & 404 | x | x | x | x | | x | | | |
| SOIL 481 | x | x | x | x | | x | | | |
| AGEC 109 | x | x | | | x | x | | | |
| AGST 309 & 310 | x | x | | x | | x | | | |
| AGST 385 | x | x | | x | | x | | | |
| APMA 157 & 158 | x | x | | | x | x | | | |
| FISH 181 | x | x | x | | | x | | x | |
| DEPS 153 | x | x | x | | x | x | x | | x |
| | | | x | | | | | | |
| | | | x | | | | | | |
| | | | x | | | | | | |
| | | | x | | | | | | |
| | | | x | | | | | | |

## 7. Curriculum structure and related information

### 7.1. Nomenclature of Degree

The courses offered should lead to awarding the degree of Bachelor of Science in Agriculture (Honours), in abbreviated form B. Sc. Ag. (Hons.)

### 7.2. System of Education: Semester

**7.3. Eligibility for Admission:** The candidates should have passed HSC/equivalent from Science Group. S/he should have GPA 7.5 combined from SSC/equivalent and HSC/equivalent without 4$^{th}$ subject; and at least GPA 3.0 separately. S/he shall have Physics, Chemistry, Mathematics and Biology in both SSC/equivalent and HSC/equivalent examinations. These criteria can be changed by central admission committee as required by the situation.

### 7.4 Duration of Degree Program

Four years divided into 8 academic semesters.

### 7.5 Academic Semester

Two regular semesters- Semester I and Semester II in an academic year. Duration of each regular semester I & II is 22 weeks. The semester I starts in January and semester II in July of each academic year.

The time duration for different portions of each semester is as follows:

| | |
|---|---|
| Classes | 16 weeks |
| Recess before Semester Final Examination | 02 weeks |
| Semester Final Examination (Theory and Practical) (approx.) | 02 weeks |
| Result Preparation and Publication | 02 weeks |
| **Total** | **22 weeks** |

### 7.6 Medium of Instruction

The medium of instruction is English.

### 7.7 Academic Credit

When a student enrolls in Sher-e-Bangla Agricultural University, S/he shall earn academic credits. In case of theoretical course, one lecture per week per semester (16 weeks) is equivalent to one credit i.e. for a 3-credit course; there are three lectures per week. In case of practical course, one practical class of three hours per week is equivalent to two credits.

### 7.8 Types of Courses

The courses offered in undergraduate curricula are divided into the following groups:

a) **Core/Compulsory courses**: In each semester specific numbers of courses are offered as compulsory courses.

b) **Elective Courses**: A number of courses are offered as elective courses.

Students have to complete four elective courses out of a number of elective courses according to their choice. The chosen elective courses are treated as compulsory courses, when enrolled.

### 7.9 Department Wise Compulsory and Elective Courses (Total Credit: 182; Compulsory 174, Elective 8)

| Departments | Compulsory Courses Credit Hours (Theory + Practical=Total) | Elective Courses Credit Hours |
|---|---|---|
| Agricultural Botany | 08+06=14 | 02 |
| Agricultural Chemistry | 06+04=10 | 02 |
| Agricultural Extension and Information System | 10+04=14 | 02 |
| Agricultural Engineering | 03+02=05 | - |
| Agroforestry and Environmental Science | 03+02=05 | 02 |
| Agronomy | 11+10=21 | 02 |
| Biochemistry | 04+04=08 | - |
| Biotechnology | 03+02=05 | 02 |
| Entomology | 08+06=14 | 02 |
| Genetics and Plant Breeding | 08+06=14 | 02 |
| Horticulture | 10+08=18 | 02 |
| Language | 00+00=00 | 02 |
| Plant Pathology | 08+06=14 | 02 |
| Soil Science | 09+08=17 | 02 |

| | | |
|---|---|---|
| Agricultural Economics | 03+00=03 | - |
| Agricultural Statistics | 03+02=05 | 02 |
| Animal Production & Management | 03+02=05 | - |
| Aquaculture | 00+00=00 | 02 |
| Development & Poverty Studies | 02+00=02 | - |
| **Total= 182 Credit Hours** | **174** | **4 Courses x 2= 8** |

### 7.10. Limits on the Credit Hours to be taken

A student must get enrolled in the core courses designed in each semester. The student may be allowed to enroll up to maximum two elective courses in a single semester. The credit earned in the elective will be added to GPA calculation.

### 7.11 Grading System

| Numerical Grade | Letter Grade | | Grade Point |
|---|---|---|---|
| 80% or above | A+ | (A plus) | 4.00 |
| 75% to Less than 80% | A | (A regular) | 3.75 |
| 70% to Less than 75% | A- | (A minus) | 3.50 |
| 65% to Less than 70% | B+ | (B plus) | 3.25 |
| 60% to Less than 65% | B | (B regular) | 3.00 |
| 55% to Less than 60% | B- | (B minus) | 2.75 |
| 50% to Less than 55% | C+ | (C plus) | 2.50 |
| 45% to Less than 50% | C | (C regular) | 2.25 |
| 40% to Less than 45% | D | (D regular) | 2.00 |
| Less than 40% | F | (Failed) | 0.00 |

### 7.12 Distribution of Marks

**Theory:**

Fifty percent (50%) of marks of a theoretical course is allotted for continuous assessment i.e. class participation/attendance, quizzes/assignment and class tests. The remaining 50% is allotted to Semester Final Examination. The distribution of theory marks for a given course will be as follows:

| | |
|---|---|
| Class Participation/Attendance | 10% |
| Quizzes/Assignment | 10% |
| 1st Class Test | 15% |
| 2nd Class Test | 15% |
| Semester Final (20% quizzes + 30% descriptive) | 50% |
| **Total** | **100%** |

**Practical:**

- Forty five (45%) marks are allotted for first practical examination
- Forty five percent (45%) marks are allotted for final practical examination and
- Ten percent (10%) marks are to be counted for class attendance.

Practical final examination is conducted by the internal and external examiners. The Controller of Examination appoints the external examiners as proposed by the Academic Committee of the Department concerned. The practical examinations include experiments and/or problems, evaluation of practical notebook, viva voce and class attendance etc.

Marks for class participation/attendance are as follows:

| **Attendance** | **Marks** |
|---|---|
| 90% and above | 10 |
| 85% to less than 90% | 9 |
| 80% to less than 85% | 8 |
| 75% to less than 80% | 7 |
| 70% to less than 75% | 6 |
| Less than 70% | 0 |

Students having less than 70% of class attendance in any class are not permitted to appear in the Semester Final Examination and s/he will have to repeat the course of that semester in the next available semester with fresh enrollment. The course teacher(s) send the attendance report for both theoretical and practical courses to the Dean through respective Departmental Chairman before filling up the form for Final Examination by the student.

## 8. Course Layout and Credit Hours for B.Sc.Ag. (Hons.) Degree under the Semester System

**LEVEL–1: SEMESTER-I**

| Title of the Courses | Courses Code | | Credit Hours | Total |
|---|---|---|---|---|
| | **Theory** | **Practical** | **Theory + Practical** | |
| **Compulsory Courses** | | | | |
| Fundamentals of Agronomy (T)<br>Fundamentals of Agronomy (P) | AGRO 101 | AGRO 102 | 2+2 | 4 |
| Fundamentals of Agricultural Botany (T)<br>Plant Morphology and Anatomy Practical | ABOT 103 | ABOT 104 | 2+2 | 4 |
| Introductory Soil Science (T)<br>Elementary Soil Experiment (P) | SOIL 105 | SOIL 106 | 2+2 | 4 |
| Chemistry of fertilizer and Radio-trace Technique (T)<br>Elementary Experiments on Agricultural Chemistry (P) | AGCH 107 | AGCH 108 | 3+2 | 5 |
| Agricultural Economics (T) | AGEC 109 | - | 3+0 | 3 |
| | | **TOTAL** | **12+8** | **20** |
| **Elective Course** | | | | |
| Advanced English Language Skills (T-E) | ENGL 131 | - | 2+0 | 2 |

**LEVEL–1: SEMESTER-II**

| Title of the Courses | Courses Code | | Credit Hours | Total |
|---|---|---|---|---|
| | **Theory** | **Practical** | **Theory + Practical** | |
| **Compulsory Courses** | | | | |
| Introduction to Floriculture and Landscaping (T)<br>Introduction to Floriculture and Landscaping (P) | HORT 151 | HORT 152 | 2+2 | 4 |
| Rural Sociology (T) | DEPS 153 | - | 2+0 | 2 |
| Chemistry of Biomolecules (T)<br>Chemistry of Biomolecules (P) | BIOC 155 | BIOC 156 | 2+2 | 4 |
| Livestock Production (T)<br>Livestock Production (P) | APMA 157 | APMA 158 | 3+2 | 5 |
| Agricultural Mechanization (T)<br>Agricultural Mechanization (P) | AGEN 159 | AGEN 160 | 3+2 | 5 |
| | | **TOTAL** | **12+8** | **20** |
| **Elective Course** | | | | |
| Integrated Aquaculture (T-E) | FISH 181 | - | 2+0 | 2 |

**LEVEL–2: SEMESTER-I**

| Title of the Courses | Courses Code | | Credit Hours | Total |
|---|---|---|---|---|
| | **Theory** | **Practical** | **Theory + Practical** | |
| **Compulsory Courses** | | | | |
| Vegetable Production (T)<br>Vegetable Production (P) | HORT 201 | HORT 202 | 3+2 | 5 |
| Cytology and Cytogenetics (T)<br>Cytology and Cytogenetics (P) | GEPB 203 | GEPB 204 | 2+2 | 4 |
| Introduction to Plant Pathology and Microbiology (T)<br>Laboratory Techniques in Plant Pathology and Microbiology (P) | PLPA 205 | PLPA 206 | 2+2 | 4 |
| Agricultural Extension and Rural Development (T)<br>Agricultural Extension and Rural Development (P) | AEIS 207 | AEIS 208 | 2+1 | 3 |
| Intermediary Metabolism and Food Nutrition (T)<br>Intermediary Metabolism and Food Nutrition (P) | BIOS 209 | BIOS 210 | 2+2 | 4 |
| | | **TOTAL** | 11+10 | **20** |
| **Elective Course** | | | | |
| Sustainable Agriculture (T-E) | AGRO 231 | - | 2+0 | 2 |
| | | **TOTAL** | **2+0** | **2** |

**LEVEL–2: SEMESTER-II**

| Title of the Courses | Courses Code | | Credit Hours | Total |
|---|---|---|---|---|
| | **Theory** | **Practical** | **Theory + Practical** | |
| **Compulsory Courses** | | | | |
| Seed Science & Technology (T)<br>Seed Science & Technology (P) | AGRO 251 | AGRO 252 | 2+2 | 4 |
| Introductory Entomology (T)<br>Introductory Entomology (P) | ENTO 253 | ENTO 254 | 3+2 | 5 |
| Soil Classification, Survey and Conservation (T)<br>Field and Laboratory Study of Soil (P) | SOIL 255 | SOIL 256 | 2+2 | 4 |
| Plant Physiology (T)<br>Plant Physiology Practical (P) | ABOT 257 | ABOT 258 | 3+2 | 5 |
| Agro-Forestry (T)<br>Agro-Forestry (P) | AFES 259 | AFES 260 | 3+2 | 5 |
| | | **TOTAL** | **13+10** | **23** |
| **Elective Course** | | | | |
| Nursery Management of Horticultural Crops (T-E) | HORT 281 | - | 2+0 | 2 |

**LEVEL–3: SEMESTER-I**

| Title of the Courses | Courses Code | | Credit Hours | Total |
|---|---|---|---|---|
| | Theory | Practical | Theory + Practical | |
| **Compulsory Courses** | | | | |
| Vegetable Seed Production and Spices(T)<br>Vegetable Seed Production and Spices (P) | HORT 301 | HORT 302 | 2+2 | 4 |
| Genetics (T)<br>Genetics (P) | GEPB 305 | GEPB 306 | 3+2 | 5 |
| Systematic Entomology and Insect Ecology (T)<br>Systematic Entomology and Insect Ecology (P) | ENTO 307 | ENTO 308 | 2+2 | 4 |
| Agricultural Statistics(T)<br>Agricultural Statistics (P) | AGST 309 | AGST 310 | 3+2 | 5 |
| In-Vitro Culture (T)<br>In-Vitro Culture (P) | BIOT 359 | BIOT 360 | 3+2 | 5 |
| | | **TOTAL** | **13+10** | **23** |
| **Elective Courses** | | | | |
| Application of GIS in Agriculture (T-E) | AEIS 383 | - | 2+0 | 2 |
| Issues of Environment and Conservation (T-E) | AFES 335 | - | 2+0 | 2 |
| Food Technology (T-E) | AGCH 361 | - | 2+0 | 2 |
| | | **TOTAL** | **6+0** | **6** |

**LEVEL–3: SEMESTER-II**

| Title of the Courses | Courses Code | | Credit Hours | Total |
|---|---|---|---|---|
| | Theory | Practical | Theory + Practical | |
| **Compulsory Courses** | | | | |
| Soil Physics and Soil Chemistry (T)<br>Physical and Chemical Analysis of Soils (P) | SOIL 303 | SOIL 304 | 2+2 | 4 |
| Weed Science (T)<br>Weed Science (P) | AGRO 351 | AGRO 352 | 2+2 | 4 |
| Principles of Plant Pathology and Seed Pathology (T)<br>Diagnosis and Management of Field Crop Diseases and Seed Health (P) | PLPA 353 | PLPA 354 | 3+2 | 5 |
| Extension Communication and Innovation Management (T)<br>Extension Communication and Innovation Management (P) | AEIS 355 | AEIS 356 | 3+1 | 4 |
| Agro-Industrial Chemistry (T)<br>Agricultural Chemistry (P) | AGCH 357 | AGCH 358 | 3+2 | 5 |

| | | | | |
|---|---|---|---|---|
| | | **TOTAL** | **13+10** | **22** |
| **Elective Courses** | | | | |
| Heterosis Breeding (T-E) | GEPB 381 | - | 2+0 | 2 |
| Data Analysis using Statistical Packages (T-E) | AGST 385 | - | 2+0 | 2 |
| Medical and Veterinary Entomology (T-E) | ENTO 333 | | 2+0 | 2 |
| | | **TOTAL** | **6+0** | **6** |

**LEVEL–4: SEMESTER-I**

| **Title of the Courses** | **Courses Code** | | **Credit Hours** | **Total** |
|---|---|---|---|---|
| | **Theory** | **Practical** | **Theory + Practical** | |
| **Compulsory Courses** | | | | |
| Crop Production Technology (T)<br>Crop Production Technology (P) | AGRO 401 | AGRO 402 | 3+2 | 5 |
| Soil Fertility & Soil Microbiology (T)<br>Experiments on Plant Nutrition and Soil Microbiology (P) | SOIL 403 | SOIL 404 | 3+2 | 5 |
| Plant Ecology (T)<br>Plant Ecology Practical (P) | ABOT 405 | ABOT 406 | 3+2 | 5 |
| Extension Organization & Management (T)<br>Extension Organization & Management (P) | AEIS 407 | AEIS 408 | 3+1 | 4 |
| Agricultural Information System (T)<br>Agricultural Information System (P) | AEIS 409 | AEIS 410 | 2+1 | 3 |
| | **TOTAL** | | 14+8 | **22** |
| **Elective Courses** | | | | |
| Clinical Plant Pathology (T-E) | PLPA 431 | - | 2+0 | 2 |
| Soil Pollution & Environmental Degradation (T-E) | SOIL 481 | - | 2+0 | 2 |
| | | **TOTAL** | **4+0** | **4** |

**LEVEL–4: SEMESTER-II**

| **Title of the Courses** | **Courses Code** | | **Credit Hours** | **Total** |
|---|---|---|---|---|
| | **Theory** | **Practical** | **Theory + Practical** | |
| **Compulsory Courses** | | | | |
| Farm and Farming System (T)<br>Farm and Farming System (P) | AGRO 451 | AGRO 452 | 2+2 | 4 |
| Fruit Production & Orchard Management (T)<br>Fruit Production & Orchard Management (P) | HORT 453 | HORT 454 | 3+2 | 5 |
| Plant Breeding (T)<br>Plant Breeding (P) | GEPB 455 | GEPB 456 | 3+2 | 5 |

| | | | | |
|---|---|---|---|---|
| Diseases of Horticultural Crops & Post- Harvest Pathology (T)<br>Diseases of Horticultural Crops & Post- Harvest Pathology (T) | PLPA 457 | PLPA 458 | 3+2 | 5 |
| Pest Management and Economic Entomology (T)<br>Pest Management and Economic Entomology (P) | ENTO 459 | ENTO 460 | 3+2 | 5 |
| | | **TOTAL** | **13+10** | **24** |
| **Elective Courses** | | | | |
| Genetic Engineering (T-E) | BIOT 433 | - | 2+0 | 2 |
| Agro-climatology (T-E) | ABOT 483 | - | 2+0 | 2 |
| | | **TOTAL** | **4+0** | **4** |

## 9. Teaching-Learning Strategy

The curriculum consists of teaching-learning strategies. The teaching methodologies employed depend to a greater extent on the preferred teaching style of the instructor and the size of the class. It is worthy to incorporate a series of questions to be answered by the students during lecture/discussion in order to keep the students engaged in continuous learning process.

- Classroom instruction (participatory, critical thinking, decision making):
- Lab exercise (Lab and field related) and preparation of Practical Notebook
- Field work/visit and reporting
- Assignment
- Field problem identification and program planning
- Industry attachment
- Extension tour

### 9.1 Study Tour:

As a part of the academic curriculum, students at levels 3 & 4 are required to perform study tour for enriching their practical knowledge. In addition, students have to perform Farm & Home Visit, Agricultural Survey, Visit to Research Organizations, Extension Organizations and Non-Governmental Organizations (NGO) and a week-long Extension field Trip at Upazilla level as the practical assignments of the Department of Agricultural Extension and Information System.

## 10. Assessment Strategy

Assessment systems are duly communicated to students at the outset of the term/semester. Assessment procedures meet the objectives of the course. The assessment system is reviewed at regular intervals. Diverse methods are used for assessment.

Both formative and summative assessment such as

- Quizzes/MCQ
- Short answer
- Essay type/Descriptive answer
- Demonstration
- Reports
- Assignment/Term papers
- Continuous assessments
- Presentations
- Viva-voce
- Practical notebook
- Summative assessment (final examination) strategies are followed.

The students are provided with result-sheet feedback immediately after the assessment. Students are being informed in advance about methods of assessment in each course.

# Department of Agricultural Botany

## Course Layout

| Sl. No. | Course Code and Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | ABOT 103: Fundamentals of Agricultural Botany (Theory) | | 02 | 1 | I |
| 2 | ABOT 104: Plant Morphology and Anatomy Practical | | 02 | 1 | I |
| 3 | ABOT 257: Plant Physiology (Theory) | | 03 | 2 | II |
| 4 | ABOT 258: Plant Physiology Practical | | 02 | 2 | II |
| 5 | ABOT 405: Plant Ecology (Theory) | | 03 | 4 | I |
| 6 | ABOT 406: Plant Ecology Practical | | 02 | 4 | I |
| 7 | ABOT 483: Agro-climatology (Theory-Elective) | | 02 | 4 | II |
| | | Theory | 08 | | |
| | | Practical | 06 | | |
| | | Elective | 02 | | |
| | | **Total** | **16** | | |

| **Course Code: ABOT 103**<br>**Course Title: Fundamentals of Agricultural Botany (Theory)** | **Credit Hours: 02** | **Level: 1** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide fundamental principles and practices of plant science pertaining to agriculture. | | | |
| **Course Objectives**<br>• Conceptualize plant systematics<br>• Describe morphological and anatomical features of the plant body<br>• Understand the importance of plant and its parts<br>• Get acquainted with the reproductive organ development process in plants | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Categorize the plant depending on the taxonomic principles<br>• Know the international code of botanical nomenclature | **Plant systematics -** Concept of taxa and botanical nomenclature, classical and modern systems of plant classification, modern taxonomic ideas and terms | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Elucidate the importance of different plants and their parts in our daily life | **Economic botany -** Introduction to the under-utilized economically important crops and their prospects of cultivation in Bangladesh | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Describe the morphology of different plants<br>• Compare the morphological features of different plant parts | **Morphology -** External morphology of important crop plants with special reference to modification of different plant organs | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Define the unit of life and understand its composition<br>• Describe the structure and function of different cell organelles | **Cell -** Ultra-structures and functions of different cell organelles; composition, structures and patterns of cell wall thickening | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Classify and explain the roles of different plant tissues and their composition | **Tissue -** Classification, characteristics and function of different plant tissues; origin and development of the epidermal, vascular and fundamental tissue systems | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |

| | | | |
|---|---|---|---|
| • Illustrate the structural arrangement of primary plant body | **Primary plant body -** Primary structures of root, stem and leaf | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Explain the process of secondary growth in plants | **Secondary growth -** Activities of vascular cambium and phellogen; process of wound healing and abscission | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Illustrate the reproductive organs development processes in plants | **Embryology -** Reproductive organs; formation of male and female spores and gametes; process of pollination and fertilization; development of embryo and endosperm | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Explain the latest research findings and information of Fundamentals of Agricultural Botany | Latest research findings and information regarding Agricultural Botany | Assignment | Report |

**Reference Books**


1. A.C. Dutta. 1974. Botany for Degree Students. Oxford University Press, Madras.
2. A.C. Dutta. 1975. A Class Book of Botany. Oxford University Press,India.
3. B.P. Pandey. 1986. Modern Practical Botany. Vol. II. S. Chand & Company(Pvt.) Ltd., New Delhi.
4. G.H.M. Lawrence. 1967. Taxonomy of Vascular Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. H.C. Gangulee, K.S. Das and C. Dutta.1984. College Botany. Vol. I. New Central Book Agency, India.
6. J.W. Purseglove. 1988. Tropical Crops Dicotyledons. English Language Book Society, Longman, London.
7. J.W. Purseglove.1988. Tropical Crops Monocotyledons. English Language Book Society, Longman, London.
8. K. Esau. 1965. Plant Anatomy. 2nd Edn. John Wiely & Sons, New York.
9. K.S. Bilgrami, L.M. Srivastava and J.L. Shreemali.1992. Fundamentals of Botany. Vikas Publishing House Pvt. Ltd., New Delhi.
10. L.S. Cobley and W.M. Steele. 1976. An Introduction to the Botany of Tropical Crops.The English Language Book Society, Longman, London.
11. P. Maheswari. 1950. An Introduction to the Embryology of Angiosperms. McGraw-Hill, New York.
12. R.H.M. Langer and G.D. Hill. 1991. Agricultural Plants. Cambridge University Press, Cambridge.
13. V.V. Sivaranjan. 1999. Introduction to the Principles of Plant Taxonomy. 2nd Edn. Oxford & IBH Pub. Co., New Delhi.

| **Course Code: ABOT 104**<br>**Course Title: Plant Morphology and Anatomy (Practical)** | **Credit Hours: 02** | **Level: 1** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide hands-on experience about the morphological and anatomical features of plant body. | | | |
| **Course Objectives**<br>• Examine the external and internal characteristics of plant body<br>• Identify systematic position of crop plants by their morphological and anatomical features<br>• Understand the structural, functional and behavioral changes of plants in changing environment | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Identify the family of different crops by their external features | Study of the important families of crop plants | Lecture<br>Demonstration<br>Discussion<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Differentiate plants of different species by their morphological characters | Study of the external morphology of important crop plants | Lecture<br>Demonstration<br>Discussion<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Handle and operate plant anatomy related laboratory instruments efficiently | Study of common laboratory techniques related to plant anatomy – microscope handling, hand sectioning of plant parts, staining and mounting to prepare temporary slides | Lecture<br>Demonstration<br>Discussion | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Identify the internal organization of plant body | Study of the anatomy of root, stem and leaf of important crop plants | Lecture<br>Demonstration<br>Discussion<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| • Identify unknown plants and get the concept about ex-situ conservation of germplasm | Visit to botanical gardens and national herbarium | Lecture<br>Field visit<br>Report writing | Report |

**Reference Books**


1. B. P. Pandey. 1986. Modern Practical Botany. Vol. II. S. Chand & Company(Pvt.) Ltd., New Delhi.
2. G.H.M. Lawrence. 1951. Taxonomy of Vascular Plants. Macmillan, New York.
3. J.W. Purseglove. 1988. Tropical Crops. Vol. 1 & 2. ELBS, London.
4. K. Esau. 1965. Plant Anatomy. 2ndEdn. John Wiely & Sons, New York.
5. P. Maheswari. 1950. An Introduction to the Embryology of Angiosperms. McGraw-Hill, New York.
6. R.H.M. Langer and G.D. Hill. 1991. Agricultural Plants. Cambridge University Press, Cambridge.
7. V.V. Sivaranjan. 1999. Introduction to the Principles of Plant Taxonomy. 2ndEdn. Oxford & IBH Pub. Co., New Delhi.

| Course Code: ABOT 257<br>Course Title: Plant Physiology (Theory) | Credit Hours: 03 | Level: 2 | Semester: II |
|---|---|---|---|

**Rationale:** This course is designed to provide the knowledge of fundamental physiological principles and processes related to crop production and crop improvement.

**Course Objectives**

- Realize the importance and mechanisms of water and nutrients uptake and their cellular distribution
- Understand the processes of solar energy conversion into chemical energy and their metabolism
- Develop knowledge on physiological mechanisms of plant growth and development
- Gather knowledge about plant responses to stresses

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Elucidate the processes of water absorption in plants<br>• Describe the mechanisms of water movement in plants | **Plant-water relations -** Properties and functions of water in plants; mechanism of and factors affecting water movement through the soil-plant-atmosphere continuum | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Explain the mechanism of nutrients uptake and their cellular distribution in plants | **Mineral absorption -** Mechanism of mineral absorption and conduction in plants | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Describe the light harvest by pigment systems, carbon assimilation and their translocation in the plant body<br>• Illustrate the mechanism of photorespiration and way of its control | **Photosynthesis -** Plant pigments and pigment-systems; light reactions; pathways of carbon assimilation and their significance; factors affecting rate of photosynthesis; photosynthetic efficiency and bio-productivity; concept, pathway and factors affecting photorespiration; key to improve crop productivity by controlling photorespiration | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Show the mechanism of energy generation from organic compounds | **Respiration -** Respiratory pathways; factors affecting respiration; respiration of plant parts during storage, ripening, damage, and at low oxygen concentrations | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |

| | | | |
|---|---|---|---|
| • Explain the function of plant growth regulators on growth, development and yield of crops | **Plant growth regulators -** Concept and classification; physiological effects of natural and synthetic growth regulators on plants; application of growth regulators in agriculture | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Discuss the flowering behavior in plants in relation to variations of the environment | **Physiology of flowering -** Floral initiation, anthesis, dehiscence of anther, stigma receptivity, pollen tube growth, fruit growth and development; photoperiodism and vernalization | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Show the process and metabolic changes in seed during germination<br>• Discuss seed dormancy of agricultural crops | **Seed physiology -** Process of seed germination, metabolic and other changes during seed germination, seed dormancy and viability, factors affecting seed dormancy and germination; exposure to bud dormancy and related aspects | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Explain the response of plants to stress and the mechanism of stress tolerance | **Stress physiology -** Concept and types; effects of stresses on plants; mode of stress tolerance | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Describe the latest research findings and information of Plant Physiology | Latest research findings and information regarding Plant Physiology | Assignment | Report |

**Reference Books**


1. A. Hemantaranjan, (Ed). 2003. Advances in Plant Physiology. Scientific Publishers, New Delhi.
2. F. Salisbury and C. Ross. 1978. Plant Physiology. Wads Worth Pub Co., Belmont.
3. L. Taiz and E. Zeiger. 2002. Plant Physiology. Sinauer Associates, Inc. Publishers, USA.
4. R.M. Devlin and F.H. Witham. 1983. Plant Physiology. 4$^{th}$Edn. CBS Publisher and Distribution, Delhi.
5. S.N. Pandey and B.K. Sinha. 1990. Plant Physiology. VikasPublishing House Pvt. Ltd., New Delhi.
6. V.K. Jain. 1999. Fundamentals of Plant Physiology. S. Chand and Company Ltd., India.

| **Course Code: ABOT 258**<br>**Course Title: Plant Physiology (Practical)** | **Credit Hours: 02** | **Level: 2** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide knowledge on physiological processes of crop plants. | | | |
| **Course Objectives**<br>• Gain practical knowledge on physiological processes in plants<br>• Demonstrate different physiological phenomena practically<br>• Acquire knowledge on growth analysis of crop plants | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Operate plant physiology related laboratory instruments efficiently | Handling and use of laboratory instruments related to plant physiology | Lecture<br>Demonstration<br>Discussion | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Demonstrate basic plant physiological processes including osmosis, plasmolysis, transpiration and respiration | Demonstration of basic physiological processes that happen in plants | Lecture<br>Demonstration<br>Discussion<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Separate, estimate and analyze plant pigments | Quantitative estimation of pigments by chromatography and spectrophotometry | Lecture<br>Demonstration<br>Discussion<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Analyze different growth parameters of crop plants and their parts | Growth analysis of a crop | Lecture<br>Demonstration<br>Discussion<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |

**Reference Books**


1. A.C. Datta and C. Subhash. 1994. Plant Physiology. New Age International Ltd., India.
2. A.C. Datta.1975. Botany for Degree Students. 6th Edn. Oxford University Press, London.
3. A.C. Leopold and P.E. Kriedemann. 1983. Plant Growth and Development. 2nd Edn. McGraw-Hill, New York.
4. F.B. Salisbury and C.M. Ross. 1986. Plant Physiology. 3rd Edn. CBS Pub., Delhi.
5. L. Taizand E. Zeiger. 1991. Plant Physiology. The Benjamin/Cummings Pub. Co. Inc., California.
6. P. Gupta and S. Kumar. 2001. Plant Physiology. East West Press, Delhi..
7. R.M. Devlin and F.H. Witham. 2000. Plant Physiology. 4th Edn. CBS Pub., Delhi.
8. S.N. Pandey and B.K. Sinha. Plant Physiology. 2nd Revised Edn. Vikas Pub., New Delhi.

| Course Code: ABOT 405<br>Course Title: Plant Ecology (Theory) | Credit Hours: 03 | Year: 4 | Semester: I |
|---|---|---|---|

**Rationale:** This course is designed to provide applicable knowledge about the basic principles of plant ecology related to crop cultivation, acclimatization and adaptation.

**Course Objectives**

- Understand the adaptation of different plants in their natural and cultivated habitats
- Develop perception about the interactions between plants and the environment
- Realize the climatic and other requirements of a crop plant

| Intended Learning Outcomes (ILOs)<br>The student will be able to - | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Describe the links between different factors of an ecosystem | **Ecosystem -** Components and functioning of natural and cultivated ecosystems | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Explain different aspects of plant population interactions and dynamics | **Population -** Population characteristics and dynamics; species interaction | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Discuss different types of community structures and their relationship with crop inter-culture | **Community -** Community structure and community dynamics; plant succession in natural and cultivated habitats | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Evaluate a crop plant to be adapted in different areas | **Adaptation -** Plant adaptation based on different environments in response to light, temperature, water, salinity and wind | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Design suitable crop models for different environment | **Phytogeography -** Principles; major vegetation regions of the world and of Bangladesh | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Realize the importance of conservation<br>• Describe the methods of plant conservation and preservation | **Biodiversity -** Importance of biodiversity in agriculture; principles and methods of conservation | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Elucidate the roles of atmospheric gases in agriculture | **Atmospheric gases -** Gaseous constituents of the atmosphere, their | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Descriptive answer |

| | | | |
|---|---|---|---|
| • Explain the impacts of greenhouse and other atmospheric gases | cycling and implications in agriculture. Greenhouse effect and ozone layer depletion; their causes, impacts and remedies | Discussion | |
| • Evaluate the sensitivity of crop plants with climate change<br>• Visualize the future of human ecology in relation to agriculture | **Global climate change -** Ecological impacts of climate change on crop production | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Descriptive answer |
| • Express the latest research findings and information of Plant Ecology | Latest research findings and information regarding Plant Ecology | Assignment | Report |

**Reference Books**


1. A.R.W. Jackson and J.M. Jackson. 1996. Environmental Science: The Natural Environment and Human Impact. Longman, Essex.
2. B. Gopal and N. Bhardwaj. 1998. Elements of Ecology. Vikas Pub., Sahidabad.
3. E.J. Kormondy. 1996. Concepts of Ecology. 4th edn. Prentice-Hall of India, New Delhi.
4. E.P. Odum. 1971. Fundamentals of Ecology. 3rdEdn. W.B. Saunders Co., Philadelphia.
5. H.D. Kumar. 1995. General Ecology. Vikas Publishing House, New Delhi.
6. J.F. Weaver and F.F. Clements. 1957. Plant Ecology. 2ndEdn. MacGraw-Hill, New York.
7. P.D. Sharma. 1999. Ecology and Environment. Kalyani Pub., New Delhi.
8. R.S. Ambhast. 1998. A Text Book of Plant Ecology. Students' Friends and Co., Varnasi.
9. S.C. Tiwari. 1992. Concepts of Modern Ecology. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
10. S.P. Palaniappan. (ed.). 1995. Agricultural Inputs and Environment. Scientific Publishers, Jodhpur, India.
11. Y. Abrol, P.N. Wattal, A. Gnanam, Govindjee, D.R. Ort and A.H. Teramura (eds.). 1991. Impact of Global Climatic Changes on Photosynthesis and Plant Productivity. Oxford & IBH Pub. Co., New Delhi.

| Course Code: ABOT 406<br>Course Title: Plant Ecology (Practical) | Credit Hours: 02 | Level: 4 | Semester: I |
|---|---|---|---|

**Rationale:** This course is designed to impart practical knowledge on ecosystem, community, community dynamics, plant adaptation and phytogeography.

**Course Objectives**

- Observe the adaptation processes in different types of plants
- Improve knowledge on community structure and different ecological plant groups

| Intended Learning Outcomes (ILOs)<br>The student will be able to - | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Identify different ecological plant groups in view of morphology and physiology | Study of different ecological plant types and their adaptation- hydrophytes, mesophytes, xerophytes, halophytes, heliophytes and sciophytes | Lecture<br>Demonstration<br>Discussion | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Compare the adaptive features of epiphytes, saprophytes and parasites | Study of botanically related plants- epiphytes, saprophytes and parasites | Lecture<br>Demonstration<br>Discussion | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Analyze structural characteristics of a plant community such as frequency, density and abundance | Study of plant community in natural and cultivated habitats | Lecture<br>Demonstration<br>Discussion | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Observe and understand biodiversity in crop field | Biodiversity expedition in the university campus and outside | Lecture<br>Demonstration<br>Discussion | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Describe the causes of plant distribution and formation of different vegetation areas of Bangladesh | Study tour to different ecological regions | Lecture<br>Demonstration<br>Discussion<br>Field visit<br>Assignment | Report |

**Reference Books**

1. A.J. Tansley and A. George. 1946. Introduction to Plant Ecology. G. Allen and Unwin, London.
2. A.K. Agrawal and P.P. Deo. 2006. Plant Ecology. Agrobios, New Delhi.
3. R.S. Ambashit. 1969. A Text Book of Plant Ecology. Students' Friends and Company, India.
4. R.S. Shukla and P.S. Chandal. 1987. Plant Ecology and Soil Science. S. Chandal and Company, India.

| Course Code: ABOT 483<br>Course Title: Agro-climatology (Theory-Elective) | Credit Hours: 02 | Level:4 | Semester: II |
|---|---|---|---|
| **Rationale:** This course is designed to provide the knowledge about climatic factors such as solar radiation, temperature, moisture, wind etc. and their manipulation for crop production. | | | |
| **Course Objectives**<br>• Understand the concept of weather and climate and their classification<br>• Realize the effect of light, temperature, water and wind on crop production and their manipulation<br>• Develop knowledge about the effect of climate change on crop production | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Discuss the factors and elements of weather and climate | **Introduction -** Climatological factors; weather and climate; macro and microclimate | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the climatic classification of Bangladesh as well as of the world<br>• Illustrate the crop production scenario of different climatic regions | **Climatic classification -** Climatic classification of the world and of Bangladesh and their influence on crops | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the solar energy balance and their effect on crop production<br>• Manipulate light environment for better production of crops | **Light -** Factors affecting the availability of light in plant canopy; effect of light on crops; manipulation of light environment | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Compare the seasonal distribution of temperature, growing degree-day and their manipulation<br>• Elucidate the role of cardinal temperature in crop production<br>• Manipulate temperature environment for better production of crops | **Temperature -** Global and seasonal distribution of soil, air and water temperatures; thermal energy cycle; effect of temperature on crops; concept and application of cardinal temperatures, thermoperiodism and degree-days; manipulation of soil, air and water temperatures | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Discuss the impact of precipitation on crop production and effects of drought and flood<br>• Manipulate moisture environment for better production of crops | **Water -** Hydrological cycling; forms of atmospheric water and precipitation; their distribution and impacts on crop production; causes and effects of drought and flood; manipulation of soil and atmospheric moisture content | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the regulation of wind environment for crop production<br>• Manipulate wind environment for better production of crops | **Wind -** Classification of wind and air masses; effects of wind on crops; causes and effects of dry wind and dust storm; regulation of wind environment | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the latest research findings and information of Agro-climatology | Latest research findings and information regarding Agro-climatology | Assignment | Report |

**Reference Books**


1. G. Merkebu. 2013. Agro-Metrology and Climatology. Lambert Academic Publishing, Germany.
2. H.G. Jones.2007. Plants and Microclimate: A Quantitative Approach to Environmental Plant Physiology. 3rd Edn. Cambridge Press, Cambridge.
3. J.O. A. H yoade. 1983. Introduction to Climatology for the Tropics. John Wiley and Sons,Chichester.
4. N.J. Rosenberg. 1983. Microclimate: The Biological Environment. Wiley-Inter Science.
5. R.S. Ambasht. 1988. A Text Book of Plant Ecology, 9thEdn. Students' Friends & Co. Varanasi.
6. V. Ganesaraja. 2011. Agroclimatology: Principle and Predictions. Associated Pub., New Delhi.

# Department of Agricultural Chemistry

## Course Layout

| Sl. No. | Course Code & Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | AGCH 107: Chemistry of Fertilizer and Radio-Tracer Technique (Theory) | | 03 | 1 | I |
| 2 | AGCH 108: Elementary Experiments on Agricultural Chemistry (Practical) | | 0 2 | 1 | I |
| 3 | AGCH 357: Agro-industrial Chemistry (Theory) | | 03 | 3 | II |
| 4 | AGCH 358: Agricultural Chemistry (Practical) | | 02 | 3 | II |
| 5 | AGCH 361: Food Toxicology (Theory-Elective) | | 02 | 3 | I |
| | | Theory | 06 | | |
| | | Practical | 04 | | |
| | | Elective | 02 | | |
| | **Total** | | **12** | | |

| **Course Code: AGCH 107**<br>**Course Title: Chemistry of Fertilizer and Radio Tracer Technique (Theory)** | **Credit Hours: 03** | **Level 1** | **Semester I** |
|---|---|---|---|
| **Rationale:** The course is designed to provide applied knowledge about fertilizer, nuclear and colloid chemistry in relation to crop production and environmental protection. | | | |
| **Course Objectives:**<br>• Acquire knowledge on the chemistry and manufacturing technologies of different fertilizers.<br>• Enrich basic knowledge on nuclear chemistry<br>• Use of radioisotopes in different fields of agriculture<br>• Develop knowledge on colloid chemistry<br>• Develop knowledge on biogas production technology | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategies** |
| • Categorize and compare different chemical fertilizers produce in Bangladesh with their major nutrient contents. | **Introduction of fertilizer technology** – Definition, concept & development of chemical fertilizers, classification of fertilizer; different names, chemical formula, % nutrients of N, P, K fertilizers. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the different steps of urea manufacturing process.<br><br>• Describe the properties of different nitrogenous fertilizers and choose one for specific use or purpose. | **Nitrogenous fertilizers-** Choice of feed stock for urea synthesis, synthesis of $CO_2$ and $NH_3$ from natural gas, urea manufacturing with flow diagram & chemical reactions, comparative study and choice of different nitrogenous fertilizers. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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|---|---|---|---|
| • Explain the different important steps of SSP and TSP manufacturing process.<br><br>• Justify the selection of different phosphate fertilizers. | **Phosphatic fertilizers-** Choice and chemical composition of raw material, manufacturing process of SSP, Preparation of phosphoric acid, manufacturing of TSP, chemistry and technology of ammonium phosphate fertilizers, comparative study and selection of phosphate fertilizers. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the different mining and recovery steps of MP.<br><br>• Compare different potash fertilizers. | **Potassic fertilizers-** Agro-industrial significance of potash. Mineralogy of potash Ores, mining and recovery of MoP, comparative study and selection of potash fertilizers. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Judge the hazard caused by fertilizer industries<br><br>• Recommend the control measure to minimize the different hazards. | **Hazard and management-** Hazard caused by fertilizer industries and its control measures. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Illustrate the manufacturing processes of different compound, mixed, liquid, controlled-release fertilizers.<br><br>• Explain their importance in agriculture. | **Other fertilizers-** Principle & manufacturing process of compound and mixed fertilizers and their importance in agriculture, list of common fertilizers containing | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| | secondary nutrients and micro-nutrient fertilizers and their chemistry & technology. Definition and classification of liquid fertilizer with their feasibility in Bangladesh. Definition and category of controlled- release fertilizers, chemistry & technology of commonly controlled - release fertilizers. Production of bio fertilizers. | | |
| • Describe the scope and importance of the different physical and chemical properties of fertilizers. | **Physical and chemical properties of fertilizers-** Definition, scope and importance of the different physical & chemical properties of fertilizers. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the various parameters for the quality control<br>• Identify commonly used fertilizers by their specifications. | **Quality control and specification of commonly used fertilizers-** Urea, Ammonium sulfate, SSP, TSP, DAP, MoP, Potassium sulfate and Zinc sulfate. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State the importance of biogas as manure<br>• Discuss the methods of biogas production as one of the means of waste recycling. | **Manures and waste recycling** Agro-wastes recycling and production of bio-gas & use of effluents. Waste reduction | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| | management & recycling of municipal & domestic wastes. Importance and utilization of slurry or effluent after the production of bio-gas & organic fertilizer (Vermicompost) | | |
| • Classify and describe the characteristics of different types of colloids.<br>• Explain different adsorption isotherms.<br>• Describe the importance in relation to plant nutrition. | **Colloid chemistry-** Definition and classification of colloids with properties. Role of colloids in agriculture. Release of essential plant nutrients from minerals & organic matter. Movement of nutrients ions from soil to plant root. Process and mechanism of ion adsorption, Definition of adsorption isotherms with their application in agricultural research, Antagonistic and synergistic relationships of ions in clay colloid system. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Distinguish different types of radioactive substance and their properties.<br>• Explain interaction of ratio active isotopes with matter.<br>• Adopt proper radiation safety measures. | **Nuclear Chemistry-** Atomic structure and nucleus; nuclear energy levels stability, nuclear atoms, nature and properties of radiation, absorption of nuclear radiation | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Use of radio isotopes in agricultural field. | by matter, half-life of radioactive isotopes, radiation doses and units, radiation safety, detection of nuclear radiation, selection of isotopes for tracer studies, importance of radio isotopes in agriculture. | | |
| • Explain the latest research findings and information of chemistry of fertilizer and Radio Tracer Technique | Latest research findings and information regarding Chemistry of Fertilizer and Radio Tracer Technique | Assignment | Report |

**Reference Books:**


1. T. Abbasi, S.M. Tauseef, S.A. Abbasi. 2012. Biogas Energy. Springer.
2. S. Ramulu, 1982. Isotopes in Agriculture. Oxford & IBH Publishing Co. India.
3. Fertilizer Manual. Edited by UNIDO and IFDC. 1998. Kluwer Academic Publishers. Netherlands.
4. P. Marschner. 2012. Mineral Nutrition of Higher Plants. Third Edition. Elsevier.
5. R. M. Pashley and M. E. Karaman 2004. Applied Colloid and Surface Chemistry. Willy.
6. C. P. Hiemenz. 1997. Principles of Colloid and Surface Chemistry. Third Edition.
7. C.L. Comar. 1985. Radioisotopes in Biology and Agriculture. Principles and practices. Mc.Grow Hill Book company, Inc. New York.
8. G. Brouwer and J. van den Eijnde. 2008. Practical Radiation Protection. Heron reeks. Netherlands.
9. N.K. Fageria. 2009. The Use of Nutrients in Crop Plants. CRC press.
10. R. M. Pashley and M. E. Karaman 2004. Applied Colloid and Surface Chemistry. Willy.
11. T.P. Hignet. 1985. Fertilizer Manual. International Fertilizer Development Center (IFDC). Alamba USA.

| **Course Code: AGCH 108**<br>**Course Title: Elementary Experiments on Agricultural Chemistry (Practical)** | **Credit Hours: 02** | **Level 1** | **Semester I** |
|---|---|---|---|
| **Rationale:** The course is designed to provide knowledge related to safety during working in an analytical laboratory, development of skills for the use of lab apparatus and equipment's using mainly the titration method. | | | |
| **Course Objectives:**<br>• Develop skills on different laboratory equipments<br>• Develop basic knowledge on analytical chemistry<br>• Acquire skills on analysis of different macro and micronutrient fertilizers.<br>• Identify commonly used fertilizers and their adulteration. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching Learning Strategies** | **Assessment Strategies** |
| • Properly operate different laboratory glassware and equipment's. | Calibration of glassware & apparatus, operation and calibration of laboratory equipment's and their safety | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Prepare different types of standard solutions as well as buffer solutions of specific pH. | Calculation and preparation of different standard solutions, preparation of buffer solutions. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Assess the pH and pOH of a solution | Determination and calculation of pH and pOH of a solution | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |

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| • Demonstrate acid-base titrations. | Acid-base titration: Strong acid-strong base, strong acid-weak base and weak acid-strong base titrations | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Determine the amount of iron from supplied samples. | Determination of Fe from samples by redox titration | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Determine the amount of calcium and magnesium from supplied samples. | Determination of Ca and Mg from samples by complexometric titration | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |
| • Identify manures and fertilizers and judge their important quality control (QC) paramaters. | Identification of commonly used fertilizers available Bangladesh, Analysis of moisture and nutrients content of manures. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short-answer<br>Identification<br>Demonstration performance<br>Viva voce<br>Practical notebook |

**Reference Books:**


1. A. B. Ghosh, J.C. Bajaj, R. Hasan and D. Singh. 1983. Soil and Water Testing Method. A Laboratory Manual. Division of Soil Science and Agricultural Chemistry. IARRI, New Delhi.
2. APHA (American Public Health Association): 1995. Standard Methods for the Examination of Water and Waste Water. 19th Eden. Water Environmental Federation, Washington, DC 2005, USA
3. H.L.S. Tandon. 1995. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizer Development and Consultation Organization, New Delhi.
4. R. Elsair. 2012. Fundamentals of Chemistry. Ventus Publishing ApS. Denmark.
5. S. P. Beier and P. D. Hede. 2013. Essentials of Chemistry. Ventus Publishing ApS. Denmark.
6. N.K. Fageria. 2009. The Use of Nutrients in Crop Plants. CRC press.
7. T.P. Hignet. 1985. Fertilizer Manual. International Fertilizer Development Center (IFDC). Alamba USA.
8. J. Mendham, R. C. Denney, J. D. Barnes and M. Thomas. 2000. Vogel's Textbook of Quantitative Chemical Analysis. 6th edn., Pearson Education Pte. Ltd., New Delhi, India.

| **Course Code**: **AGCH 357**<br>**Course Title: Agro-industrial Chemistry (Theory)** | **Credit Hours: 03** | **Level 3** | **Semester II** |
|---|---|---|---|

**Rationale:**

The course is designed to provide applied knowledge about different agro-industrial product with main focus on pesticide and environmental chemistry. The production technologies and chemistry of major agro-industrial crops such as sugarcane, tea, rubber and instrumental method of analysis are included.

**Course Objectives:**

- Describe pesticide formulations
- Explain the chemistry and underlying manufacturing technologies for different pesticides
- Discuss the transportation and fate of different agricultural and industrial pollutants, their impact on environment and their remediation
- Compare various analytical techniques and their applications
- Explain the manufacturing, processing, quality control, storage and use of different agro-industrial crops.

| **Intended Learning Outcomes (ILOs)**<br>The students will able to- | **Course Content** | **Teaching Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Identify and categorize pesticides and their formulations. | **Pesticide formulation-**<br>Introduction to pesticide and pesticide formulations. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the mode of action of different pesticides along with their uses.<br>• Discuss different types of pesticide compatibility.<br>• Describe the effect of pesticide in public health | **Chemistry of pesticide-**<br>Preparation, properties, mode of action and uses of organochlorine, organophosphorus, organocarbamate and synthetic pyrethroid insecticides, synthetic fungicides, herbicides and acaricides. Compatibility of pesticides with agrochemicals, Impact of pesticide in relation to public health. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Illustrate the effects of pesticide on environment<br>• Explain quality control processes by following rules & regulations. | **Environmental fate of pesticides-**<br>Environmental fate of pesticides in different environmental segments, their | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| | adverse effects, remediation and pesticide ordinance. Concept of pesticide residues, toxicological significance, principles of residue analysis. | | |
| • Distinguish the principles of major analytical techniques and select suitable instruments for chemical analyses. | **Instrumental methods of analysis-**<br><br>Principle, instrumentation and application of colorimetry, spectrophotometry, flamephotometry, atomic absorption spectrophotometry, chromatography. | Lecture<br>Visual presentation,<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Identify toxic elements as well as contaminants produced from agro-industry.<br>• Describe the source, transport, fate and management of pollutants. | **Environmental chemistry-** Concept, segment, nomenclature of environment; agro-industrial toxic chemicals; biochemical effects of contaminants; environmental fate of inorganic and organic contaminants; remediation of the polluted environments; occupational health safety in pesticide production plant. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the technologies involved in rubber production, processing and maintenance.<br>• Categorize synthetic rubbers according to their chemical structure and physical properties.<br>• Contrast natural rubber and synthetic rubber | **Agro-industrial products-**<br><br>**Rubber:** Tapping system; composition and processing of natural rubber; physiology of latex flow, vulcanization of rubber, coagulation of rubber, properties and synthesis of synthetic rubber | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain manufacturing technology of sugar and utilization of sugar mill by-products. | **Sugar:** Condition and quality of sugarcane, manufacture of plantation white sugar, industrial utilization of sugar mill by products | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Illustrate the manufacturing, processing and quality of black tea | **Tea:**<br><br>Manufacturing processes and changes of chemical | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Contrast the manufacturing process of black tea with other tea<br>• Explain the health benefit of tea<br>• Identify different bioactive compounds of tea. | composition in tea leaves, aroma, tea infusion and liquoring quality of tea. Effect of tea on health. Bioactive compounds of tea. | | |
| • Explain the latest research findings and information of Agro-industrial Chemistry | Latest research findings and information regarding Agro-industrial chemistry | Assignment | Report |

**Reference Books:**


1. G. Matolcsy, M. Nadasy and V. Andriska. 1988. Pesticide Chemistry. Elsevier.
2. S. P. Balraj and S.T. Sarman. 2004. Pesticide Formulation Theory and Practice. CBS publication. New Delhi.
3. L.S. Chopra and J.S. Kanwar. 1980. Analytical Agricultural Chemistry. Kalyani Publishers, Ludhiana, New Delhi. India.
4. S.E. Manahan. 1984. Environmental Chemistry. 4th edn. Brooks/Cole Publishing Company, Monterey, California.
5. C. Ho, J. Lin and F. Shahidi. . Tea and Tea Products, Chemistry and Health-Promoting Properties. CRC Press.
6. D.P. Kulkarni. 2001. Cane Sugar Manufacturing in India. The Sugar Technologists' Association of India. New Delhi. India
7. A. Ciesielski. 1999. An Introduction to Rubber Technology. Rapra Technology Limited. UK.
8. L.M.L Nollet and H.S. Rathore. 2010. Handbook of Pesticides. CRC Press.
9. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney. 1989. Vogel's Textbook of Quantitative Chemical Analysis. Longman Group UK Ltd. England.

| **Course Code**: **AGCH 358**<br>**Course Title:**<br>**Agricultural Chemistry (Practical)** | **Credit Hours: 02** | **Level 3** | **Semester II** |
|---|---|---|---|
| **Rationale:**<br>The course is designed to provide instrumental analytical skills to conduct research works. | | | |
| **Course Objectives:**<br>• Develop skill in qualitative and quantitative analysis of metals, organic compounds, and natural products<br>• Learn to operate various analytical tools/ instruments.<br>• Conduct pesticide residue analysis. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will able to- | **Course Content** | **Teaching Learning Strategies** | **Assessment Strategies** |
| • Identify and select suitable chemicals and apparatus for analysis. | Instructions for the use of laboratory chemicals and glassware with their safety measures. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Operate various analytical tools/ instruments. | Spectrophotometer, flame emission spectrophotometer, atomic absorption spectrophotometer and gas chromatography. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Plant sample collection & preparation for chemical analysis | Sample preparation & digestion | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Analyze different mineral elements from a sample and make a statement about their deficiency or excessiveness in it. | Analysis of samples for essential nutrient elements or other minerals (P, S ) by spectrophotometer and flame emission (Na,K) spectrophotometer. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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|---|---|---|---|
| • Analyze a plant sample to know if there is any nitrogen deficiency or not. | Determination of the amount of nitrogen from a sample by macro Kjeldahl method | Lecture, Discussion Demonstration Problem solving | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Decide either the water of a specific area is suitable or not for irrigation or in boiler. | Determination of the amount of carbonate and bicarbonate from water samples. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Analyze different pesticide | Analyze different pesticide for the determination of active ingredients and residues. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1. A. B. Ghosh, J.C. Bajaj, R. Hasan and D. Singh. 1983. Soil and Water Testing Method. A Laboratory Manual. Division of Soil Science and Agricultural Chemistry. IARRI, New Delhi.
2. APHA (American Public Health Association): 1995. Standard Methods for the Examination of Water and Waste Water. 19th Eden. Water Environmental Federation, Washington, DC 2005, USA
3. H.L.S. Tandon. 1995. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizer Development and Consultation Organization, New Delhi.
4. FSSAI. 2015. Manual of Methods of Analysis of Foods Pesticide Residues. Food Safety and Standards Authority of India. New Delhi.
5. J. Mendham, R. C. Denney, J. D. Barnes and M. Thomas. 2000. Vogel's Textbook of Quantitative Chemical Analysis. 6th edn., Pearson Education Pte. Ltd., New Delhi, India.
6. R. T. Morison and R. N. Boyd. 2006. A Text Book of Organic Chemistry. 6th edn., Dorling Kindersley (India) Pvt. Ltd., New Delhi, India.
7. D. A. Skoog, D. M. West and F. J. Holler. 2001. Fundamentals of Analytical Chemistry. 7th edn., Harcourt Asia Pvt. Ltd., Singapore.

| Course Code: AGCH 361<br>Course Title: Food Toxicology (Theory-Elective) | Credit Hours: 02 | Level 3 | Semester I |
|---|---|---|---|

**Rationale:** The course is designed to provide applied knowledge about the nature, properties, effects and detection of toxic substances in agricultural products, food additives, mycotoxins, and pesticides related to public health.

**Course Objectives:**

- Acquire fundamental knowledge on food safety
- Enrich basic knowledge in aspects of food chemistry and toxicology
- Develop knowledge on major food borne toxicants
- Develop knowledge on regulatory science in relation to food toxicology.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching Learning Strategy** | **Assessment Strategies** |
|---|---|---|---|
| • Categorize and compare toxicology, food toxicology, risk assessment and risk perception. | **Introduction to food toxicology** –<br>Definition of toxicology and food toxicology, historical context of toxicology, toxicology and risk analysis, Human health risk assessment, perception about chemicals, toxicological issues beyond cancer. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe how toxicants are classified.<br>• Explain the different types of toxic responses. | **Concepts in toxicology-**<br>Acute, subchronic and chronic toxicity. Different types of applied toxicology, classification of toxicants, types of toxic responses. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Develop an introductory understanding of pesticide use and monitoring in the human food chain.<br>• Comprehend the risk vs. benefits analysis of pesticides. | **Pesticide residues in food-**<br>Special application of pesticides, legal basis for monitoring, discussion about RfD, MRL and safety standard. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the types of adverse food reactions.<br>• Differentiate food | **Food allergy-**<br>History of food allergy, adverse food reactions. | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type |

| | | | |
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| allergy, sensitivity and intolerance. | most common allergic food groups, hypersensitivity. | Discussion | answer |
| • Elucidate the background and principles of safety assessment of food additives.<br>• Explore the basics of testing related to food additives safety. | **Food additives-**<br>Scope and importance of food additives, categories of food additives. Consumption of food additives, exempt chemicals, GRAS. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the background and history of the GMO in food debate.<br>• Explore the range of crops and foods that currently contain GMOs. | **GMOs-**<br>Major areas in GMO debates.<br>GMO risks and perception challenges. current GMO crops. The regulatory issues of GMOs. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain biochemical adaptation and the roles of secondary metabolites in plants.<br>• Evaluate the impacts of plant toxicants in agricultural crops and human food chain. | **Natural toxin in plants-**<br>Phytochemicals in plants. Scope and importance of phytotoxins in plants. Plant toxins in agricultural crops and human food chain. Separation and detection process of phytotoxins. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explore the uses of lead and arsenic in agriculture.<br>• Illuminate the toxicology of lead and arsenic in relation to public health. | **Human Health Risk Assessment (HHRA) of lead and arsenic-**<br>History of lead and arsenic poisoning, sources and uses, toxicology of lead and arsenic, review the Bangladesh arsenic crisis. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the latest research findings and information of Food Toxicology | Latest research findings and information regarding Food Toxicology | Assignment | Report |

**Reference Books:**


1. W.W. Hughes. . Essentials of environmental toxicology.
2. T. Shibamoto. L. F. Bjeldanes. 2009. Introduction to food toxicology. 2nd Edn.
3. V.C. Runeckles. 1975. Recent advances in phytochemistry. Vol 9. Springer US.
4. D. Kealey and P. J. Haines. 2002. Analytical chemistry. Bios Sci. Publishers Ltd.

# Department of Agricultural Extension and Information System

## Course Layout

| Sl. No. | Course Code and Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 01 | AEIS 207 | Agricultural Extension and Rural Development (Theory) | 2 | 2 | I |
| 02 | AEIS 208 | Agricultural Extension and Rural Development (Practical) | 1 | 2 | I |
| 03 | AEIS 355 | Extension Communication and Innovation Management (Theory) | 3 | 3 | II |
| 04 | AEIS 356 | Extension Communication and Innovation Management (Practical) | 1 | 3 | II |
| 05 | AEIS 407 | Extension Organization and Management (Theory) | 3 | 4 | I |
| 06 | AEIS 408 | Extension Organization and Management (Practical) | 1 | 4 | I |
| 07 | AEIS 409 | Agricultural Information Systems (Theory) | 2 | 4 | I |
| 08 | AEIS 410 | Agricultural Information Systems (Practical) | 1 | 4 | I |
| 09 | AEIS 383 | Applications of GIS in Agriculture (Theory-Elective) | 2 | 3 | I |
| | | **Theory** | 10 | | |
| | | **Practical** | 4 | | |
| | | **Elective** | 2 | | |
| | | **Total** | **16** | | |

| Course Code : AEIS 207<br>Course Title: Agricultural Extension and Rural Development (Theory) | Credit Hours: 02 | Level: 02 | Semester: I |
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| **Rationale:** This course is designed to provide basic knowledge on agricultural extension education, extension teaching methods and rural development approaches to improve socio-economic condition of the farming community. | | | |
| **Course Objectives:**<br>• Understand the concepts and philosophies of agricultural extension education,<br>• Acquire knowledge about types of education and learning,<br>• Acquaint with extension teaching methods and aids, and<br>• Getting familiar with the approaches of rural development. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to: | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|---|---|---|---|
| ▪ Describe Concept, scope, principles and philosophies of agricultural extension<br>▪ Describe the development of agricultural extension in Bangladesh and beyond | **Agricultural Extension:** Concept and evolution of Agricultural Extension; Scope and Objectives of Extension; Principles and Philosophies of Agricultural Extension; History and development of agricultural extension work in Bangladesh and beyond; Integrated functions of agricultural education, Research and extension services. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Distinguish between formal and non-formal education.<br>▪ Describe the laws and theories of learning.<br>▪ Explain Blooms taxonomy of learning | **Education and Learning:** Definition, meaning, objectives, types of education; Adult education and its characteristics; Teaching-learning process; Principles, laws and theories of learning and their application in extension work; Criteria for effective learning; Taxonomy of learning objectives (Bloom's Taxonomy). | Lecture,<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Demonstrate the teaching extension methods, their use and effectiveness<br>▪ Apply extension teaching aids and criteria and evaluation of these aids.<br>▪ Select effective teaching methods by considering different | **Extension Teaching Methods and Aids:** Understanding extension teaching methods; Factors to be considered in selecting extension teaching methods; Combination of teaching methods for greater effectiveness; Result demonstration vs. method demonstration; Meaning of extension teaching aids; Classification, benefits, advantages, disadvantages, and choice of extension teaching aids: audio-aids, | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| factors | visual-aids & audio-visual aids; Criteria for selection and evaluation of extension teaching aids | | |
| ▪ Describe the concept, scope, and history of rural development;<br>▪ Explore the causes of rural poverty and its solutions.<br>▪ Comprehend the influence of rural youth and women in development activities and the roles of NGOs and GOs in alleviating rural poverty. | **Rural Development:** Understanding the concept 'rural development'; Rural poverty: causes and solutions; Peoples' participation in rural development activities; Involvement of rural youth, rural women and landless farmers in rural development activities of Bangladesh; Role of GOs and NGOs in rural development and poverty reduction in Bangladesh. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Obtain latest research findings and information regarding agricultural extension and rural development | Latest Research Findings and Information Regarding Agricultural Extension & Rural Development | Assignment | Report |

**Reference Books**


1. M. A. Kashem. 2004. Fundamentals of Extension Education. BAU. Mymensingh, Bangladesh.
2. C. Leeuwis and A. Van den Ban. 2004. Communication for rural innovation: rethinking agricultural extension. Blackwell Science Ltd, London, UK.
3. C. Leeuwis and A. Van den Ban. 2004. Communication for rural innovation: rethinking agricultural extension. Blackwell Science Ltd, London, UK.
4. M. H. Bhuiyan. 1999. Extension Organisation and management (in Bengali). Gulshan Publications, Dhaka, Bangladesh.
5. M. H. Bhuiyan, M.A.M. Miah, M.G.R. Akanda and M.A. Bashar 2014. Agricultural Extension Education. G-Science Implementation and publication, Dhaka, Bangladesh.
6. G. L. Roy. 2006. Extension Communication and Management. Joy Prakashani. Calcutta, India.

| **Course Code: AEIS 208**<br>**Course Title: Agricultural Extension and Rural Development (Practical)** | **Credit Hour: 01** | **Level: 02** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge on basic facts of Bangladesh, organizational role in agricultural development, micro-teaching, and teaching and learning methods. | | | |
| **Course Objectives:**<br>• Acquire knowledge on basic facts of Bangladesh including agriculture and socio-demographic data,<br>• Know about various GOs and NGOs working for agricultural development,<br>• Understand the procedure of lecturing, and<br>• Learn approaches of teaching methods and aids. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
| ▪ Describe some basic concept of agriculture such as cropping pattern, cropping intensity, net cropped area, total cropped area etc.<br>▪ Discuss the current status of administrative unit, population size, literacy rate and major export and import items. | Understanding basic facts of Bangladesh : agriculture, population, education, administration, export, import, etc. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |
| ▪ Describe the role and responsibility of DAE, DLS, DF, BRDB, BADC, BARD, RDA, CARE, BRAC, PROSHIKA and RDRS in agricultural development. | An introduction to different organizations related to agricultural development in Bangladesh | Lecture<br>Discussion,<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |
| ▪ Compare the role and working procedure of government and non-government organization | Orientation and visit to offices (head and local) of selected GOs and NGOs | Lecture<br>Discussion<br>Multimedia presentation<br>Visit office<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Report<br>Viva voce |
| ▪ Demonstrate the procedure of formal lecture | Lecture and its practice | Lecture<br>Discussion<br>Individual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| | | | Practical notebook<br>Presentation performance<br>Viva voce |
| ▪ Prepare PowerPoint presentation. | Preparation of PowerPoint presentation | Lecture<br>Multimedia presentation,<br>Class room exercise<br>Presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Presentation performance<br>Viva voce. |
| ▪ Explain the process of microteaching.<br>▪ Arrange the time allocation for each segment of presentation. | Microteaching practice | Lecture<br>Discussion<br>Multimedia presentation<br>Class room exercise | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Presentation performance<br>Viva voce. |
| ▪ Prepare some common visual teaching aids and their use in lecture | Preparation and use of some selected low cost teaching aids: Poster, Flash Cards, Charts and Graphs | Lecture<br>Discussion<br>Multimedia presentation,<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Report<br>Viva voce. |
| ▪ Demonstrate the procedure and importance of Farm and home visit in disseminating agricultural technology | Farm and home visit | Lecture<br>Discussion<br>Multimedia presentation<br>Farm visit | Quiz/MCQ<br>Short answer<br>Essay type<br>Practical notebook<br>Viva voce. |
| ▪ Compare the procedure of method demonstration and result demonstration | Conducting method demonstration and result demonstration | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce. |

**Reference Books:**


1. M. H. Bhuiyan. 2012. Generation and Diffusion of Agricultural Innovation. G-Science Implementation and publication, Dhaka, Bangladesh.
2. M. H. Bhuiyan, M.A.M. Miah, M.G.R. Akanda and M.A. Bashar. 2014. Agricultural Extension Education. G-Science Implementation and publication, Dhaka, Bangladesh.
3. Agricultural Extension Manual, 2000.
4. Statistical Pocket Book, 2015. Bangladesh Bureau of Statistics, Ministry of Agriculture, Dhaka, Bangladesh.

| **Course Code: AEIS 355**<br>**Course Title: Extension Communication and Innovation Management (Theory)** | **Credit Hours: 03** | **Level: 03** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide knowledge on extension communication, motivation, and adoption process of agricultural technology among the farmers. | | | |
| **Course Objectives:**<br>• Understand the process of extension communication;<br>• Acquire knowledge about rural social system and psychology of farmers behaviour;<br>• Gather knowledge about motivation and its application in extension work;<br>• Understand the diffusion and adoption process of agricultural technology.<br>• Gain knowledge on how to effectively manage agricultural innovations. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
| • Explain communication model and elements of communication process<br>• Describe factors influencing communication<br>• Demonstrate the importance of communication to agricultural and rural development. | **Extension Communication:** Concept, scope and importance of communication; Communication models; Barriers and noise of communication; Feedback of communication; Critical factors of extension communication; Communication gap; Types and forms of communication; Communication strategy for agricultural and rural development. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce. |

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| • Describe the structure of rural and urban society.<br>• Acquire knowledge on human psychology.<br>• Explain the effects of social cultures, norms and interaction on the change of behavior<br>• Explain the factors and theories of personality development.<br>• Determine the causes of farmers' frustration and how to reduce their frustration. | **Rural Sociology and Psychology:** Definition of rural sociology, society & community; Difference between rural and urban society; Concept and factors associated with the acceptance and pattern of social change; Socialization - concept & process; Behavior - concept, formula and model of behaviour, Concept and theories of personality, Frustration - concept, characteristics of frustrated individuals, causes of frustration of farmers of Bangladesh, adjustment activities to frustration. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |
| • Describe the role, technique and application of motivation in extension work.<br>• Describe the theories of motivation. | **Motivation:** Concept of motivation and its cycle; Role of motivation in job performance; Techniques of motivation; Application of motivation in extension work; Theories of motivation, Job characteristics model and their application in extension work. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |
| • Describe diffusion and adoption process of technology;<br>• Explain the influencing factors of technology adoption.<br>• Illustrate adoption of innovation process.<br>• Describe the factors affecting agricultural technology transfer.<br>• Manage the agricultural innovations effectively. | **Innovation Management:** Meaning and definition of technology/innovation; Diffusion process & elements of diffusion process; Innovation-decision process, its concept and model; Innovativeness and adopter categories; Types and attributes of innovation; Factors influencing adoption of innovation; Rejection and discontinuance of innovations; Barriers in adoption & diffusion of innovations, management of innovation. | Lecture Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |

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| ▪ Obtain latest advancement in extension communication and innovation management concept | Latest Research Findings and Information Regarding Extension Communication and Innovation Management | Assignment | Report |

**References Books**


1. M.H. Bhuiyan, M.A.M. Miah, M.G.R. Akanda and M.A. Bashar. 2014. Agricultural Extension Education. G-Science Implementation and publication, Dhaka, Bangladesh.
2. C. Leeuwis and A. Van den Ban. 2004. Communication for rural innovation: rethinking agricultural extension. Blackwell Science Ltd, London, UK.
3. E.M. Rogers. 2003. Diffusion of innovations. Third Edition. The Free Press. New York.
4. The World Bank. 2012. Agricultural Innovation Systems: An Investment Sourcebook. Washington DC: The World Bank.
5. M.H. Bhuiyan. 2012. Generation and Diffusion of Agricultural Innovation. G-Science Implementation and publication, Dhaka, Bangladesh.
6. E.M. Rogers. 2003. Diffusion of innovations. Third Edition. The Free Press. New York.
7. G. L. Roy. 2006. Extension Communication and Management. Joy Prakashani. Calcutta, India.

| **Course Code: AEIS 356**<br>**Course Title: Extension Communication and Innovation Management (Practical)** | **Credit Hour: 01** | **Level: 03** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge on data collection instruments, data collection methods, preparing survey report, preparation of printed materials, and preparing and practicing farm radio talk. | | | |
| **Course Objectives:** The prime objectives of the course are to-<br>• Understand basic knowledge on research in agricultural extension education;<br>• Acquire knowledge about data collection instruments and methods and their application;<br>• Gather knowledge about how to prepare research report, e.g. thesis;<br>• Understand agricultural extension printed materials and farm radio talks, and how they prepare. | | | |
| **Intended Learning Outcomes (ILOs)** | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
| The students will be able to<br>• Describe and apply different instruments for data collection.<br>• Illustrate types and forms of questionnaire.<br>• Prepare a good questionnaire.<br>• Conduct an interview. | Data collection instruments: preparation of interview schedule and procedure of interviewing | Lecture<br>Discussion<br>Class room exercise<br>Assignment | Quiz/MCQ,<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report |
| • Develop a survey for data collection.<br>• Gather technical know-how on compilation and tabulation of data<br>• Acquire knowledge on descriptive and inferential data analysis | Survey and collection of data: compilation, tabulation and analysis of data | Lecture,<br>Discussion<br>Class room exercise<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report. |
| • Illustrate parts of reports, their function and placement.<br>• Gather hands-on experience on style of writing, construction of tables and figures, writing headings, bibliography and footnote. | Preparation and presentation of a survey report | Lecture,<br>Discussion,<br>Multimedia presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report. |

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|---|---|---|---|
| • Describe the objectives, merits and demerits of agricultural extension printed materials.<br>• Acquire practical knowledge on how to prepare printed materials. | Preparation of leaflet, folder, bulletin and circular letter | Lecture<br>Discussion<br>Multimedia presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report |
| • Discuss the ins and out (e.g. methods of preparing radio talk) of farm radio talks.<br>• Gather experience on technical aspects (e.g. microphone technique and speed of delivery) farm radio talks<br>• Deliver farm radio talks | Preparation of farm radio talks and its practice | Lecture<br>Discussion<br>Multimedia presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report. |

**References Books**


1. M.H. Bhuiyan, M.A.M. Miah, M.G.R. Akanda and M.A. Bashar. 2014. Agricultural Extension Education. G-Science Implementation and publication, Dhaka, Bangladesh.
2. G. L. Roy. 2006. Extension Communication and Management. Joy Prakashani. Calcutta, India.
3. Department of Agricultural Extension & Information System. Agricultural Extension practical Manual. AEIS, Sher-e-Bangla Agricultural University.

| **Course Code: AEIS 407**<br>**Course Title: Extension Organization and Management (Theory)** | **Credit Hours: 03** | **Year: 04** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide an advanced understanding on extension organization, management, administration, supervision, programme planning, monitoring, and evaluation. | | | |
| **Course Objectives:**<br>• Understand the structure of organisation and extension organization;<br>• Acquaint with group, group dynamics and leadership in agricultural extension;<br>• Acquire knowledge on extension management, administration and supervision and how they work;<br>• Understand principles and procedures of extension programme planning, monitoring and evaluation. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
| ▪ Discuss the structure and duties of extension organization,<br>▪ Describe the New Agricultural Extension Policy,<br>▪ Gain skills at various agricultural extension approaches.<br>▪ Describe the basic functions of a manager<br>▪ Learn different stress and conflict management techniques | **Extension Organization, Administration, Management & Supervision:**<br>• Extension Organization: Meaning, structure, principles, environment, factors; policy formulation in extension organization; New Agricultural Extension Policy (NAEP); agricultural extension approaches in Bangladesh.<br>• Administration, Management & Supervision: Concepts, definition, principles of administration, management and supervision; functions of management; management theories; conflict, stress and grievance management; methods of supervision. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| ▪ Describe and apply the procedure of extension programme planning, monitoring and evaluation<br>▪ Acquaint with participatory methods of programme planning, monitoring and evaluation.<br>▪ Explain the causes of failure in agricultural extension programme.<br>▪ Evaluate the effectiveness of extension programme. | **Extension Programme Planning, Monitoring and Evaluation:** Programme planning; Characteristics of a good programme; People's participation in extension programme planning; Participation; Participatory methods; Reasons for failure of extension programme; Monitoring and evaluation; Areas, tools and procedure of monitoring and evaluation; Difference between monitoring and evaluation; Extension programme evaluation. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Describe the roles of group, group dynamics and leadership in agri-based socio-economic development.<br>▪ Prepare training module for developing ideal leadership for agricultural development. | **Group, Group Dynamics and Leadership:** Definition, Importance, feature, types and importance of group; Reasons for group affiliation by the farmers, Stages of group development, Causes of failure of groups; Group dynamics; External and internal forces of group dynamics; Types, importance of leadership; Qualities and qualifications of a good leader; Role of leaders; Characteristics of local and opinion leadership; Selection, training and recognition of local leaders. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Describe the concepts and needs of capacity development of agricultural advisory services,<br>▪ Learn the different approaches of capacity development, particularly for agricultural advisory services. | **Capacity Development of Agricultural Advisory Services:** concepts, definition, objectives, approaches of capacity development; capacity development of agricultural extension service personnel (individual, organization and country level) | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| ▪ Update themselves with latest theoretical and practical aspects of extension organization and management | Latest Research Findings and Information Regarding Extension Organization and management | Assignment | Report |

**Reference Books**


1. E.M. Rogers. 2003. Diffusion of innovations. Third Edition. The Free Press. New York.
2. M.H. Bhuiyan, M.A.M. Miah, M.G.R. Akanda and M.A. Bashar 2014. Agricultural Extension Education. G-Science Implementation and publication, Dhaka, Bangladesh.
3. C. Leeuwis and A. Van den Ban. 2004. Communication for rural innovation: rethinking agricultural extension. Blackwell Science Ltd, London, UK.
4. G. L. Roy. 2006. Extension Communication and Management. Joy Prakashani. Calcutta, India.
5. M.A. Kashem. 2004. Fundamentals of Extension Education. BAU. Mymensingh, Bangladesh.
6. M.H. Bhuiyan. 1999. Extension Organisation and management (in Bengali) Gulshan Publications, Dhaka, Bangladesh.

| **Course Code: AEIS 408**<br>**Course Title: Extension Organization and Management (Practical)** | **Credit Hour: 01** | **Level: 04** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide hands-on experience on office management; project proposal preparation; training programme; seminar, symposium, workshop and conference; planning extension programme; plan of work and calendar of work; and extension field trip. | | | |
| **Course Objectives:**<br>• Understand skills and procedures of office management;<br>• Acquire knowledge about training and how to organize training programmes;<br>• Gather knowledge about how to prepare project proposal and conduct a project;<br>• Understand plan of work and calendar of work and extension field trip;<br>• Describe and organize seminar, symposium, workshop and conference. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|---|---|---|---|
| • Explain different types of skills required for office management.<br>• Explain types of document and records and how to enhance their security.<br>• Know filling procedure and principle of official correspondence.<br>• Manage an office. | Methods and procedures of office management | Lecture<br>Discussion<br>Class room exercise | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Demonstration performance |
| • Capable to write a good project proposal.<br>• Monitor, evaluate and prepare budget of a project. | Preparation of a project proposal | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |

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| • Explain and differentiate education and training.<br>• Illustrate types of training and training approaches.<br>• Conduct training needs analysis through administering job, task, knowledge and skill-gap analysis<br>• Gather practical knowledge on preparing training module and selecting a training method. | Preparation of a training program and practicing training | Lecture, Discussion, Multimedia presentation, Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report |
| • Comprehend details about seminar, symposium, workshop and conference.<br>• Acquire practical knowledge on how to conduct about seminar, symposium, workshop and conference. | Organization of seminar, symposium, workshop and conference | Lecture<br>Discussion<br>Class room exercise | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Demonstration performance |
| • Illustrate the ins and out of agricultural extension programme.<br>• Gather experience on how to plan an agricultural extension Programme: identification of problems, analysis of stakeholder and development of logical framework.<br>• Implement an agricultural extension programme | Planning an agricultural extension programme | Lecture<br>Discussion<br>Multimedia presentation, Assignment. | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report |
| • Prepare a plan of work and calendar of work<br>• Prepare and present a plan of work and calendar of work | Preparation of plan of work and calendar of work | Lecture<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Report |

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| • Plan an extension field trip at Upazila level.<br>• Gather hands-on training on data collection, and experience on meeting with field level extension personnel.<br>• Acquire with agricultural extension activities at the upazila and block levels.<br>• Write a survey report, incorporating data and experiences gathered from field trip. | Extension field trip to an upazila headquarters | Visit Upazila Extension activities Assignment | Report |

**Reference Books**


1. Department of Agricultural Extension & Information System 2000. Agricultural Extension practical Manual. AEIS, Sher-e-Bangla Agricultural University.
2. G. L. Roy. 2006. Extension Communication and Management. Joy Prakashani. Calcutta, India.
3. M.H. Bhuiyan, M.A.M. Miah, M.G.R. Akanda and M.A. Bashar. 2014. Agricultural Extension Education. G-Science Implementation and publication, Dhaka, Bangladesh.

| **Course Code: AEIS 409**<br>**Course Title: Agricultural Information Systems (Theory)** | **Credit Hours: 02** | **Year: 04** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course presents students with a fundamental understanding of Information Systems (ISs) and their various applications in agriculture. | | | |
| **Course Objectives:**<br>• Understand the concept, principles, functions and types of IS<br>• Learn application of Geographical Information (GIS) in agriculture<br>• Understand premises of Knowledge Management System (KMS) and learn techniques to effectively manage knowledge in agricultural advisory services | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
| ▪ Describe various types of information systems to support organizational decision making process<br>▪ Apply the information systems concepts in enabling organizational performance,<br>▪ Demonstrate the understanding of telecommunication in enhancing the capability of organization. | **Information Systems in Organization:** Concepts & importance; types (TPS, MIS, DSS, EIS) and interrelationship; functions of IS; dimensions of IS; environment, IS and organization interrelationship; contemporary approach of IS; Enterprise application (ERP, CRM, SCM, KMS); opportunities & challenges of enterprise application; systems for collaboration & teamwork. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Explain the basic concepts and functions of GIS,<br>▪ Familiar with the different types of GIS and their application in agriculture<br>▪ Capable of using GIS in land and crop management | **GIS in Agriculture:** Concept, types, use & application of GIS in agriculture (land management, crop management); GIS-based mapping. | Lecture<br>Discussion<br>Class room exercise | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| ▪ Discuss the concept and utility of precision agriculture<br>▪ Develop skills at various tools & techniques of precision agriculture<br>▪ Learn effective use of precision agriculture concept for better farm management. | **Precision Agriculture:** Concepts, definition, tools & techniques, geo-spatial data collection and management**.** | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Explain the core concepts, methods, techniques and tools of knowledge management.<br>▪ Demonstrate the ability to apply KM solutions to agricultural knowledge acquisition and dissemination.<br>▪ Demonstrate the ability to use IT-based KM tools in agriculture. | **Knowledge Management for Agricultural Extension Service:** Concept & foundation; KM solutions; KM models; KM theories; KM impacts; KM & its significance in agricultural development; KM tools for managing knowledge in organization. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ▪ Obtain latest research and practices in agricultural information systems | Latest research findings and information regarding Agricultural Information Systems | Assignment | Report |

**Reference Books**


1. Laudon, Kenneth C., Laudon, Jane P. *Management Information Systems: Managing the Digital Firm.* 14th Edition, Pearson.
2. Becerra-Fernandez, I. and Sabherwal, R. 2010. *Knowledge Management: Systems and Processes, M.E. Sharpe.*
3. O, Huisman, & Rolf, A. De. 2001. Principles of Geographic Information Systems: An Introductory Textbook. ITC, the Netherlands.

| Course Code: AEIS 410<br>Course Title: Agricultural Information Systems (Practical) | Credit Hour: 01 | Level: 04 | Semester: I |
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**Rationale:** This course teaches students the wide array of information systems applications such as database management, wireless & internet technology, telecommunication & network basics, GIS mapping, KM tools.

**Course Objectives:**

- Comprehend the basic requirements for information systems use in organization,
- Learn and develop hands-on experience on various information systems applications in agriculture,
- Develop skills to effectively apply and manage information systems applications in real-world cases,

| Intended Learning Outcomes (ILOs)<br>The students will be able to | Course Content | Teaching-Learning Strategy | Assessment Strategy |
|---|---|---|---|
| • Learn the problems of traditional file management,<br>• Identify the major capabilities of a database management systems<br>• Design and develop a database systems. | Database Management Systems | Lecture<br>Discussion<br>Multimedia presentation<br>Database application | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Performance on database application |
| • Describe the basics of telecommunication and network<br>• Identify the requirements and capabilities of a telecommunication network needed for effective communication<br>• Identify and use of major telecommunication transmission media | Telecommunication and Network Basics | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Demonstration performance |
| • Explain the principle technologies and standards for the Internet and Wireless technology,<br>• Identify and understand the system requirements for various types of Internet and Wireless technology. | The Internet and Wireless Technology | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Demonstration performance |

| | | | |
|---|---|---|---|
| • Select appropriate tools for collecting geo-spatial data<br>• Use GIS to prepare maps for land/crop management | Application of GIS for mapping | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce<br>Demonstration performance |
| • Identify key knowledge resources, acquire, synthesis and customize agricultural information for delivery to farmers, extension personnel and community leaders,<br>• Utilize a variety of methods for information sharing with farmers, extension personnel, community leaders for sustainable agricultural practices and market information such as text messaging, mobile devices, app etc.<br>• Learn on how to develop an ICT-based agricultural knowledge hub | Knowledge Management for Agricultural Advisory Service | Lecture<br>Discussion<br>Presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Practical notebook<br>Viva voce |

**Reference Books/Materials:**

- Instructors will provide varieties of scholarly/peer-reviewed research papers and learning materials related to the topic during the lab sessions.
- Instructors will also demonstrate various software applications in the lab. Students are expected to learn, practice and use the software to produce solutions of real-world problems.

| **Course Code: AEIS 383**<br>**Course Title: Application of GIS in Bangladesh Agriculture (Theory-Elective)** | **Credit Hours: 02** | **Level: 03** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to gather knowledge on scope of GIS application to develop Bangladesh agriculture. | | | |
| **Course Objectives:** The main objectives of this course are to-<br>▪ Acquire knowledge on basic concept about GIS<br>▪ Learn application of GIS in agriculture and development planning<br>▪ Gain technical know- how about spatial data collection tools and techniques | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to | **Course Content** | **Teaching-Learning Strategy** | **Assessment Strategy** |
|---|---|---|---|
| • Describe the concept of GIS and its application in agriculture and development planning | **Introduction of GIS**<br>Concept, meaning and definition of GIS; Development of GIS, Uses of GIS in agriculture and development planning. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the types of GIS data<br>• Select appropriate tool for data collection<br>• Explain the steps for spatial or agricultural data collection method | **Data collection tools and techniques**<br>Concept and meaning of GIS data, Data vs information, Types of GIS data, Common sources of GIS data, Spatial and agricultural data collection tools and techniques. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the scaling of map Understand the basic elements of map | **Basic Map Concept**<br>Concept and definition of map, Mapping authority, Basic elements of map, Types of Map, Map and scale. | Lecture<br>Discussion<br>Multimedia presentation, Video presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the data processing and organization | **Data Processing and Organization**<br>Editing, coding, classification and tabulation of data; Organization of data for storage and retrieval. | Lecture<br>Discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Obtain latest research and applications of GIS in agriculture | Latest Research Findings and Information Regarding Application of GIS in Agriculture | Assignment | Report |

**Reference Books**


- O, Huisman and A. De. Rolf. 2001. Principles of Geographic Information Systems: An introductory textbook. ITC, the Netherlands.
- Campbell, J. and Shin, M. 2011. Essentials of Geographic Information Systems. Open Textbook Library, University of Minnesota.
- S. M. M. Haque. 2008. Basic Concept on GIS. A booklet of the training program 'Certificate Course on GIS' Jahangir Nagar University, Savar, Dhaka, Bangladesh.
- B. Anderson. 2003. Introduction to Arc View. 2nd edition. University of New Hampshire Cooperative Extension. USA.

# Department of Agricultural Engineering

## Course Layout

| Sl. No. | Course Code and Title | Credit Hours | Level | Semester |
|---|---|---|---|---|
| 1. | AGEN 159. Agricultural Mechanization (Theory) | 03 | 1 | II |
| 2. | AGEN 160. Agricultural Mechanization (Practical) | 02 | 1 | II |
| | **Total** | **05** | | |

| **Course Code: AGEN 159**<br>**Course Title : Agricultural Mechanization (Theory)** | **Credit Hours: 03** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to develop knowledge on important technologies used in the field of Agricultural Engineering for mechanized and modern Agricultural operations. | | | |
| **Course Objectives:**<br>• Acquire knowledge about modern farm technologies and machineries.<br>• Know about the current status, needs and opportunities of mechanized farming.<br>• Develop knowledge on crop water requirement and efficient irrigation technologies.<br>• Getting familiar with farm structure design and construction materials for farm structure.<br>• Gather knowledge on post-harvest losses, storage, processing and preservation technologies of agricultural products. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Categorize and criticize the level of Mechanization of Bangladesh. | **Agricultural Mechanization-** Status of Agricultural Mechanization in Bangladesh; its scope, importance, application, trends, advantages and disadvantages and sources of agricultural power and its applications. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Know the type of engine and their working principles.<br>• Compare between two and four stroke engines.<br>• Differentiate between petrol and diesel engines.<br>• Develop knowledge of RM of engines. | **Engines and its Internal Systems**- Definition**,** classification of engines, engine parts, two and four stroke engines, petrol and diesel engines and their working principles and different internal systems in tractors and power tiller engines**,** repair and maintenance of engines, estimation of power, energy and efficiencies of engines. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

| | | | |
|---|---|---|---|
| • Classify the type of tillage implements and machineries.<br>• Describe tillage implements, sprayers and harvesters and their uses.<br>• Explain the uses of solar energy.<br>• Estimate the power, energy and efficiencies of agricultural machineries. | **Farm Implements and Machinery**- Primary and secondary tillage implements; ploughs, harrows, rotavator, rakes, leveler, seeding machines and transplanters, fertilizer applicator, weeders, mulching machine. Sprayers, reapers, threshers, combine harvesters, potato-maize and sugarcane harvesters, uses of solar energy, calculation of soil – implement relation forces, analysis of forces, and estimation of power, energy and efficiencies of machines. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Predict the shelf-life of agricultural products.<br>• Compare between different processing, preservation and drying technologies.<br>• Acquire knowledge of processing and preservation technologies.<br>• Estimate moisture content and drying time for mechanical dryers. | **Post-Harvest Technology-** Importance of grain drying and storage of agricultural products, perishable and semi-perishable products, shelf-life of products, moisture content of grains, EMC, RH, ERH, factors affecting grain drying, methods of drying, dryer types, methods of preservation and storage of agricultural products, milling (processing) of cereal grains, vegetable oil extraction machines, calculation of moisture contents and drying time for mechanical dryers. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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|---|---|---|---|
| • Describe the methods of irrigation.<br>• Estimate the irrigation requirements and efficiencies.<br>• Compare various irrigation technologies.<br>• Estimate the power requirement of pumping and cost of power.<br>• Determine the water requirements for different crops.<br>• Develop knowledge about RM of irrigation pumps.<br>• Develop knowledge about discharge of water through different controlling structures. | **Irrigation and Drainage-** Importance, methods of irrigation, determination of irrigation efficiencies, irrigation pumps and tube wells and their classification, Low Lift Pump (LLP), working principle of centrifugal pumps, repair-maintenance and troubleshooting of centrifugal pump. Introduction to water controlling and measuring structures, principle of discharge through them and related problems, solutions, simple irrigation canal design, determination of water requirement for different crops and related problem solutions. Calculation of pumping power, motor sizes and cost of pumping. | Lecture<br>Visual presentation<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Select and evaluate the quality of construction materials.<br>• Estimate the amount of engineering materials required for construction.<br>• Estimate the cost of engineering construction and earthwork.<br>• Analyze the engineering materials in the laboratories. | **Common Engineering Materials-** Bricks, cement, sand and timber and their constituents, classification and uses, manufacturing processes and their field and laboratory tests, estimation of common engineering materials – brick, sand, cement, khoa, timber, steel etc. estimation of earthworks and canal lining materials. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the latest research findings and information of Agricultural Mechanization | Latest research findings and information regarding Agricultural Mechanization | Assignment | Report |

**Reference Books**


1. R. A. Kepner, Roy Bainer and E. L. Barger. Principles of farm machinery.3rd Ed.1987, CBS Publishers & Distributors, New Dellhi 110032. India.
2. A. M. Michael. Irrigation: Theory and Practice, Reprint Ed.1997, Vikas publishing house Pvt. Ltd. New Delhi, India.
3. S. K. Garg, Irrigation Engineering and Hydraulic Structures. 7th Ed. New Delhi: Khanna Publishers.
4. Dr. M. A. Aziz. Engineering Materials, Revised Edition 1995.Published by Kazi Mahfuzur Rahman, available at Hafiz book centre, new market, Dhaka-1205, Bangladesh.
5. S. P. Mahajan and Sanjay Mahajan. Civil Estimating and Costing, 2nd Ed. 1990. Satya Prakashan, New Dellhi 11005, India.
6. Amalendu Chakraverty, Arun S. Mujumdar, Hosahalli S. Ramaswamy. Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. 2003, Publishedby CRC Press. England
7. Donnell Hunt, David Wilson. Farm Power and Machinery Management, Eleventh Edition, Iowa State University press, Ames, Iowa 50014, USA.
8. A. M Michael, S. D Khepar, and S. K Sondhi. Water Wells and Pumps, 2nd Ed.Published by Tata McGraw – Hill, India.

| **Course Code: AGEN 160**<br>**Course Title: Agricultural Mechanization (Practical)** | **Credit Hours: 02** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide students the practical experience of using available machinery or to provide a closer overview of important technologies used in the domain of Agricultural Engineering for mechanized and modern Agricultural operations. | | | |
| **Course Objectives:**<br>• Acquire knowledge on selection of best suited machine or engine and to do proper management and maintenance in practical situations.<br>• Know the technique and methods of determining the exact irrigation requirement.<br>• Become familiar with various construction materials for farm structure.<br>• Acquaint with post-harvest care, losses and crop processing technologies. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Identify and use common hand tools. | Common hands tools. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain the functions of different parts of engines<br>• Use farm equipment's. | Different parts of engines and farm equipment's. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Differentiate the engines and criticize their working principles. | Two and four stroke cycle engines, diesel and petrol engines. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Practical notebook |
| • Know the technique of starting different types of engine. | Starting of different types of internal combustion engine. | Lecture<br>Discussion<br>Demonstration<br>Group work | Demonstration performance |
| • Explain the different engine systems of tractor and power tiller. | Fuel system of diesel and petrol engine, Cooling system, ignition systems, Lubrication system of engines, Power transmission systems of tractor and power | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| | tiller. | | |
| • Explain and identify the farm implements, machineries, irrigation pumps, and dryers.<br>• Describe the suitability of machines in various types of agricultural operations. | Moldboard plow, disc plow, harrows, tines for wet and dryland, seed drills, transplanters, sprayers, irrigation pumps, reapers, threshers, harvesting machinery and dryers. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva-voce<br>Practical notebook |
| • Operate and determine the capacity of centrifugal pump. | Experiment on determination of centrifugal pump capacity. | Lecture<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Viva-voce<br>Practical notebook<br>Demonstration performance |
| • Estimate the crop (grain) yield by using measuring tools. | Measurement of crop yield (grain). | Lecture<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Viva-voce<br>Practical notebook<br>Demonstration performance |
| • Operate the power tiller and tractor. | Tractor and power tiller driving. | Lecture<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Identification<br>Viva-voce<br>Practical notebook<br>Demonstration performance |
| • Justify the field of farm machinery available for agricultural operations.<br>• Observe modern agricultural machineries using in agricultural field. | Visit to ideal Agricultural Engineering Farms, Research Institutes (BARI, BRRI, and BADC) and Farm machinery manufacturing industries. | Visiting the related organization | Report |

**Reference Books:**


1. J. M. Shippen, C. R. Ellin and C. H. Clover. Basic Farm Machinery, 3rd Ed. 1980, Published by Pergamon Press Oxford, UK
2. A. M. Michael. Irrigation: Theory and Practice, Reprint Ed.1997, Vikas publishing house Pvt. Ltd. New Delhi, India.
3. "খামার যন্ত্রপাতি (ম্যানুয়াল)", ১৯৮৮. Published by Department of Agricultural Extension, Ministry of Agriculture, Bangladesh
4. Study guide, lecture sheet and leaflets.
5. https://www.youtube.com/TheAutoPartsShop

# Department of Agroforestry and Environmental Science

## Course Layout

| Sl. No. | Course Code and Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 01 | AFES 259: Agroforestry (Theory) | | 03 | 2 | II |
| 02 | AFES 260: Agroforestry (Practical) | | 02 | 2 | II |
| 03 | AFES 335: Issues of Environment and Conservation (Theory-Elective) | | 02 | 3 | I |
| | | Theory | 03 | | |
| | | Practical | 02 | | |
| | | Elective | 02 | | |
| | | **Total** | **07** | | |

| Course Code: AFES 259<br>Course Title: Agroforestry (Theory) | Credit Hours: 03 | Level: 2 | Semester: II |
|---|---|---|---|
| **Rationale:** This course is designed to provide fundamental concept of Agroforestry and different agroforestry systems practiced in Bangladesh. | | | |
| **Course Objectives:**<br>• Conceptualize Agroforestry components and species compatibility.<br>• Understand Agroforestry, Agroforestry systems and management.<br>• Know about social forestry and forest of Bangladesh. | | | |

| Intended Learning Outcomes (ILOs)<br><br>The students will be able to- | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Know the concept, scope and components of agroforestry.<br>• Describe the importance of agroforestry-biomass, fuel, timber, fodder and food production. | **Introduction**:<br>History, concept and scope of agroforestry; components of agroforestry; importance of agroforestry-biomass, fuel, timber, fodder and food production. | Lecture<br>Interactive discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the characteristics of different agroforestry systems.<br>• Illustrate different agroforestry systems in Bangladesh.<br>• Elucidate region specific agroforestry adoption technology.<br>• Explain the benefits of agroforestry. | **Classification of Agroforestry systems and Practices in Bangladesh:**<br>Concept and basic elements of agroforestry system; basis of agroforestry classification; composition and structures of different agroforestry systems and their potential benefits. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Acquire knowledge on the forest and forest resources of Bangladesh.<br>• Learn about the distribution and types of forest in Bangladesh.<br>• Elucidate problems and prospects of Bangladesh forest. | **Forest of Bangladesh:**<br>Concept, overview, importance and problems of forest in Bangladesh; ecological classification of forest of Bangladesh; important flora and fauna of Bangladesh forest; ecological, social and environmental contribution of forest. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Know the suitable agroforestry species in different AEZ. | **Agroforestry Species and their Compatibility:**<br>Concept of agroforestry | Lecture<br>Interactive discussion | Quiz/MCQ<br>Short answer<br>Essay type |

| | | | |
|---|---|---|---|
| • Learn the suitable tree crop association.<br>• Assess the effect of different MPTs.<br>• Explain the role of nitrogen fixing trees in agroforestry systems.<br>• Know the adaptability of different tree species in problem soils of Bangladesh. | species; desirable characteristics of agroforestry species; woody and non-woody species suitable for agroforestry systems; multipurpose trees(MPTs) and their benefits in agroforestry; nitrogen fixing trees; criteria of Agroforestry species; their compatibility and adaptability in different agro-ecological zones with special reference to salinity, drought, marshy and degraded lands of Bangladesh. | Visual presentation | answer |
| • Describe the various tree-crop interactions in agroforestry system.<br>• Evaluate the interaction factors on which agroforestry production depends. | **Tree-crop Interactions:** Concept and types of tree-crop interactions; various interactions (above and below ground) between trees and crops for light, temperature, air, water and nutrients. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Know the homestead agroforestry.<br>• Express the principles, planning and layout of homestead agroforestry.<br>• Explain homestead microsites, their composition and productivity.<br>• Describe the prospect and role of homestead agroforestry in Bangladesh. | **Homestead Agroforestry:** Definition of homestead Agroforestry; types and structure of homestead based on ecological region of Bangladesh; principals, planning and layout of homestead agroforestry; homestead micro sites, their composition and productivity; role of owners in homestead utilization; planning of homestead agroforestry having one bigha land. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Learn the various agroforestry system and practices commonly found in Bangladesh.<br>• Elucidate agroforestry system management. | **Agroforestry System Management:** Definition of Agroforestry systems and practices; various agroforestry practices commonly found in Bangladesh; regeneration techniques of agroforestry | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Describe regeneration of Agroforestry species and nursery management techniques. | species and nursery management; management of trees and other components. | | |
| • Discuss the concept of social forestry.<br>• Describe the problems and constrains of social forestry in Bangladesh.<br>• Explain the role of social forestry in climate change.<br>• Discuss the social forestry acts of Bangladesh.<br>• Illustrate the concept of social forestry in different countries. | **Social Forestry:** Concept, basic characteristics and objectives of social forestry; problems and constrains of social forestry practices; social forestry act; role of social forestry in climate change; social forestry in different countries. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the latest research findings and information of Agroforestry. | Latest research findings and information regarding Agroforestry | Assignment | Report |

**Reference Books:**


1. Young. 1997. Agroforestry for Soil Management. CAB International, New York, and ICRAF, Nairobi, Kenya, ISBN: 0-85199-189-0.
2. L.E. Buck, J.P. Lassoie and E.C.M. Fernandes. 1999. Agroforestry in Sustainable Agricultural Systems. CRC Press LLC, New York, NY ISBN: 1-56670-294-1.
3. P.K.R. Nair, 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, Netherlands, ISBN: 0-7923-2134-0.
4. P. Huxley. 1999. Tropical Agroforestry. Blackwell Science, Oxford, UK, http://www.blackwell-science.com ISBN: 0-632-04047-5.
5. G. Schroth, G.A.B. da Fonseca, C.A. Harvey, C. Gascon, H.L. Vasconcelos, and A-M.N. Izac. 2004. Agroforestry and Biodiversity Conservation in Tropical Landscapes. Island Press, Washington, DC. ISBN: 1-55963-357-3.
6. A.P. Dwivedi. 1992. Agroforestry Principal and Practices. Oxford and IBH publishing co. pvt. Ltd., New Delhi.
7. A.P. Wojtkowski, (1998). The theory and practices of Agroforestry design. Oxford and IBH publishing co. pvt. Ltd., New Delhi.
8. M.K. Alam, and M. Mohiuddin. 1992. Some potential multipurpose trees for homestead in Bangladesh. BARC Winrock International.
9. A.A. Bhuiya. 1994. Forest Land Agroforestry: The North Bengal Experience. BARC Winrock International.
10. M.K. Chowdhury and B.S. TejMahat. 1993. Agroforestry farming system linkage in Bangladesh. BARC Winrock International.
11. E. Toquebiau 1990. Agroforestry concept. ICRAF, Nairobi.

| **Course Code: AFES 260**<br>**Course Title: Agroforestry (Practical)** | **Credit Hours: 02** | **Level: 02** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge in relation to the application of agroforestry practices in the field level. | | | |
| **Course Objectives:**<br>• Identify different multipurpose trees and shrubs used in agroforestry<br>• Achieve some practical field experience<br>• Practice on some agroforestry management practices | | | |
| **Intended Learning Outcomes (ILOs)**<br><br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Identify different MPTs.<br>• Describe different MPTs. | Identification of MPTs (multipurpose trees) and their importance in agroforestry | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva voce<br>Practical notebook |
| • Learn the silvan feature of different MPTs.<br>• Represent the geographical distribution of Important MPTs. | Study on silvan features of different MPTs | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva voce<br>Practical notebook |
| • Learn the root management technique by field observation.<br>• Apply root pruning in the crop field. | Study on root pruning of trees grown in agroforestry system | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Report<br>Viva voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| • Know the different shoot management techniques.<br>• Apply pollarding, coppicing, lopping etc. in the crop field. | Study on tree shoot management grown in crop field | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva voce<br>Practical notebook |
| • Demonstrate the nursery establishment techniques.<br>• Establish nursery. | Preparation of nursery for raising seedlings/saplings of different trees | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva voce<br>Practical notebook |
| • Practice various plantation techniques.<br>• Learn the post plantation management | Study of tree plantation techniques and after care. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva voce<br>Practical notebook |
| • Estimate the biomass of trees. | Determination of biomass of trees and other components. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Identification<br>Viva voce<br>Practical notebook |
| • Gather practical knowledge about the bio-diversified areas of Bangladesh and preparation of report. | Field visit to different bio-diversified area / natural resource of Bangladesh and preparation of reports individually. | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Identification<br>Viva voce<br>Practical notebook |

Reference Books:


1. L.E. Buck, J.P. Lassoie, and E.C.M. Fernandes. 1999. Agroforestry in Sustainable Agricultural Systems. CRC Press LLC, New York, NY ISBN: 1-56670-294-1.
2. A.P. Dwivedi. 1992. Agroforestry Principal and Practices. Oxford and IBH publishing co. pvt. Ltd., New Delhi.
3. P.K.R. Nair. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands, ISBN: 0-7923-2134-0.
4. G. Schroth, G.A.B. da Fonseca, C.A. Harvey, C. Gascon, H.L. Vasconcelos, and A-M.N. Izac 2004. Agroforestry and Biodiversity Conservation in Tropical Landscapes. Island Press, Washington, DC. ISBN: 1-55963-357-3.
5. Young. 1997. Agroforestry for Soil Management. CAB International, New York, and ICRAF, Nairobi, Kenya, ISBN: 0-85199-189-0.
6. M.K. Alam, and M. Mohiuddin. 1992. Some potential multipurpose trees for homestead in Bangladesh. BARC Winrock International.
7. A.A. Bhuiya. 1994. Forest Land Agroforestry: The North Bengal Experience. BARC Winrock International.
8. M.K. Chowdhury. and B.S. TejMahat 1993. Agroforestry farming system linkage in Bangladesh. BARC Winrock International.
9. E. Toquebiau. 1990. Agroforestry concept. ICRAF, Nairobi.
10. A.P. Wojtkowski. 1998. The theory and practices of Agroforestry design. Oxford and IBH publishing co. pvt. Ltd., New Delhi.

| **Course Code: AFES 335**<br>**Course Title: Issues of Environment and Conservation (Theory)** | **Credit Hours: 02** | **Level: 3** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to acquire knowledge on environment and conservation in relation to climate change. | | | |
| **Course Objectives:**<br>• Know the climate change issues.<br>• Understand the causes of different types of environmental pollution and their prevention measures.<br>• Discuss on ecosystem and biodiversity conservation. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Know the concept of environment and conservation.<br>• Learn about the consequence of various environmental issues.<br>• Describe different environmental layers and their characteristics. | **Introduction:** Definition and concept of environment and conservation. Various environmental layers, their characteristics and role. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Show various important biogeochemical cycles.<br>• Learn the effects of biogeochemical cycles on global environmental changes. | **Important biogeochemical and their sources and cycles:** Carbon, Nitrogen, Sulphur, black carbon, particulate matter; their implication for global environmental changes. | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the concept of different types of environmental pollution.<br>• Illustrate the solid waste management techniques.<br>• Explain the control measures of various pollution. | **Environmental pollution:** Definition, causes, effects and control measures of air pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards; solid waste (causes, effects & control measures of urban and industrial wastes). | Lecture<br>Interactive discussion<br>Visual presentation<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

| | | | |
|---|---|---|---|
| • Know about structure and functions of ecosystem.<br>• Describe the different types of ecosystem.<br>• Explain the energy flow in various ecosystem | **Ecosystem:** Concept, structure and functions of an ecosystem; producers, consumers and decomposers, Energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. | Lecture<br>Multimedia presentation<br>Interactive discussion, | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Know the various issues of climate change.<br>• Describe the impact of climate change on agriculture.<br>• Explain the causes of ozone layer depletion and its harmful effect. | **Climate change and environmental issues:** Definition of weather, climate and climate change, greenhouse gases, their impact and projection of future emissions; global warming, acid rain, ozone layer depletion and their implication on agriculture. | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the concept of biodiversity and it's classification.<br>• Discuss the role of biodiversity on agricultural development.<br>• Explain the role of biodiversity in environmental conservation. | **Biodiversity and its conservation:** Introduction and definition of genetic, species & ecosystem diversity; biogeographical classification of Bangladesh; value of biodiversity; biodiversity at global, national and local levels; conservation of biodiversity, in-situ and ex-situ conservation of biodiversity. | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Gather knowledge about various national and international environmental laws, treaties and protocols.<br>• Explain earth summit and various issues of UNFCCC. | National and International Environmental Law, treaty, summit policy, summit and protocols: National and international environmental laws, treaties and protocols, earth summit/UNFCCC. | Lecture<br>Multimedia presentation<br>Interactive discussion | Quiz/MCQ<br>Short Answer<br>Essay type answer |
| • Describe the latest research findings and information about Issues of Environment and Conservation | Latest research findings and information regarding Issues of Environment and Conservation | Assignment | Report |

**Reference Books:**


1. B. B. Daniel, and A. K. Edward. 2007. Environmental science: Earth as a living planet. 6th edition, John wiley& Sons, INC.
2. R. W.Spencer. 2003. The Discovery of Global Warming.ISBN 0-674-03189-X.
3. B.Michael, R. T.Colin and L. H.John. 2006.Ecology: From Individuals to Ecosystems. ISBN 978-1-4051-1117-1.
4. *M. B.Paul and C. B.Linfield. 2004. Pollution Prevention and Control: Part II Material and Energy Balances. ISBN: 978-87-403-0773-3.*
5. *S.Terry. 2003. Introductory Climate Science. Global Warming Explained. ISBN: 978-87-403-1408-3.*
6. *M.Mark. 2005.Global Warming: A Very Short Introduction. Oxford University Press, USA.*
7. J.H. Chang, 1971. Climate and Agriculture. Aldine Pub. Co. Chicago.
8. C.J. Wiesner, 1970. Climate, Irrigation and Agriculture. Angus and Robertson Sydney.
9. I.J. Jackson, 1977. Climate, Weather and Agriculture in the tropics. ELBS and Longman, London.
10. N.J. Rogenberg, B.L Blad, and S.B. Verma. 1983. Microclimate: The Biological Environment. John Wiley & Sons. New York.

# Department of Agronomy

## Course Layout

| Sl. No. | Course Code and Course Title | Credit Hours | Level | Semester |
|---|---|---|---|---|
| 1 | AGRO 101: Fundamentals of Agronomy (Theory) | 02 | 1 | I |
| 2 | AGRO 102: Fundamentals of Agronomy (Practical) | 02 | 1 | I |
| 3 | AGRO 231: Sustainable Agriculture (Theory- Elective) | 02 | 2 | I |
| 4 | AGRO 251: Seed Science and Technology (Theory) | 02 | 2 | II |
| 5 | AGRO 252: Seed Science and Technology (Practical) | 02 | 2 | II |
| 6 | AGRO 351: Weed Science (Theory) | 02 | 3 | II |
| 7 | AGRO 352: Weed Science (Practical) | 02 | 3 | II |
| 8 | AGRO 401: Crop Production Technology (Theory) | 03 | 4 | I |
| 9 | AGRO 402: Crop Production Technology (Practical) | 02 | 4 | I |
| 10 | AGRO 451: Farm and Farming System (Theory) | 02 | 4 | II |
| 11 | AGRO 452: Farm and Farming System (Practical) | 02 | 4 | II |
| | Theory | 11 | | |
| | Practical | 10 | | |
| | Elective | 02 | | |
| | **Total** | **23** | | |

| **Course Code: AGRO 101**<br>**Course Title : Fundamentals of Agronomy (Theory)** | **Credit Hours: 02** | **Level: 1** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide fundamental concepts of agronomy and different agronomical practices involved in crop production. | | | |
| **Course Objectives:**<br>• Conceptualize Agriculture & Agronomy<br>• Acquire knowledge on weather & climate, agro-ecological zones and distribution of crops therein<br>• Understand plant nutrients and their management<br>• Acquaint with crop production practices. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Define agronomy & crops<br>• Classify & identify crops<br>• Describe scope and basic principles of agronomy | **Concept of Agronomy-** Definition, evolution and importance of agriculture, scope and basic principles of agronomy. Classification of agronomic crops | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define weather and climate, macro and micro climate.<br>• Evaluate different environmental parameters.<br>• Explain the impacts of weather components on different crop production. | **Agro-meteorology-** Definition, macro and micro climate, weather elements - their effects on crop production. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and classify tillage operation, tillage systems and classification.<br>• Explain the effective application of tillage for improvement of crop yield. | **Tillage-** Definition, advantages and disadvantages, classification, types, tilth & plough pan | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Compare different cropping seasons in relation to weather.<br>• Describe cropping seasons and its impacts on crop production and distribution | **Cropping seasons-** Types, characteristics and Influence | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Gather knowledge on different intercultural operations.<br>• Minimize yield loss & boost up crop production . | **Intercultural operations-** Definition, objectives, types, advantages and disadvantages. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Apply judicious management of irrigation water in relation to crop production.<br>• Explain the importance of drainage on crop production. | **Irrigation and Drainage-** Definition, objectives and methods with their advantages and disadvantages. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss plant nutrient elements & fertilizers<br>• Justify balanced fertilization in crop production | **Crop Nutrition and Fertilizer Management-** Concept, classification, principles, application methods, advantages and disadvantages, balanced fertilization. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain organic matter, its importance and present status<br>• Know the role of organic matter in soil health improvement.<br>• Describe causes of organic matter depletion and improvement | **Organic matter management-** Concept, importance and present status, organic matter depletion and its improvement | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Attain latest research findings and information regarding agro-meteorology, irrigation and drainage, crop nutrition and fertilizer management and organic matter management. | Latest research findings and information regarding agro-meteorology, irrigation and drainage, crop nutrition and fertilizer management and organic matter management. | Assignment | Report |

| **Course Code: AGRO 102**<br>**Course Title : Fundamentals of Agronomy (Practical)** | **Credit Hours: 02** | **Level: 1** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course provides practical knowledge on crops, manures &fertilizers, farm implements, weather instruments and crop raising | | | |
| **Course Objectives:**<br>• Gather basic knowledge on crops, farm implements, manures & fertilizers<br>• Practice organic manure preparation<br>• Practice different operations<br>• Crop raising | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Identify, classify and describe different field crops, manures, fertilizers<br>• Familiar with agricultural implements & agro-meteorological instruments | Concept, identification, classification of field crops, manures, fertilizers, farm implements & agro-meteorological instruments | Lecture<br>Visual presentation<br>Field visit<br>Discussion<br>Assignment<br>Field work | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook<br>Herbarium |
| • Explain trend of weather components. | Weather components<br>Visit to meteorological and Agricultural research stations. | Lecture<br>Multimedia presentation<br>Field visit<br>Discussion<br>Assignment | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook |
| • Prepare and present weather data by different graphs | Preparation & presentation of graphs using weather data | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Assignment | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook |
| • Determine optimum moisture status of soil<br>• Exercise ploughing operation | Determination of Soil 'joe' condition<br>Practice ploughing and laddering. | Lecture<br>Visual presentation<br>Demonstration<br>Exercise | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration |

| | | | |
|---|---|---|---|
| | | Discussion<br>Assignment<br>Field work | performance<br>Report<br>Practical notebook |
| • Gather knowledge about crop raising<br><br>• Practice agronomic operations for crop production | Cultivation of crops<br>Practicing weeding, thinning, mulching, top-dressing and rouging | Lecture<br>Visual presentation<br>Demonstration<br>Discussion<br>Assignment<br>Field work | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook |
| • Apply and understand the effect of fertilizers on crop. | Study the effect & observation plant nutrients on crops. | Lecture<br>Visual presentation<br>Field visit<br>Discussion<br>Assignment<br>Field work | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook |
| • Apply different methods and time of application of fertilizer in crops. | Different application methods of fertilizer | Lecture<br>Visual presentation<br>Field visit<br>Discussion<br>Assignment<br>Field work | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook |
| • Prepare and preserve compost and farm yard manure. | Preparation and preservation of compost and farm yard manure- | Lecture<br>Visual presentation<br>Field visit<br>Discussion<br>Assignment<br>Field work | Quiz/MCQ<br>Identification<br>Short answer<br>Viva voce<br>Demonstration performance<br>Report<br>Practical notebook |

**Reference Books:**


1. N. R. Das, 2009. Practical Manual on Basic Agronomy. Scientific Publishers.
2. Handbook of Agriculture, ICAR Publication
3. G. C. De, 1997. Fundamentals of Agronomy. Oxford & IBH Publishing Company Private, Limited.
4. S.C. Panda, 2014. Agronomy, AGROBIOS Publication, New Delhi, India.

| **Course Code: AGRO 231**<br>**Course Title: Sustainable Agriculture (Theory-Elective)** | **Credit Hours: 02** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course comprises sustainable agriculture, organic farming, intercropping, soil fertility, rainfed farming, coastal farming and hill farming. | | | |
| **Course Objectives:**<br>• Acquaint with sustainable agriculture and organic farming<br>• Provide knowledge on intercropping and multiple cropping<br>• Provide knowledge on soil fertility<br>• Acquaint with rainfed farming, coastal farming and hill farming. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Define sustainable agriculture and related other terms<br>• Explain biodiversity, sustainable farming and its management<br>• Describe the environmental complications-ecology<br>• Explain different ecological factors<br>• Elucidate environmental problems and its management | **Sustainable agriculture-** Concepts and constraints, resource management, biodiversity and sustainability of farming system, environmental complications, macro and micro-environment | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe organic farming and its management.<br>• Gain knowledge on Integrated Plant Nutrient System (IPNS) | **Organic farming-** Concept, objectives and importance, bio-fertilizer, Integrated Plant Nutrient System (IPNS) | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the issues of multiple cropping.<br>• Discuss the plant interaction in multiple cropping. | **Multiple cropping -** Interference, interactions , mutualisms, species combinations-principles and practices. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe and explain intercropping systems. | **Intercropping-** Intercropping systems, intercropping cereals with cereals, legumes with cereals, multicrop intercropping. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Learn about intercropping managements.<br>• Describe the cultural management techniques<br>• Discuss the soil fertility management . | **Cultural management - T**illage, weed control. planting dates, planting pattern | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| | **Fertility management- F**ertilizer recommendation based on cropping systems and cropping patterns | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Conceptualize rainfed farming and its managements. | **Rainfed farming-** Concept, distribution, ecological characteristics, management practices | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Acquire knowledge on coastal farming and its managements. | **Coastal farming-** Concept, characteristics,, scope agronomic management | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Gain knowledge on hill farming and its managements.<br>• Describe future prospect of hill farming. | **Hill farming-** concept, ecological characteristics. present status and prospects. appropriate management | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Obtain latest research findings and information regarding organic farming, rainfed farming, hill and coastal farming. | Latest research findings and information regarding organic farming, rainfed farming, hill and coastal farming, | Assignment | Report |

**Reference Books:**


1. A.K. Sharma, 2006. A hand book of organic farming. Agrobios, India.
2. A.K. Dahama, 2008. Organic farming (2nd ed.). Agrobios, Jodhpur, India.
3. H. Panda, and D. Hota, 2009. Biofertilizer and organic farming (2nd ed.) Genet-Tech Books, New Delhi-110 002.
4. L. Rahman, 2012. Sustainable agriculture for national food security, RDF Research Development Foundation. Dhaka.
5. S.S. Purahit, and D. Gehiot, 2006. Organic farming in indi, Agrobios, Jodhpur, India.
6. U. Thapa, and P. Tripathy, 2013. Organic farming in India (2nd ed.), Agrotech. Publishing Academy. Udaipur, India.

| **Course Code: AGRO 251**<br>**Course Title : Seed Science and Technology (Theory)** | **Credit Hours: 02** | **Level: 2** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide fundamental aspects of seed and technology, seed quality, seed production, seed processing & preservation and seed legislation | | | |
| **Course Objectives:**<br>• Provide basic concept on seed and seed technology<br>• Acquire knowledge about seed quality<br>• Learn about seed production and processing<br>• Provide knowledge about seed legislation | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Acquire knowledge about seed.<br>• Learn about the aspect of seed technology.<br>• Explain seed formation and development process. | **Seed and seed technology-** Definition, importance, classification, structure, seed formation, seed development | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain and describe seed quality.<br>• Explain quality determining parameters of seed. | **Seed quality-** Importance, characteristics ,factors, seed sampling, determination of purity, moisture, dormancy, germination, viability, vigor. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe seed treatment, its importance and seed treating chemicals<br>• Acquire knowledge about the seed treating equipments and their functions | **Seed treatment-** Concept, objectives, types and methods, seed treatment on storage, germination and seedling establishment, seed treating chemicals and equipments | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Determine of seed rate of crops.<br>• Describe the factors of determining seed rate | **Seed rate-** Definition, ,objectives, factors, seed rate determination | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Gain knowledge on principles of seed production.<br>• Describe production technology of hybrid and composite seeds of cros.<br>• Explain the demand and supply of seeds | **Seed production-** Basic principles, seed production of major agronomic crops, hybrid seed production, seed ecology, seed dispersion, present status of seed production, demand and supply of seeds | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Discuss seed processing activities<br><br>• State the storage procedure of seed.<br><br>• Describe the factors affecting seed longevity and deterioration | **Seed processing and seed storage-** Concept, principles, importance, types, factors safe storage conditions , seed longevity and deterioration | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe seed legislation and explain seed certification.<br>• Discuss the role of National Seed Board and Seed Certification Agency | **Seed legislation -** Definition, objectives. Seed quality class, seed certification procedure, role of national seed board and seed certification agency | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Attain latest research findings and information regarding seed science, seed technology and seed legislation. | Latest research findings and information regarding seed science, seed technology and seed legislation. | Assignment | Report |

**Reference Books:**


1. A. S.Barva. 2002. Seed Quality. CBS Publisher and Distributor, New Delhi. India.
2. B. K Bala. 1997. Drying and Storage of Cereal Grains. Science Publishers, Inc. USA.
3. L.O. Copeland. 2005. Principles of Seed Science and Technology (4th Ed.). Bargress Publishing Co. Minnesota, USA.
4. N. P. Nema. 1985. Principles of Seed Certification and Testing. Selied Publishers Limited, New Delhi.
5. R. L. Agrawal. 1995. Seed Technology. Oxford & IBH Publishing Company Pvt. Limited New Delhi.
6. Seed Certification Agency. 1976. Seed Certification Manual. Ministry of Agriculture, Govt. of the People's Republic of Bangladesh.

| **Course Code: AGRO 252**<br>**Course Title : Seed Science and Technology (Practical)** | **Credit Hours: 02** | **Level: 2** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge on seed, seed testing, seed production and processing | | | |
| **Course Objectives:**<br>• Provide practical knowledge on seed and seed testing<br>• Acquaint with seed production and processing | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Identify and collect seeds & prepare seed album. | Identification & collection of seeds<br>Preparation of seed album | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Laboratory work<br>Assignment | Quiz/MCQ<br>Short answer<br>Identification<br>Job<br>Viva- voce<br>Report<br>Seed album<br>Practical notebook<br>Viva -voce |
| • Use and evaluate seed technological equipments. | Study on seed technological equipment. | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Laboratory work<br>Assignment | Quiz/MCQ<br>Short answer<br>Identification<br>Report<br>Demonstration performance<br>Practical notebook<br>Viva- voce |
| • Describe and differentiate morphological parts of seed. | Study the structure of monocotyledonous and dicotyledonous seeds. | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Laboratory work<br>Assignment | Quiz/MCQ<br>Short answer<br>Identification<br>Job<br>Report<br>Demonstration performance<br>Practical notebook<br>Viva- voce |

| | | | |
|---|---|---|---|
| • Practice seed sampling, testing and grading. | Technique of seed sampling.<br>Testing of seed for purity, moisture, germination, viability and vigor. | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Laboratory work<br>Assignment | Quiz/MCQ<br>Short answer<br>Identification<br>Report<br>Demonstration<br>Performance<br>Practical notebook<br>Viva- voce |
| • Gather knowledge and calculate seed rate of different crops. | Calculation of seed rate of different crops: True seed and vegetative propagated seed. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Job<br>Calculation<br>Report<br>Viva- voce<br>Practical notebook |
| • Cultivate quality seed | Production of seed crops in individual plots. | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Assignment<br>Field work | Quiz/MCQ<br>Short answer<br>Report<br>Demonstration<br>Performance<br>Practical notebook<br>Viva -voce |
| • Acquire practical knowledge on the activities of GOs and NGOs related to seed production and processing. | Visit to a seed production farm and report preparation. | Lecture<br>Visual presentation<br>Discussion<br>Farm visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Job<br>Report<br>Practical notebook<br>Viva- voce |

**Reference Books:**


1. R.L. Agrawal, 1995. Seed Technology. Oxford & IBH Publishing Company Pvt. Limited New Delhi.
2. L.O. Copeland, 2005. Principles of Seed Science and Technology (4th Ed.). Bargress Publishing Co. Minnesota, USA.
3. N.P. Nema, 1985. Principles of Seed Certification and Testing. Selied Publishers Limited, New Delhi.
4. Seed Certification Agency. 1976. Seed Certification Manual. Ministry of Agriculture, Govt. of the People's Republic of Bangladesh.
5. USDA. 1961. Seeds. The Yearbook of Agriculture 1961. The United States Department of Agriculture, Washington, D.C.
6. International Seed Testing Association (IST A). 1976. International Rules for seed testing. Seed Science and Technology. Vol 4. P. 3-49.
7. M. N. Huda, 2001. Why quality seed. Dr. Richard Lowrynowicz, Team leader, Bangladesh German Seed Development Project, Dhaka, Bangladesh.
8. O.L. Justice, and L.N. Bass, 1978. Principles and Practices of Seed Storage. Agricultural Hand Book No. 506.
9. Seed Certification Agency. 1992. Proceedings of National seed Technology Seminar. MOA. Govt. of the Peoples Republic of Bangladesh.

| **Course Code: AGRO 351**<br>**Course Title : Weed Science (Theory)** | **Credit Hours: 02** | **Level: 3** | **Semester: II** |
|---|---|---|---|
| **Rationale:** Enables students with an appreciation of weed science and management as it correlates with agricultural production and losses in modern agricultural systems. | | | |
| **Course Objectives:**<br>• To equip students with a broad understanding on weed science in managing modern agriculture | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Develop a basic understanding of the principles of weed science.<br>• Explain the importance of weed biology and ecology in relation to the components of integrated weed management systems.<br>• | **Introduction to Weed-** Definition, characteristics and classification. Harmful and beneficial effects of weed. Brief accounts of weeds of Bangladesh with emphasis on the biology and ecology of major weeds. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Address the weed propagation, dispersal and persistence of weeds. | **Propagation and Persistence-** Propagation, dispersal and persistence of weeds. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Justify distribution of weeds in different ecological conditions and crop production practices. | **Distribution of Weeds-** Weed distribution in relation to soil, season, topography, crop and crop production practices. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Differentiate the weed management thresholds and the critical period for weed control and crop-weed interactions. | **Crop-Weed Competition-** Concept, critical period of crop-weed competition and factors affecting it. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Conceptualize allelopathy and its effect in crop production.<br>• Narrate the ecological principles that govern plant species, plant communities through allelopathy. | **Allelopathic Effects of Weeds-** Concept, allelopathic effects of weeds on crop and vice-versa. Some examples of weeds having allelopathic effects. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

| | | | |
|---|---|---|---|
| • Gain technical knowledge on weeds and their management options.<br>• Evaluate weed management options within ecological, economic, and social constraints and design effective integrated management systems for an organic farm. | **Weed Management-** Concept, principle of weed management, weed eradication, weed prevention and weed control. Cultural and biological methods of weed control with their advantages and disadvantages. Integrated Weed Management (IWM) - concepts and examples of some Integrated Weed Management with advantages and disadvantages. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Select and apply the main methods of weed control.<br>• Aware of the basics of herbicide use and safety.<br>• Explain the weed control measure using herbicide.<br>• Describe the fate of herbicide in soil, plant and environment.<br>• Select herbicide by considering different factors. | **Herbicidal Methods in Weed Management-** Concept and types of herbicide, herbicide formulation, mode of action of herbicide, herbicide selectivity and factors affecting it. Fate of herbicide in soil and plant. Herbicidal weed control in major crops viz., rice, jute, wheat, cotton and sugarcane. Toxic symptoms of herbicide on soil and crop. Effects of herbicide on environment. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Obtain latest research findings and information regarding weed science and integrated weed management. | Latest research findings and information regarding weed science and integrated weed management. | Assignment | Report |

**Reference Books:**


1. R. A. Hence, and K. Holly, 1990. Weed Control Handbook: Principles, 8th Edition by Blackwell Scientific Publications.
2. M. A. Ross, and C. A. Lembi, 1999. Applied Weed Science: 2nd Edition, Prentice Hall.
3. R. J. Aldrich, and R.J. Kremer, 1997. Principles in Weed Management, Iowa State University Press
4. P.J. Terry 1984. A guide to weed control in East African crops Kenya Literature Bureau

| **Course Code: AGRO 352**<br>**Course Title : Weed Science (Practical)** | **Credit Hours: 02** | **Level: 3** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This is a foundation course in agriculture dealing with practical knowledge on weed management | | | |
| **Course Objectives:**<br>• To acquaint the students with identification and effective management systems of weeds | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Identify weeds, weeding implements and collect weeds. | Identification of weed, weed seed/ propagules and weeding implements. | Lecture<br>Visual presentation<br>Discussion<br>Field work | Quiz/MCQ<br>Short answer<br>Job Performance test<br>Viva voce<br>Practical notebook |
| • Collect weeds and prepare weed herbarium. | Preparation of weed herbarium. | Lecture<br>Visual presentation<br>Discussion<br>Field work<br>Assignment | Quiz/MCQ<br>Short answer<br>Job<br>Report<br>Viva voce<br>Practical notebook<br>Weed herbarium |
| • Develop skills in preparing a weed herbarium of plant community. | Study of life cycle and morphology of major weeds. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Job<br>Report<br>Viva voce<br>Practical notebook |
| • Identify different herbicides and their characteristics. | Study on identification of herbicides and their physical characteristics. | Lecture<br>Visual presentation<br>Discussion<br>Laboratory work<br>Assignment | Quiz/MCQ<br>Short answer<br>Identification<br>Report<br>Viva voce<br>Practical notebook |
| • Exercise the calibration of field sprayer. | Calibration of a sprayer. | Lecture<br>Visual presentation<br>Discussion<br>Field work | Quiz/MCQ<br>Short answer<br>Job<br>Report |

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|---|---|---|---|
| | | Exercise<br>Assignment | Viva voce<br>Practical notebook |
| • Determine the requirement of herbicide for crop field application. | Herbicide calculation. | Lecture<br>Visual presentation<br>Discussion<br>Exercise | Quiz/MCQ<br>Short answer<br>Calculation<br>Viva voce<br>Practical notebook |
| • Apply different types of herbicides in crop field.<br><br>• Describe the effects of herbicide in crop production. | Application of non-selective, pre-emergence and post-emergence herbicides in crop field to study their effects on crop and soil. | Lecture<br>Visual presentation<br>Discussion<br>Field work<br>Assignment | Quiz/MCQ<br>Short answer<br>Demonstration herbicide application<br>Report<br>Viva voce<br>Practical notebook |
| • Initialize and apply integrated weed management. | Practicing integrated weed management and to study its performance. | Lecture<br>Visual presentation<br>Discussion<br>Assignment<br>Field work | Quiz/MCQ<br>Short answer<br>Demonstration integrated weed management<br>Report<br>Viva voce<br>Practical notebook |

**Reference Books:**


1. R. A. Hence, and K. Holly, 1990. Weed Control Handbook: Principles, 8th Edition by Blackwell Scientific Publications.
2. M. A. Ross, and C. A. Lembi, 1999. Applied Weed Science: 2nd Edition, Prentice Hall.
3. R. J. Aldrich, and R. J. Kremer, 1997. Principles in Weed Management, Iowa State University Press
4. P.J. Terry 1984. A guide to weed control in East African crops Kenya Literature Bureau

| Course Code: AGRO 401<br>Course Title : Crop Production Technology (Theory) | Credit Hours: 03 | Level: 4 | Semester : I |
|---|---|---|---|

**Rationale:** The maximum yield productivity of the field crops can be achieved only growing the crops using optimum production technologies. Appropriate management technologies assure favourable physiological phenomena to the crop plants needed for higher yields.

**Course Objectives:**

- To make students familiar with appropriate production technologies of different field crops for obtaining maximum yield.
- To teach students how physiological phenomena of crop plants respond to the used production technologies.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Gain knowledge on crop growth, development and yield.<br>• Describe the phenomena of crop plants suitable for achieving the highest productivity.<br>• Explain the factors affecting growth, developments and yield of crops. | **Crop Growth, Development and Yield-** Concepts of crop growth, development and yield. Phases and stages of growth, factors affecting growth, developments and yield. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the production technologies of field crops are.<br>• Describe about post harvest practices of crops.<br>• Calculate the cost of production of field crops. | **Production Technology of Different field Crops-** Origin, climate and soil requirements, characteristics of species and cultivars, cultivation practices, post-harvest operations, quality control and cost of production of the following crops. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain optimum crop production technologies of different cereal crops. | **Cereal Crops-** Rice, Wheat, Maize and Barley. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Enumerate about the production technologies of different pulse crops. | **Pulse Crops-** Lentil, Mungbean, Grasspea, Pea, Chickpea, Pigeonpea, Blackgram and | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type |

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|---|---|---|---|
| | cowpea. | Discussion<br>Assignment | answer<br>Report |
| • Describe the production technologies of different oilseed crops. | **Oilseed Crops-** Rapeseed and Mustard, Soybean, Groundnut, Sesame, Niger, Sunflower, Safflower, Linseed and Castor. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Discuss the production technologies of different fiber crops. | **Fiber Crops-** Jute, Cotton, Sunhemp, Mesta and Kenaf. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the production technologies of different sugar crops. | **Sugar Crops-** Sugarcane and Sugarbeet. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type<br>Report |
| • Narrate production technologies of different beverage crops. | **Beverage Crops-** Tea, Coffee and Cocoa. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the production technologies of different narcotic crops. | **Narcotic Crops-** Tobacco. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the production technologies of different minor cereal crops. | **Minor Cereals-** Foxtail millet, Proso millet, Finger millet and pearl millet. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Elucidate the suitable production technologies of different fodder crops. | **Fodder Crops-** Maize, Sorghum, Cowpea, Napier and Para grass. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Acquire latest research findings and information regarding production package of agronomic crops and integrated water management. | Latest research findings and information regarding production package of agronomic crops and integrated water management. | Assignment | Report |

**Reference Books:**


1. A.C. Pant, 2010. Production and processing of Oilseed. Oxford Book Co. New Delhi, India.
2. C. S. Wayene, and H. D. Robert 2002. Rice: Origin, History, Technology and Production. John Willey & Sons.
3. P.C. Das, 2012. Jute Production Technology. WSIC. EBook. Ltd. India.
4. J. N. Wintgent, Coffee: Growing, Processing, Sustainable Production. Willey VCH.
5. P.S. Rathore, 2000. Technologies and Management of Field Crop Production. Agrobios (India).
6. Tobacco. 1999. Production, Chemistry and Technology. Willey-Blackwell.
7. Z. D. Plesis, 2003. Maize Production. Department of Agriculture, Republic of South Africa.
8. C. Thakur, 1971. Scientific crop production. Bhagalpur University Press.
9. D. K. Majumder, 2011. Pulse Crop Production: Principles and practices. PHI. Learning Pvt. Ltd. India.
10. BARI. 1982. Wheat Production Manual.Bangladesh Agricultural Research Institute, Joydebpur, Gazipur.
11. V.E. Hansen, O. W. Israelson and G.E. Stringham, 1980. Irrigation Principles and Practices. Hohn Willey & N.Y. Sons.
12. G.R Squire, (1993). The Physiology of Tropical Crop Production. CAB International. U.K.
13. P.R. Goldsworthy, and N. Fisher, U.S. Gupta, 1975. Pysiological Apects of Dryland Farming.
14. F. P. Gardner, R.B. Pearce, and R. L. Mitchell, 1985. Physiology of Crop Plants. The Iowa State University Press. U.S.A.
15. M.S. Prasad, Y. V. R. Reddy, Y. S. Ramakrishna, L. L. Somani, N. N. Reddy and B. M. K. Reddy, 2008. Maize Production Technology. Agrotech Publication.
16. CABI. 1997. Wheat Production and Utilization: Systems, Quality and Environment.

| **Course Code: AGRO 402**<br>**Course Title : Crop Production Technology (Practical)** | **Credit Hours: 02** | **Level: 4** | **Semester: I** |
|---|---|---|---|

**Rationale:** This course is designed about technology of different crop production. Moreover, students will be taught how to write a review paper focusing a science related problem in the field of Agriculture which will also prepare him/her to conduct research and writing research reports. Calculation of irrigation requirement of crop.

**Course Objectives:**

- Grow crops by the students in the plot assigned to him/her by the Course Instructor.
- Make review and write science articles related to current problem(s) in agriculture by the students.
- Make students able to compute cost of cultivation of different field crops to make growing crops profitable.
- Make students familiar with different growth stages of crops so as to match agronomic practices on proper time.
- Grow and incorporate a green manuring crops.
- Know the irrigation schedule for field crops.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Grow crops in the field. | Raising a crop in an individual plot. | Lecture<br>Visual presentation<br>Discussion<br>Field work<br>Assignment | Quiz/MCQ<br>Short answer<br>Demonstration crop raising<br>Viva voce<br>Report<br>Practical notebook<br>Performance test |
| • Review and write science articles related to current problem(s) in agriculture. | Preparation of a term paper. | Lecture<br>Visual presentation<br>Discussion<br>Assignment<br>Library work | Quiz/MCQ<br>Short answer<br>Viva voce<br>Term paper<br>Practical notebook |
| • Prepare and compare different seed bed for raising crop seedlings. | Preparation of seed beds for raising rice and tobacco seedlings. | Lecture<br>Visual presentation<br>Discussion<br>Field work | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |

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|---|---|---|---|
| • Prepare trench and knows how to place setts in the trenches for growing sugarcane. | Preparation of trenches and practicing different methods of sett placement for sugarcane production. | Lecture<br>Visual presentation<br>Discussion<br>Field work | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |
| • Compute costs of cultivation of different field crops. | Computation of production cost for different crops. | Lecture<br>Visual presentation<br>Discussion<br>Problem calculation<br>Field work<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Calculation<br>Report |
| • Illustrate different growth stages of field crops related to agronomic managements. | Identification of different growth stages of agronomic crops. | Lecture<br>Visual presentation<br>Discussion<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Report |
| • Cultivate and incorporate a green manuring crop. | Cultivation of green manuring crop and incorporation into the crop field. | Lecture<br>Visual presentation<br>Discussion<br>Field work | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |
| • Prepare an irrigation schedule for crops and calculate water requirements of crops. | Preparation of irrigation schedules for different field crops. | Lecture<br>Visual presentation,<br>Discussion Assignment<br>Field work<br>Exercise | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Calculation |

**Reference Books:**


1. A.C. Pant, 2010. Production and processing of Oilseed. Oxford Book Co. New Delhi, India.
2. C. S. Wayene, and H. D. Robert 2002. Rice: Origin, History, Technology and Production. John Willey & Sons.
3. P.C. Das, 2012. Jute Production Technology. WSIC. EBook. Ltd. India.
4. P. R. Goldsworthy, and N. M. Fisher, (Ed). 1974. The Physiology of Tropical Field Crops. John Willey and N.Y. Sons.
5. J. N. Wintgent, Coffee: Growing, Processing, Sustainable Production. Willey VCH.
6. P.S. Rathore, 2000. Technologies and Management of Field Crop Production. Agrobios (India).
7. Tobacco. 1999. Production, Chemistry and Technology. Willey-Blackwell.
8. Z. D. Plesis, 2003. Maize Production. Department of Agriculture, Republic of South Africa.
9. C. Thakur, 1971. Scientific crop production. Bhagalpur University Press.
10. D. K. Majumder, 2011. Pulse Crop Production: Principles and practices. PHI. Learning Pvt. Ltd. India.
11. BARI. 1982. Wheat Production Manual.Bangladesh Agricultural Research Institute, Joydebpur, Gazipur.
12. V.E. Hansen, O. W. Israelson and G.E. Stringham, 1980. Irrigation Principles and Practices. Hohn Willey & N.Y. Sons.
13. G.R Squire, (1993). The Physiology of Tropical Crop Production. CAB International. U.K.
14. P.R. Goldsworthy, and N. Fisher, U.S. Gupta, 1975. Pysiological Apects of Dryland Farming.
15. F. P. Gardner, R.B. Pearce, and R. L. Mitchell, 1985. Physiology of Crop Plants. The Iowa State University Press. U.S.A.
16. M.S. Prasad, Y. V. R. Reddy, Y. S. Ramakrishna, L. L. Somani, N. N. Reddy and B. M. K. Reddy, 2008. Maize Production Technology. Agrotech Publication.
17. CABI. 1997. Wheat Production and Utilization: Systems, Quality and Environment.
18. P. R. Goldsworthy, and N. M. Fisher, (Ed). 1974. The Physiology of Tropical Field Crops. John Willey and N.Y. Sons.

| **Course Code: AGRO 451**<br>**Course Title : Farm and Farming System (Theory)** | **Credit Hours: 02** | **Level: 4** | **Semester: II** |
|---|---|---|---|

**Rationale:** This course is based on land utilization, agricultural farm establishment, cropping system, farming system, integrated farming system, crop evaluation, forecasting and water management for crop production and stress agronomy.

**Course Objectives:**

- Explain the cultivation intensity and statistics of Bangladesh agricultural lands.
- Enrich knowledge on establishment of agricultural farm and its management.
- Prepare cropping scheme and crop calendar.
- Describe farming system, integrated farming system and cropping system.
- Forecast crop production from standing field crops.
- Explain the dynamics of water in crop production.
- Understand the effect of stress in crop production and its managements.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Explain different land categories and land utilization of Bangladesh.<br>• Gain knowledge on crop statistics and trend of crop production. | **Land use and Crop Statistics in Bangladesh-** Categories of land utilization, area, production and yield of major crops of Bangladesh and their general trend | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Acquire self-confident in planning, establishment of agricultural farm and its managements<br>• Discuss the farm budgeting and farm records. | **Farm Planning and Management-** Factors to be considered for establishment of a farm. Farm layout, farm budgeting, farm and land record keeping with purpose and description. Economic principles of farm management. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the importance of cropping scheme of farm and its preparation in advance. | **Cropping Scheme-** Concept, objectives, ability and preparation. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Illustrate the farming system of Bangladesh knowing the world ones. | **Farming System-** Concept, determinants, classification, components of farming | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type |

| | | | |
|---|---|---|---|
| • Explain farming system research and development (FSRD) in Bangladesh and future thrusts to be given to FSRD. | system, interaction between/ among components of farming system of Bangladesh. Farming system research and development (FSRD) in Bangladesh and future thrusts to be given to FSRD. | Assignment | answer<br>Report |
| • Conceptualize sustainable farming system and its management through integrated farming system. | **Integrated Farming System-** Concept, constraints, resources for sustainable agriculture, management for sustainable agriculture. Role of integrated farming for sustainable agriculture. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain cropping system with its cropping pattern, crop rotation, multiple cropping and crop diversification.<br><br>• Illuminate their importance, limitation and improvement.<br><br>• Acquire knowledge about present status and future strategies of crop diversification. | **Cropping System-** Concept and determinants<br>- Cropping: Objectives, types, advantages and disadvantages.<br>- Multiple Cropping pattern: concept, determinants, major cropping patterns of Bangladesh. Possible improvement of cropping patterns of Bangladesh.<br>- Crop rotation: Principles of crop rotation, advantages of crop rotation, crop rotation vs. continuous cropping. Planning of crop rotation.<br>- Crop diversification: Concept, importance, limitations, present status and future strategy in Bangladesh. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe different types of crop calendar in a farm with its necessity.<br><br>• Conceptualize the procedure of advance preparation of crop calendar. | **Crop Calendar-** Definition, objectives, utilities, types of crop calendar and procedure of their preparation. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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| • Evaluate the crop performance during growth, development in the field.<br><br>• Estimate crop yield for forecasting the crop production after crop cutting and finally crop report preparation. | **Crop Evaluation-** Crop reporting, crop cutting experiment, crop yield estimation and crop forecasting. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the importance of water in crop production and its use efficiency (WUE) by crop.<br><br>• Improve WUE through agronomic management with estimation of irrigation requirements. | **Water Management in crop production-** Water and irrigation requirements of different crops. Factors affecting water use efficiency. Agronomic means for increasing water use efficiency. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain stress as natural hazards with its types and effect on crops.<br><br>• Explain agronomic managements for reducing the effect of different types of stress on crop production. | **Stress Agronomy-** Definitions, importance and types. Effects of different types of stress on crops. Management of different stresses in crop production. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Obtain latest research findings and information regarding cropping system, farming system, multiple cropping and stress agronomy. | Latest research findings and information regarding cropping system, farming system, multiple cropping and stress agronomy. | Assignment | Report |

**Reference Books:**


1. B. W. Chaterjee, S. Maiti, and B. K. Mandal, 1989. Cropping System (Theory and Practical). Oxford & IBH Pub. Co. Pvt. Ltd. New Delhi.
2. S. S. Ranaand, M. C. Rana, 2011. Cropping System. Department of Agronomy, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India.
3. Prasad, N. K. 2014. Stress Agronomy.Daya publishing house, India.
4. R. D. Misra, and M. Ahmad, 1990. Manual of Irrigation Agronomy. Oxford and IBH Publishing Co. New Delhi, India.
5. K. Sharma, 2005. Hand Book of Agriculture. Indian Council of Agricultural Research. New Delhi, India.
6. B. Chandrasekaram, K. Annadurai, and E. Somasundaram, 2010. A TextBook of Agronomy. New Age International (P) Limited Publisher, New Delhi, India.
7. General land use pattern- Shodhganga Shodhganga.inflibnet.ac.in/bitstream/10603/4339/…/10_chapter%204.pd

| Course Code: AGRO 452<br>Course Title : Farm and Farming System (Practical) | Credit Hours: 02 | Level: 4 | Semester: II |
|---|---|---|---|

**Course Rationale:** This course is designed to disseminate practical knowledge on land utilization, farm and land records keeping, cropping scheme preparation, agricultural farm layout, crop calendar preparation, and crop cutting experiment, evaluation and reporting.

**Course Objectives:**

- Prepare different graphs on land utilization and crop statistics.
- Prepare project report.
- Maintain farm and land records.
- Prepare cropping scheme and crop calendar.
- Draw layout an agricultural farm.
- Conduct crop cutting experiment followed by reporting.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Define and classify different types of graphs<br>• Prepare table, graph pai chart with different data on land utilization and crop yield<br>• Explain the interpretation of land utilization. | Graphical representation of data pertaining to land utilization and crop statistics of Bangladesh. | Lecture<br>Visual presentation<br>Discussion<br>Exercise<br>Laboratory work | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |
| • Define Project paper, conduct experiment for agronomic studies of crop production.<br>• Prepare a project report. | Definition and components of Project paper, conduction of a simple experiment to study the effect of agronomic practices on crop production and prepare a project report. | Lecture<br>Visual presentation<br>Discussion<br>Assignment<br>Field work<br>Laboratory work | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Report |
| • Explain different farm and land records with their preparation and maintenance. | Study on farm and land records and their maintenance. | Lecture<br>Visual presentation<br>Discussion<br>Assignment<br>Visit farm office | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook |

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| • Discuss and prepare cropping scheme. | Preparation of cropping scheme. | Lecture<br>Visual presentation,<br>Discussion | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook |
| • Prepare and describe layout of agricultural farm. | Lay out of an agricultural farm. | lecture<br>Visual presentation,<br>Discussion | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |
| • Prepare and interpret crop calendar . | Preparation of Crop calendar and interpretation. | Lecture<br>Visual presentation,<br>Discussion<br>Exercise | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |
| • Conduct crop cutting experiment.<br>• Prepare and present a scientific report. | Conduction & preparation of Crop cutting experiment & crop reporting | Lecture<br>Visual presentation,<br>Discussion<br>Demonstration<br>Field work. | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook<br>Performance test |

**Reference Books:**


1. B. W. Chaterjee, S. Maiti, and B. K. Mandal, 1989. Cropping System (Theory and Practical). Oxford & IBH Pub. Co. Pvt. Ltd. New Delhi.
2. S. S. Rana, and M. C. Rana, 2011. Cropping System. Department of Agronomy, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, India.
3. N. K. Prasad, 2014. Stress Agronomy.Daya publishing house, India.
4. R. D. Misra, and M. Ahmad, 1990. Manual of Irrigation Agronomy. Oxford and IBH Publishing Co. New Delhi, India.
5. K. Sharma, 2005. Hand Book of Agriculture. Indian Council of Agricultural Research. New Delhi, India.
6. B. Chandrasekaram, , K. Annadurai, and E. Somasundaram, 2010. A TextBook of Agronomy. New Age International (P) Limited Publisher, New Delhi, India.
7. General land use pattern- Shodhganga
Shodhganga.inflibnet.ac.in/bitstream/10603/4339/…/10_chapter%204.pd

# Department of Biochemistry

## Course layout

| Sl. No. | Course Code & Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | BIOC 155, Chemistry of Biomolecules (Theory) | | 02 | 1 | II |
| 2 | BIOC 156, Chemistry of Biomolecules (Practical) | | 02 | 1 | II |
| 3 | BIOC 209, Intermediary Metabolism & Food Nutrition (Theory) | | 02 | 2 | I |
| 4 | BIOC 210, Intermediary Metabolism & Food Nutrition (Practical) | | 02 | 2 | I |
| | | Theory | 04 | | |
| | | Practical | 04 | | |
| | | Total | **08** | | |

| **Course Code: BIOC 155**<br>**Course Title : Chemistry of Biomolecules (Theory)** | **Credit Hours:02** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** The Course is designated to provide fundamental concepts of biomolecules and its analysis. | | | |
| **Course Objectives:**<br>● Conceptualize chemistry of biomolecules<br>● Acquire knowledge about the sources, structure and function of biomolucles<br>● Understand nutrients and their importance's for living organism | | | |
| **Intended Learning Outcomes (ILOs)**<br>The student will be able to – | **Course Content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| ● Describe and illustrate of different kind of carbohydrates in respect of definition, occurrence, classification, physical and chemical properties.<br>● Explain the nutritional value of carbohydrate. | **Carbohydrates:**<br>Occurrence, definition, classification, physical and chemical properties. Chemistry of carbohydrate monosaccharides, disaccharides and polysaccharide.<br>Composition- chemical linkages of disaccharide, oligosaccharide and polysaccharide with special reference to starch, glycogen, cellulose, inulin, chitin and cell wall polysaccharides. Nutritional aspect of carbohydrates | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| ● Classify different types of protein in respect of functions, physical chemical properties and structures.<br>● Demonstrate Amino acid composition of peptides.<br>● Explain the nutritional value of proteins and importance of amino acids | **Proteins:**<br>Definition, classification, functions, physical and chemical properties, structures. Amino acid composition of peptides and proteins. Hydrolysis of proteins, structures & reactions of amino acids as ampholytes. Isoelectric point, plant proteins - leaf, seed and cereal proteins. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ● Describe different types of lipid with their physical & chemical properties.<br>● Discuss the nutritional value of lipids and explain its importance. | **Lipids :**<br>Definition, classification, physical and chemical properties, Fatty acid composition of fats. Essential fatty acids, structures of lipids. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

| | | | |
|---|---|---|---|
| | Chemical reactions of fatty acids. Edible oils and their characteristic fatty acid composition. characterization of fats, oils and waxes. Phospholipids with special reference to lecithin and cephalin and sphingomyelin phospholipids and glycolipids as membrane components. | | |
| ● Discuss nucleic acid and their importance.<br>● Illustrate different types of nucleic acids.<br>● Explain importance of nucleic acids. | **Nucleic acids**:<br>Occurrence, composition, classification and structural features. Chemical and physical properties. Important functions of nucleic acids. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ● Illustrate the enzyme, enzyme activity and their regulation.<br>● Explain the importance of enzyme in Biochemical system. | **Enzymes:**<br>Definition, classification and chemical nature of enzymes. Concept of coenzymes and prosthetic groups. Mode of action of enzymes. Factors affecting enzymatic reaction. Enzyme specificity and inhibition with special reference to plant proteolytic enzymes. Concept of active entre. Principle of enzyme assay. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| ● Describe and classify vitamins and explain their deficiency symptom.<br>● Identify different defiency symptom and its importance on human biology. | **Vitamins:**<br>Definition, source, classification , biochemical functions and defiency symptoms and diseases. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| ● Classify and describe and plant hormone and explain its occurrence<br>● Explain the role of plant hormone in plant Biology. | **Plant Hormones:**<br>Classification and biochemical functions. Secondary Plant Compounds: Occurrence and Physiological action. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

| | | | |
|---|---|---|---|
| ● Classify and explain the role of glycosides, alkaloids and **i**soprenoids in plant biology. | a) Glycosides (b) Alkaloids (c) Isoprenoids. | | |
| Attain latest research findings and information regarding Chemistry of Biomolecules | Latest research findings and information regarding Carbohydrates, Proteins, Lipids, Nucleic acids, Enzymes and Plant Hormones | Assignment | Report |

**Reference Books:**


1. A. L. Lehnininger. 1982. Biochemistry, 2nd Edition, Kalyani Publishers, Lubiana, New Delhi,
2. J.L.Jain.2001. Fundamentals of Biochemistry, 5th Edition, published by Chand & Company Ltd. Ram Nagar, New Delhi, 110055.
3. Lubret stryer.1986. Biochemistry, Published by S.K. Jain for CBS Publishers and Distributors, 485, Jani Bhaban, Bholanath Nagar, Delhi, India.
4. M. Swaminathan.1992.Handbook of food and Nutrition.
5. N. M. Goodwin and Mercer. 2003. Introduction to Plant Biochemistry. 2nd CBS Publishers and Distributors. New Delhi, India.
6. R.L. Karet, Denniston, K.J. and Topping, J.J. 1997. Principles and Applications of Inorganic, Organic and Biological Chemistry. WCB, McGraw-Hill.
7. V.H. Kretovich, Nowarowski, T.Z. and Clarke, A.J. 1996. Principles of Plant Biochemistry. Pergamon Press. Oxford. London, New York. Paris.
8. E.S., West, W.R. Todd, S.M Mason, and J.T. Van Bruggen. 1967. Text Book of Biochemistry, Mcmilan Co. New York.
9. Plummer D.T. 1992. An Introduction to Practical Biochemistry. Tata Mcdraw-Hill Publishing Company Limited, New Delhi.

| **Course Code: BIOC 156**<br>**Course Title : Chemistry of Biomolecules (Practical)** | **Credit Hours:02** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** The Course is designated to provide fundamental concepts involved in biochemical analysis. | | | |
| **Course Objectives:**<br>● Conceptualize physical and chemical properties of biomolecules<br>● Acquire knowledge about the sources, structure and function of biomolecules<br>● Understand nutrients quality and their importance's for living organism | | | |

| **Intended Learning Outcomes (ILOs)**<br>The student will be able to – | **Course Content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| ● Acquire knowledge of buffer solution and pH.<br>● Estimate the conc. Of different buffer of soln. | Preparation of buffer solutions and determination of $p^{H}$. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| ● Explain importance of $p^{ka}$ value.<br>● Determine the pKa value for solution. | Determination of $p^{Ka}$ value | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| ● Identify different carbohydrate sample. | Colour tests of carbohydrates. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| ● Identify different protein sample. | Colour tests of proteins. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| ● Identify different fats and oil. | Preparation of esters and solubility tests for fats. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| ● Prepare starch and detect amylase activity | Preparation of starch and detection of amylase activity, | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| ● Describe the nature & function of vitamin C.<br>• Determine the amount of vitamin C in different fruit samples | Determination of vitamin C | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| ● Explain the knowledge of proximate analysis of fat, protein, crude fibre and ash.<br>• Analyze the Moisture, fat, protein, crude fibre in plant samples | Proximate analysis: Moisture, fat, protein, crude fibre and ash. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1. A. L. Lehnininger. 1982. Biochemistry, 2nd Edition, Kalyani Publishers, Lubiana, New Delhi,
2. J.L.Jain.2001. Fundamentals of Biochemistry, 5th Edition, published by Chand & Company Ltd. Ram Nagar, New Delhi, 110055.
3. Lubret stryer.1986. Biochemistry, Published by S.K. Jain for CBS Publishers and Distributors, 485, Jani Bhaban, Bholanath Nagar, Delhi, India, 1986.
4. M. Swaminathan.1992.Handbook of food and Nutrition.
5. R. J. Jayaramon. Practical Biochemistry, Delhi, India, 1986.
6 N. M. Goodwin and Mercer. 2003. Introduction to Plant Biochemistry. 2nd CBS Publishers and Distributors. New Delhi, India.
6. R.L. Karet, Denniston, K.J. and Topping, J.J. 1997. Principles and Applications of Inorganic, Organic and Biological Chemistry. WCB, McGraw-Hill.
7. V.H. Kretovich, Nowarowski, T.Z. and Clarke, A.J. 1996. Principles of Plant Biochemistry. Pergamon Press. Oxford. London, New York. Paris.
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9. Plummer D.T. 1992. An Introduction to Practical Biochemistry. Tata Mcdraw-Hill Publishing Company Limited, New Delhi.

| **Course Code: BIOC 209**<br>**Course Title : Intermediary Metabolism & Food Nutrition (Theory)** | **Credit Hours:02** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:** The Course is designated to provide fundamental concepts of metabolism and nutrition | | | |
| **Course Objectives:**<br>• Conceptualize metabolism of biomolecules.<br>• Acquire knowledge about regulation and synthesis of different of biomolucles.<br>• Understand nutrient digestion and their absorption. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The student will be able to – | **Course Content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Classify and illustrate different types of free energy and their sources. | **Bioenergetics:**<br>Free energy, entropy and enthalpy. Exergonic and endergonic reaction, ADP-ATP cycle. ATP as universal currency of energy in biological systems. Anabolism and catabolism. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain digestion & absorption of Food in living organism. | **Digestion and absorption:**<br>Food in human. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain how energy production and used through different cycle. | **Carbohydrate Metabolism:**<br>Glycolysis and alcoholic fermentation. Krebs cycle. Electron transport chain. Shuttle systems. Pentose phosphate pathway. Gluconeogenesis, Biosynthesis of sucrose and starch. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Acquire knowledge replication and transcription.<br>• Classify and illustrate different types of replication. | **Nucleic acid metabolism:**<br>Replication and transcription of genetic code. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe protein metabolism in respect of transamination, deamination, decarboxylation and nitrogen cycle.<br>• Explain protein metabolism. | **Protein metabolism:**<br>Transamination, deamination, decarboxylation, deamidation. Assimilation of ammonia in plants. Nitrogen cycle. Urea cycle. Protein | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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| | synthesis – translation of genetic message. | | |
| • Elucidate fat metabolism in respect of beta, alpha and omega oxidation of fatty acids.<br>• Explain glyoxalate Pathway in plant, fatty acid biosynthesis.<br>• Explain fat metabolism for nutritional purpose. | **Fat Metabolism:**<br>Beta, alpha and omega oxidation of fatty acids. Glyoxalate Pathway. Fatty acid biosynthesis. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the vitamins and minerals.<br>• Classify and explain importance of vitamins. | **Vitamins and minerals**:<br>Occurrence, biochemical functions and deficiency symptoms, RDA. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe and understand the food protein quality evaluation.<br>• Illustrate the value of foods. | **Food protein quality evaluation:** Biological value, PER, NPU etc. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Know the nutrient contents and availability.<br>• Classify different types of food. | **Nutrient contents and availability:**<br>Basic food groups; Cereals, legumes, oil seeds, fruits, vegetables etc. Antinutritional factors, dietary fibre. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe and understand energy requirement.<br>• Explain energy requirement. | **Energy:**<br>Requirement according to age, sex and weight. Basal metabolic rate, respiratory quotient, balanced diet. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State that national nutritional policy.<br>• Explain and correlate it's with crop diversification. | **Nutrition and Agriculture:**<br>National nutritional policy. Crop diversification in relation to human nutrition. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Attain latest research findings and information regarding Metabolism & Food Nutrition | Latest research findings and information regarding protein, &fat, metabolism, food protein quality evaluation. | Assignment | Report |

**Reference Books:**


1. A. L. Lehnininger. 1982. Biochemistry, 2nd Edition, Kalyani Publishers, Lubiana, New Delhi,
2. J.L.Jain.2001. Fundamentals of Biochemistry, 5th Edition, published by Chand & Company Ltd. Ram Nagar, New Delhi, 110055.
3. Lubret stryer.1986. Biochemistry, Published by S.K. Jain for CBS Publishers and Distributors, 485, Jani Bhaban, Bholanath Nagar, Delhi, India, 1986.
4. M. Swaminathan.1992.Handbook of food and Nutrition.
5. N. M. Goodwin and Mercer. 2003. Introduction to Plant Biochemistry. 2nd CBS Publishers and Distributors. New Delhi, India.
6. R.L. Karet, Denniston, K.J. and Topping, J.J. 1997. Principles and Applications of Inorganic, Organic and Biological Chemistry. WCB, McGraw-Hill.
7. V.H. Kretovich, Nowarowski, T.Z. and Clarke, A.J. 1996. Principles of Plant Biochemistry. Pergamon Press. Oxford. London, New York. Paris.
8. E.S., West, W.R. Todd, S.M Mason, and J.T. Van Bruggen. 1967. Text Book of Biochemistry, Mcmilan Co. New York.
9. Plummer D.T. 1992. An Introduction to Practical Biochemistry. Tata Mcdraw-Hill Publishing Company Limited, New Delhi.

| **Course Code: BIOC 210**<br>**Course Title : Intermediary Metabolism & Food Nutrition (Practical)** | **Credit Hours: 02** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:** The Course is designated to provide fundamental concepts of metabolism, nutrition and its analysis | | | |
| **Course Objectives:**<br>• Conceptualize metabolism of biomolecules and its identification<br>• Acquire knowledge about their assay and estimation | | | |

| **Intended Learning Outcomes (ILOs)**<br>The student will be able to – | **Course Content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Describe the estimation of isoclectric pH. | Determination of isoelectric pH | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Describe the estimation of protein. | Biuret method of protein estimation. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain the Fehling's methods. | Fehlings and Folin-Wu methods of glucose estimation. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Describe and understand the fats/oil qualitative character. | Determination of saponification value, iodine value and acid value of fats. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Describe the separation techniques by using Rf value of amino acids. | Separation of amino acids by paper chromatography. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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|---|---|---|---|
| • Explain the procedure of TLC. | Separation of sugar by TLC | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Discuss how DNA can extract and quantify DNA.<br>• Explain different extraction estimation method. | Extraction and estimation of DNA | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Describe the nature of albumin and globulin.<br>• Explain the method of extraction of albumia globulin form plant sample. | Extraction of albumin and globulin from plant sample | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration<br>Performance<br>Viva-voce<br>Practical notebook |
| • Explain the different plant pigments.<br>• Explain the method of extraction of plant pigments. | Extraction and estimation of plant pigments. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Elucidate the assay of glucose oxidase.<br>• Illustrate the function of glucose oxidase. | Assay of glucose oxidase. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1 A. L. Lehnininger. 1982. Biochemistry, 2nd Edition, Kalyani Publishers, Lubiana, New Delhi,
2 J.L.Jain.2001. Fundamentals of Biochemistry, 5th Edition, published by Chand & Company Ltd. Ram Nagar, New Delhi, 110055.
3 Lubret stryer.1986. Biochemistry, Published by S.K. Jain for CBS Publishers and Distributors, 485, Jani Bhaban, Bholanath Nagar, Delhi, India, 1986.
4 M. Swaminathan.1992.Handbook of food and Nutrition.
5 R. J. Jayaramon, 1986. Practical Biochemistry, Delhi, India, 1986.
6 N. M. Goodwin and Mercer. 2003. Introduction to Plant Biochemistry. 2nd CBS Publishers and Distributors. New Delhi, India.
7 R.L. Karet, Denniston, K.J. and Topping, J.J. 1997. Principles and Applications of Inorganic, Organic and Biological Chemistry. WCB, McGraw-Hill.
8 V.H. Kretovich, Nowarowski, T.Z. and Clarke, A.J. 1996. Principles of Plant Biochemistry. Pergamon Press. Oxford. London, New York. Paris.
9 E.S., West, W.R. Todd, S.M Mason, and J.T. Van Bruggen. 1967. Text Book of Biochemistry, Mcmilan Co. New York.
10. Plummer D.T. 1992. An Introduction to Practical Biochemistry. Tata Mcdraw-Hill Publishing Company Limited, New Delhi.

# Department of Biotechnology

## Course Layout

| Sl. No. | Course Code & Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 01. | BIOT 359: *In vitro* Culture (Theory) | | 3 | 3 | I |
| 02. | BIOT 360: *In vitro* Culture (Practical) | | 2 | 3 | I |
| 03. | BIOT 433 Genetic Engineering (Theory-Elective) | | 2 | 4 | II |
| | | Theory | 3 | | |
| | | Practical | 2 | | |
| | | Elective | 2 | | |
| | | **Total** | **7** | | |

| **Course Code: BIOT- 359**<br>**Course Title: *In vitro* Culture (Theory)** | **Credit Hours: 3** | **Level: 3** | **Semester: I** |
|---|---|---|---|
| **Rationale**: The course is designed to study the basic technique of plant tissue culture and its application in agriculture. | | | |
| **Course Objectives:**<br>• Understand the theme of *in vitro* culture.<br>• Acquire knowledge on tissue culture laboratory, culture media and sterilization technique.<br>• Enrich knowledge on micropropagation, anther culture, protoplast culture, somaclonal variation and cryopreservation.<br>• Disseminate the application of plant tissue culture knowledge in agriculture sector of Bangladesh. | | | |
| **Intended Learning Outcomes (ILOs)** | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| The students will be able to- | | | |
| • Know the concept and importance of plant tissue culture | **Introduction-** Definition of *In vitro* culture, remarkable contributions in cell biology and cell culture, scope and importance, limitations | Lecture<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Essay type answer<br>Short answer<br>Report |
| • Design and maintain a tissue culture lab independently | **Laboratory organization-** Lab designing and basic requirements of tissue culture lab, laboratory safety and daily maintenance | Lecture<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Essay type answer<br>Report |
| • Explain the cell totipotency and its application in cell biology | **The principles of plant tissue culture-** Cellular totipotency and differentiation, factors responsible for differentiation of cell, growth and development, morphogenesis, plasticity | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Prepare of culture medium for in *vitro* regeneration.<br>• Analyze the composition of plant nutrient | **Culture media ingredients and its preparation-** Important media with their major function, media composition: description and major function of each media ingredients, terminology related to media preparation, molarity, molecular weight, normality, equivalent weight of an acid, equivalent weight of a base, protocol for preparation of different culture media | Lecture<br>Interactive discussion<br>Problem solving exercise<br>Class room exercise<br>Lab visit | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Elucidate with the sterilization procedure of tissue culture | **Methods of sterilization-** Sources and causes of infection, types of sterilization and their description | Lecture<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Know the explants and culture type | **Explant and culture types-** Explants, culture types: brief introduction to different culture types | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain *in vitro* plant regeneration<br>• Describe the commercial exploitation of micropropagation | **Micropropagation-** Definition; steps involved in micropropagation, types of micropropagation and their description, application and limitation of micropropagation | Lecture<br>Discussion<br>Poster presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Enrich knowledge on anther culture for haploid plant production<br>• Able to use of anther culture in crop improvement | **Anther culture-** Introduction; factors influence anther culture, androgenesis, confirmation of ploidy status, chromosome doubling, application of haploids in agriculture, limitations | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Know the embryo rescue technique and its utilization in agriculture | **Embryo culture-**Introduction, types of embryo culture, embryo culture procedure, application of embryo culture and limitation | Lecture<br>Interactive discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Isolate and culture protoplast<br>• Describe the technique of somatic hybridization<br>Exploit the technique for boosting new genome development | **Protoplast culture and somatic hybridization-**Introduction, isolation and culture procedure, protoplast viability and density, somatic hybridization, procedure of protoplast fusion; Selection of somatic hybrid cell, symmetric, asymmetric hybrid, difference somatic hybrid and cybrid, homokaryon and heterokryon, applications and limitation of somatic hybridization | Lecture,<br>Discussion<br>Lab visit<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Create somaclonal varients for plant breeding program | **Somaclonal variation-** Introduction, mechanisms of somaclonal variation; schemes for somaclonal variation; factors that | Lecture<br>Discussion<br>Assignment<br>Visual | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| | influence somaclonal variation, applications and limitation of somaclonal variation | presentation | Report |
| • Illustrate germplasm conservation procedures<br>• Apply cryo preservation technique for bio-diversity conservation | **Germplasm Conservation and Cryopreservation-** Introduction, *in situ* conservation, *ex-situ* conservation, cryopreservation, technique for cryopreservation, application of cryopreservation | Lecture<br>Discussion<br>Visual presentation<br>Assignment<br>Gene bank visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Attain latest research findings and information regarding *In vitro* Culture, Micropropagation and Germplasm Conservation and Cryopreservation | Latest research findings and information regarding *In vitro* Culture *In vitro* Culture | Assignment | Report |

**Reference Books:**


1. M.S.R. Bhuiyan and M.E. Hoque.2008. An Introduction to plant Tissue Culture. 1st Edn. Z. N. Shahana and M. D. Nesa, Sher-e- Bangla Agricultural University, Dhaka-1207.
2. R.C Dubey.2007. A Text book of Biotechnology. S. Chand & Company Ltd. An Iso 9001: 2000 company RAM NAGAR, New Delhi-110055.
3. B.D. Singh. 2014 Biotechnology: Expanding Horizon, 4th Edn. Kalyani Publishers, India
4. M. K. Razdan. 2004. Introduction to plant Tissue culture. 2nd Edu. Oxford & IBH publishing Co. Put. Ltd. New Delhi, India.

| **Course Code: BIOT- 360**<br>**Course Title: *In vitro* Culture (Practical)** | **Credit Hours: 2** | **Level: 3** | **Semester: I** |
|---|---|---|---|
| **Rationale**: This course is designed to develop skill on different plant tissue culture techniques for micro-propagation and crop improvement. | | | |
| **Course Objectives:**<br>• Acquire knowledge about the operational procedure of different lab equipments.<br>• Learn the plant tissue culture ingredient and media preparation procedure.<br>• Know the sterilization technique.<br>• Develop skill on *in vitro* plant regeneration technique.<br>• Learn the procedure of anther culture, embryo culture and protoplast culture. | | | |
| **Intended Learning Outcomes (ILOs)**<br>• The students will able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
| • Operate and demonstrate tissue culture laboratory equipment | Introduction and demonstration about the use of different lab equipments. | Lecture<br>Discussion<br>Group work<br>Lab visit<br>Demonstration<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Identification<br>Demonstration performance<br>Practical notebook<br>Report |
| • Gather knowledge on plant tissue culture ingredients.<br>• Prepare media for tissue culture | Preparation of plant tissue culture media. | Lecture<br>Discussion<br>Group work<br>Demonstration<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Demonstration performance<br>Practical notebook<br>Report |
| • Sterilize tissue culture media using different technique | Sterilization of tissue culture media and explants. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Demonstration performance<br>Practical notebook |
| • Establish *in vitro* regeneration protocol and callus induction method | Initiation and maintenance of callus from potato explants. | Lecture<br>Discussion<br>Demonstration<br>Group work<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Demonstration performance<br>Practical notebook<br>Report |

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|---|---|---|---|
| • Apply culture anther technique for haploid plant regeneration | Study on anther culture. | Lecture<br>Discussion<br>Group work<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Demonstration performance<br>Practical notebook<br>Report |
| • Develop skill on embryo culture procedure | Study on embryo culture. | Lecture<br>Discussion<br>Demonstration<br>Group work<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Demonstration performance<br>Practical notebook<br>Report |
| • Get acquainted with the application and advancement of tissue culture in crop sector | Visit to different tissue culture laboratory in home and abroad. | Lecture<br>Discussion<br>Demonstration<br>Group work<br>Assignment<br>Lab visit | Quiz/MCQ<br>Short answer<br>Viva-voce<br>Demonstration performance<br>Practical notebook<br>Report |

**Reference Books:**


1. M. S. R. Bhuiyan and M.E. Hoque.2008. An Introduction to plant Tissue Culture. 1st Edn. Z. N. Shahana and M. D. Nesa, Sher-e- Bangla Agricultural University, Dhaka-1207.
2. R.C Dubey.2007. A Text book of Biotechnology. S. Chand & Company Ltd. An Iso 9001: 2000 company RAM NAGAR, New Delhi-110055.
3. B.D. Singh. 2014 Biotechnology: Expanding Horizon, 4th Edn. Kalyani Publishers, India
4. Roberta H. Smith. *2013.* Plant Tissue Culture. 2nd Edn. Oxford & IBH Publishing Co. Pvt. Lid. New Delhi, India.
5. M. K. Razdan. 2004. Introduction to plant Tissue culture. 2nd Edu. Oxford & IBH publishing Co. Put. Ltd. New Delhi, India.

| **Course code: BIOT-433**<br>**Course Title: Genetic Engineering (Theory-Elective)** | **Credit Hours: 2** | **Level: 4** | **Semester: II** |
|---|---|---|---|
| **Rationale**: The course layout provides the fundamental knowledge of biotechnology and advanced molecular biology techniques. | | | |
| **Course Objectives:**<br>• Conceptualize the molecular biology and biotechnology.<br>• Acquaint with biochemistry of nucleic acids and gene organization.<br>• Secure knowledge on protein biosynthesis.<br>• Focus about DNA and RNA extraction methods.<br>• Acquire knowledge on PCR technology in molecular biology.<br>• Obtain knowledge on molecular plant breeding<br>• Analyze recombinant DNA technology and gene cloning.<br>• Discuss about genetic engineering and its application in crop improvement. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Describe the concept, scope and importance of biotechnology | **Introduction-** Concept, definition, history, branches, scope and importance of molecular biology and biotechnology | Lecture<br>Interactive discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Learn the structure of DNA and RNA<br>• Illustrate the DNA double helix model.<br>• Illustrate DNA replication procedures | **Biochemistry of Nucleic Acids-** Types, structure and function of DNA and RNA, Watson-Crick model of DNA, replication of DNA | Lecture<br>Discussion<br>Class room exercise<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the Mendelian and molecular concept of gene<br>• Explain the function of different components of a gene | **Organization of Gene-** Concept of gene, components of a gene: promoters, UTRs, exon, intron | Lecture<br>Discussion<br>Lab visit<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain about genetic code | **Genetic code-** Properties of genetic code, codon, anticodon, wobble hypothesis | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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| • Explain the technique the DNA and RNA isolation.<br>• Illustrate the gel electrophoresis technique<br>• Analyze the role of Polymerase Chain Reaction (PCR) in molecular biology | **Molecular Techniques-** DNA and RNA isolation, gel electrophoresis, polymerase chain reaction (PCR) | Lecture<br>Interactive discussion<br>Visual presentation<br>Assignment<br>Lab visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe gene cloning technique<br>• Explain about recombinant DNA technology for transgenic plant development | **Recombinant DNA Technology-** Introduction **,** restriction endonucleases, ligase, plasmids, cloning vectors, gene constructs, steps in gene cloning | Lecture<br>Interactive discussion<br>Visual presentation<br>Class room exercise<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain gene transformation technique in cell | **Genetic Transformation-** Approaches and methods of gene transfer | Lecture<br>Discussion<br>Visual presentation<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Obtain latest research findings and information regarding Biotechnology | Latest research findings and information regarding Biochemistry of Nucleic Acids , Genetic code, Molecular Techniques of DNA and RNA, Recombinant DNA Technology and Genetic Transformation | Assignment | Report |

**Reference Books:**


1. B.D. Singh. 2014 Biotechnology: Expanding Horizon, 4th Edn. Kalyani Publishers, India
2. J. D. Watson R. Losick 2004. Molecular Biology of the Gene. 5th Edn.Pearson Education (Singapore) Pte. Ltd., Indian Branch, New Delhi, India.
3. R.C Dubey.2007. A Text book of Biotechnology. S. Chand & Company Ltd. An Iso 9001: 2000 company RAM NAGAR, New Delhi-110055.
4. E. F. Sambrook. Fritsch and T. Maniatis. 1989. Molecular Cloning: A Laboratory manual I, II, III. 2nd Edu. Cold Spring Harbor-Laboratry Press, USA.

# Department of Entomology

## Course Layout

| Sl. No. | Course Code and Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | ENTO 253: Introductory Entomology (Theory) | | 03 | 2 | II |
| 2 | ENTO 254: Introductory Entomology (Practical) | | 02 | 2 | II |
| 3 | ENTO 307: Systematic Entomology and Insect Ecology (Theory) | | 02 | 3 | I |
| 4 | ENTO 308: Systematic Entomology and Insect Ecology (Practical) | | 02 | 3 | I |
| 5 | ENTO 459: Pest Management and Economic Entomology (Theory) | | 03 | 4 | II |
| 6 | ENTO 460: Pest Management and Economic Entomology (Practical) | | 02 | 4 | II |
| 7. | ENTO 333: Medical and Veterinary Entomology (Theory-Elective) | | 02 | 3 | II |
| **Total** | | Theory | 08 | | |
| | | Practical | 06 | | |
| | | Elective | 02 | | |
| | | **Total** | **16** | | |

| **Course Code: ENTO 253**<br>**Course Title: Introductory Entomology(Theory)** | **Credit Hours: 03** | **Level: 2** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide fundamental concept of insects and other related arthropods | | | |
| **Course Objectives**<br>• Acquire knowledge about concept and importance of insects and related arthropods in agriculture and other aspects<br>• Know external morphology and different appendages of insects, their modifications and functions<br>• Gain knowledge on embryonic development, moulting and metamorphosis of insects<br>• Learn classification and identification of adult and immature insects and their economic importance<br>• Understand different physiological systems and sense organs of insects and their functions | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Define entomology and insect<br>• Describe importance of insects and other related arthropods in agriculture and other aspects | **Introduction:** Concept of entomology and importance of insects and other related arthropods in agriculture and other aspects | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe general characteristics of Arthropoda and its classification<br>• Describe characteristics of Class Arachnida and Insecta<br>• Differentiate Arachnida and Insecta | **Arthropoda:** General characteristics and classification, class: Arachnida and Insecta | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe external morphology of a typical insect<br>• Describe different appendages of insect, their modifications with functions and adaptations | **Insect Morphology:** External morphology of a typical insect, integument, antennae, legs, wings and mouthparts of insects | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type |
| • Explain developmental process of insect embryo<br>• Describe moulting and metamorphosis of insects<br>• Describe different types of larvae and pupae | **Embryology:** Development and formation of embryo in insects<br>**Metamorphosis:** Moulting and metamorphosis, types of metamorphosis in insects, types of larvae and pupae | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Classify orders of insects and other arthropods<br>• Describe importance of various insects and related arthropods in agriculture and other aspects | **Systematic Entomology:** Identifying characters and economic importance of important orders of insects and other arthropods of agricultural importance | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe anatomical features and physiological processes of different systems of insects | **Insect Physiology:** Digestive system, digestion and absorption; excretory system, excretory organs and mechanism of excretion; circulatory system, circulatory organs and mechanism of circulation; respiratory system, respiratory organs, respiration in terrestrial, aquatic and endoparasitic insects; nervous system, neurons, types of nervous system; reproductive system of insect and types of reproduction, oogenesis and spermatogenesis of insects. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe endocrine glands and hormones of insects<br>• Explain role of hormones in physiological events of insect life | **Endocrine Glands and Hormones:** Major endocrines glands and hormones in insect, hormonal control of moulting, metamorphosis and diapause | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe various sensory organs of insects with functions | **Sense Organs:** Mechanoreceptor, chemoreceptor, photoreceptor, auditory receptor, temperature and humidity receptors | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Attain latest research findings and information regarding Introductory Entomology | latest research findings and information regarding Embryology, Metamorphosis, Insect Physiology , Endocrine Glands and Hormones of insects | Assignment | Report |

**Reference Books**


1. A.D. Imms. 1965. A General Text Book of Entomology. The English Language Book Society, UK.
2. D.B. Tembare. 1984. A Text Book of Insect Morphology,Physiology and Endocrinology. S. Chand and Co. Ltd., Ramnagar, New Delhi.
3. J.B. Whitfield and A.H. Purcell. 2013. Daly and Doyen's Introduction to Insect Biology and Diversity. 3rd edition. Oxford University Press, New York.
4. N.F. Johnson and C.A. Triplehorn. 2004. Borror and DeLong's Introduction to the Study of Insects. 7th Edn. Cengage Learning.
5. Novak, V.J.A. 1966. Insect Hormones. Methuen and Co., London.
6. P.J. Gullan and P.S. Cranston. 2014. The Insects: An Outline of Entomology. 5th edition, John Wiley and Sons, Ltd, UK.
7. R.F. Chapman. 1982. The Insects: Structure and function. 3rd edition. The English Language Book Society and MacMillan India Ltd., Bangalore, India.
8. V.B. Wigglesworth. 1979. The Principles of Insect Physiology. English Language Book Society, England.
9. W.S. Romoser and J.G. Stoffolano. Jr. 1998. The Science of Entomology. 4th Edn. WCB McGraw-Hill Science, New York.

| Course Code: ENTO 254<br>Course Title: Introductory Entomology (Practical) | Credit Hours: 02 | Level-2 | Semester: II |
|---|---|---|---|

**Rationale:** This practical course is designed to develop skill on collection, preservation and identification of insects; their morphological and anatomical structures and functions

**Course Objectives**

- Acquire skills for collecting, mounting and preserving insects for scientific study
- Identify insects under major orders by sight
- Learn anatomical modifications and physiological processes of major groups of insects

| Intended Learning Outcomes (ILOs)<br><br>The students will be able to | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Collect, prepare and preserve insects | Methods of collection, preparation and preservation of insects | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Exercise | Quiz/MCQ<br>Short answer<br>Collection<br>Demonstration performance<br>Practical notebook<br>Viva-voce |
| • Identify the insects and their relatives to its order of economic importance | Identification of different Orders of insects and other arthropods of economic importance in Bangladesh | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Collection and sorting<br>Identification<br>Preservation | Quiz/MCQ<br>Short answer<br>Identification<br>Practical notebook<br>Viva-voce |
| • Dissect and demonstrate external and internal anatomy of insects | Study on external and internal anatomy of grasshopper, bugs and Lepidopteran insects | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Dissection<br>Drawing | Quiz/MCQ<br>Short answer<br>Dissection<br>Demonstration performance<br>Practical notebook<br>Viva-voce |
| • Identify different appendages of insects and their structural modifications for functional adaptations. | Study of different types of antennae, mouthparts, legs and wings of insects | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Identification<br>Drawing | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Practical notebook<br>Viva-voce |
| • Prepare and demonstrate slides | Preparation of temporary and | Lecture<br>Discussion | Quiz/MCQ<br>Short answer |

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|---|---|---|---|
| of insect appendages | permanent slides of antennae, legs, wings and mouthparts of insects | Demonstration<br>Lab exercise | Demonstration performance<br>Practical notebook<br>Viva-voce |
| • Collect and identify immature stages of insect | Collection and identification of different types of larvae and pupae of insects | Lecture<br>Discussion<br>Demonstration<br>Field visit<br>Collection<br>Exercise | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Practical notebook<br>Viva-voce |

**Reference Books**


1. A. Prakash. 2001. Laboratory Manual of Entomology. New Age International Publishers, India.
2. G.T. Tonapi. 1994. Experimental Entomology: An Aid to Laboratory and Field Studies. CBS Publishers and Distributors.
3. M.M. Trigunayat. 2009. A Manual of Practical Entomology. 2nd edition. Scientific Publishers, Jodhpur, India.
4. N.F. Johnson and C.A. Triplehorn. 2004. Borror and DeLong's Introduction to the Study of Insects. 7th edition. Cengage Learning.
5. T.J. Gibb and C.Y. Oseto. 2006. Arthropod Collection and Identification: Field and Laboratory Techniques. 2ndEdn. Elsevier-Academic Press.

| Course Code: ENTO 307<br>Course Title: Systematic Entomology and Insect Ecology (Theory) | Credit Hours: 02 | Level: 3 | Semester: I |
|---|---|---|---|

**Rationale:** This course is designed to identify important families of insects and allied arthropods, and to understand their ecological aspects.

**Course Objectives**

- Acquire knowledge on systematic entomology and taxonomic identification of insects
- Understand the concepts of insect ecology
- Monitor insect population and crop loss assessment

| Intended Learning Outcomes (ILOs)<br>The students will be able to | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Describe identifying characteristics of important families of insects and related arthropods<br>• Describe habitat and economic importance of insects | **Systematic Entomology:** Identifying characters and economic importance of important families of insects and other arthropods of agricultural importance | Lecture<br>Visual presentation<br>Discussion<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe insect ecology, population dynamics in agro-ecosystem<br>• Elucidate ecological factors and their role on insect population<br>• Explain and characterize different insect growth forms | **Insect Ecology:**<br>• Insect population, ecological niche and habitats, agro-ecosystem, population dynamics<br>• Influence of environmental factors on insect population<br>• Growth forms of insect populations | Lecture<br>Visual presentation<br>Discussion<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe and categorize insect polymorphism<br>• Explain their adaptation in agro-ecosystem | **Insect polymorphism:** Various types of insect polymorphism and their adaptation in agro-ecosystem | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe pest monitoring and forecasting in insect pest management | **Monitoring and Forecasting:** Surveillance, monitoring, forecasting and warning system of pest attack in insect pest management | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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|---|---|---|---|
| • Describe insect population estimation methods<br>• Estimate crop yield loss due to insect pests | **Population estimation and crop loss assessment:** Aggregation pattern, types of pest damage, sampling, methods of population estimation, methods of crop yield loss assessment | Lecture<br>Visual presentation<br>Discussion<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Calculation<br>Report |
| • Attain latest research findings and information regarding Systematic Entomology and Insect Ecology | Latest research findings and information regarding insect ecology and polymorphism, monitoring and forecasting and estimation and crop loss assessment | Assignment | Report |

**Reference Books**


1. A.D. Imms. 1965. A General Text Book of Entomology. The English Language Book Society, UK.
2. A.S. Atwal. 1976. Agricultural pests of South Asia and their management. KalyaniPublishers. Ludhiana. India.
3. D. S. Hill. 1987. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York, USA.
4. D. S. Hill. 1987. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York. USA.
5. E.H. Smith and D. Pimentel. 1978. Pest Control Strategies. Academic Press Inc., New York, USA.
6. G.A.Mathews. 1984. Pest Management. Longman Inc., New York, USA.

P.W. Price. 1997. Insect Ecology. 3rdEdn. John Wiley and Sons Inc., New York, USA.

| Course Code: ENTO 308<br>Course Title: Systematic Entomology and Insect Ecology (Practical) | Credit Hours: 02 | Level: 3 | Semester: I |
|---|---|---|---|

**Rationale:** This course is designed to develop practical knowledge on identification of important insects under different families, predators, parasitoids and pesticides of different groups, operating pesticide appliances and assessment of crop loss by insect and vertebrate pests

**Course Objectives**

- Acquire knowledge on identification of insects and related arthropods under important families
- Understand different pesticides and pesticide appliances and their operation procedures
- Gather practical knowledge on bio-control agents of insect pests
- Gain knowledge on loss assessment of crops by insect and vertebrate pests

| Intended Learning Outcomes (ILOs)<br>Student will be able to | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Identify insects and related arthropods under important families<br>• Describe importance of insects and related arthropods | Identification of important families of insects and other arthropods under different Orders | Lecture<br>Visual presentation<br>Discussion<br>Practical demonstration<br>Field visit<br>Lab exercise | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Report<br>Practical notebook<br>Viva-voce |
| • Classify and identify pesticides and their efficacy on the target organisms | Study of commonly used pesticides for controlling insect, mite and rodent pests in Bangladesh | Lecture<br>Visual presentation<br>Discussion<br>Practical demonstration | Quiz/MCQ<br>Short answer<br>Identification<br>Practical notebook<br>Viva-voce |
| • Demonstrate different application methods of pesticides in field and homestead areas | Study on pesticides application techniques | Lecture<br>Visual presentation<br>Discussion<br>Practical demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Practical notebook<br>Viva-voce |
| • Compute correct dose of pesticides for field and home application | Formulation of pesticides and computation of doses | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving<br>Lab exercise | Quiz/MCQ<br>Short answer<br>Computation<br>Practical notebook<br>Viva-voce |

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|---|---|---|---|
| • Take precautionary measures during handling and using of chemical pesticides | Precautionary measures for handling and using of pesticides | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field practice | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Practical notebook<br>Viva-voce |
| • Operate and maintain pesticide appliances in pest management strategies and their operation and maintenance | Pest control appliances, their operation and maintenance | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field practice | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Practical notebook<br>Viva-voce |
| • Identify predators and parasitoids of insect pests | Identification of potential predators and parasitoids of insect pests in Bangladesh | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Collection & sorting<br>Identification<br>Assignment | Quiz/MCQ<br>Short answer<br>Identification<br>Practical notebook<br>Viva-voce |
| • Measure population density of pests using different estimation methods | Measurement of insect population density with absolute and relative methods | Lecture<br>Discussion<br>Field visit<br>Demonstration<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Estimation<br>Practical notebook<br>Viva-voce |
| • Estimation of crop yield loss due to insect pest infestation | Techniques of crop yield loss assessment in pest infested fields | Lecture<br>Discussion<br>Field demonstration<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Estimation<br>Practical notebook<br>Viva-voce |

**Reference Books**


1. A.D. Imms. 1965. A General Text Book of Entomology. The English Language Book Society, UK.
2. A.S. Atwal. 1976. Agricultural pests of South Asia and their management. Kalyani Publishers, Ludhiana, India.
3. D. S. Hill. 1987. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York, USA.
4. D. S. Hill. 1987. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York, USA.
5. E.H. Smith and D. Pimentel. 1978. Pest Control Strategies. Academic Press Inc., New York, USA.
6. G.A. Mathews. 1984. Pest Management. Longman Inc., New York, USA.
7. P.W. Price. 1997. Insect Ecology. 3rd Edn. John Wiley and Sons Inc., New York, USA.

| Course Code: ENTO 333<br>Course Title: Medical and Veterinary Entomology<br>(Theory- Elective) | Credit Hours: 02 | Level: 3 | Semester: II |
|---|---|---|---|

**Rationale:** This course is designed to provide knowledge on arthropods of medical and veterinary importance, food contamination, venom secretion and public health pesticides

**Course Objectives**

- Acquire knowledge on arthropods concerned with medical and veterinary importance, their systematic position, disease transmission and management
- Gather knowledge on arthropods related to food contamination, toxin and venom secretion
- Understand public health pesticides, their use and hazards

| Intended Learning Outcomes (ILOs)<br><br>Students will be able to | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Describe importance of medical and veterinary entomology<br>• Describe arthropods related to disease transmission of human and domestic animals and their taxonomic position<br>• Explain mechanism of disease transmission and their control | **Diseases carrying arthropods and their control:** Introduction to medical and veterinary entomology, systematic of arthropods of medical and veterinary importance, arthropod borne diseases, modes of transmission, prevention and control of arthropods of medical and veterinary importance | Lecture<br>Visual presentation<br>Discussion,<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe insects and other arthropods involved in food contamination and their management. | **Food contamination by arthropods**: Insects and other arthropods related to contamination of food, their classification, prevention and control | Lecture<br>Visual presentation<br>Discussion,<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe venom secreting arthropods, their taxonomic position and management | **Venoms of arthropods:** Venom of insects and other arthropods, their taxonomic position, effect of venoms on human and domestic animals and their prevention and control | Lecture<br>Visual presentation<br>Discussion,<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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|---|---|---|---|
| • Explain public health pesticides and their effect on human and domestic animals | **Public Health Pesticides:** Public health pesticides, pesticide poisoning and pesticide residue problems, toxicity and hazards of public health pesticides | Lecture<br>Visual presentation<br>Discussion,<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

**Reference Books**


1. E.H. Smith and D. Pimentel. 1978. Pest Control Strategies. Academic Press Inc., New York.
2. G. Mullen and L. Durden. 2002. Medical and Veterinary Entomology. Academic Press, California, U.S.A.
3. G.A. Mathews. 1984. Pest Management. Longman Inc., New York.
4. J. Smart. 2003. A Handbook for the Identification of Insects of Medical Importance. 2nd Edn., Biotech Books, New Delhi, India.
5. J.G. Leach. 1997. Insect Transmission of Plant Diseases. Biotech Books, New Delhi, India.
6. M.R. Ghosh. 1989. Concepts of Insect Control. Wiley Eastern Ltd., New Delhi, India.
7. R.L. Metcalf and W.H. Luckman. 1994. Introduction to Insect Pest Management. 3rd Edn., Intercept Ltd., Hampshire, UK.
8. S.C. Saxena. 1992. Biology of Insects. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India.

W.H. Robinson. 2005. Handbook of Urban Insects and Arachnids. Cambridge University Press, UK.

| Course Code: ENTO 459<br>Course Title: Pest Management and Economic Entomology (Theory) | Credit Hours: 03 | Level:4 | Semester: II |
|---|---|---|---|

**Rationale:** This course is designed to develop knowledge on integrated pest management (IPM), biology, nature of damage and control measures of major crop pests in Bangladesh, industrial insects and plant disease transmission by insects

**Course Objectives**

- Acquire knowledge on different pest management tactics and their integration (IPM) principles and implementation
- Obtain knowledge on biology, nature of damage and control measures of major crop pests in Bangladesh
- Understand biology, nature of damage and control measures of stored products, nursery and forest pests
- Gain knowledge on apiculture, sericulture and lac culture with their scope and prospect
- Learn plant disease transmission by insect vectors

| Intended Learning Outcomes (ILOs)<br><br>Students will be able to | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Describe injury, damage, economic injury level, economic threshold, general equilibrium position<br>• Explain crop injury and make decision to control pest | **Pest Management:** Concepts of pests and pest management, economic threshold (ET), economic injury level (EIL) and general equilibrium position (GEP) | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe different pest management methods with their merits and demerits<br>• Prescribe appropriate techniques of pest management for particular pest problem | **Tactics of Pest Management:** Cultural, mechanical, physical, biological and chemical control: insecticides, attractants, repellants, antifeedants, pheromones, botanicals, insect growth regulators. Host plant resistance, sterility techniques and regulatory practices | Lecture<br>Visual presentation<br>Discussion,<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain IPM with its principles and prospects | **Integrated Pest management (IPM):** Principles, prospects and | Lecture<br>Visual presentation<br>Discussion, | Quiz/MCQ<br>Short answer |

| | | | |
|---|---|---|---|
| | limitations of IPM, its development and implementation | Field visit<br>Group work<br>Assignment | Essay type answer<br>Report |
| • Describe biology, nature of damage and prescribe control measures of major insect and mite pests of field crops | **Economic Entomology**<br>**Field crop pests**: Bio-ecology, nature of damage and control measures of major insect and mite pests of rice, wheat, jute, cotton, sugarcane, pulses, oilseeds, tobacco and tea | Lecture<br>Visual presentation<br>Discussion,<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe biology, nature of damage and prescribe control measures of major insect and mite pests of horticultural crops in field and nursery | **Horticultural crop pests:** Bio-ecology, nature of damage and control measures of major insect and mite pests of vegetables, fruits, spices, ornamental and nursery plants | Lecture<br>Visual presentation<br>Discussion,<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe biology, nature of damage and prescribe control measures of major insect and mite pests of forest trees and timber | **Forest pests:** Bio-ecology, nature of damage and control measures of major insect and mite pests of forest plants | Lecture<br>Visual presentation<br>Discussion,<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe biology, nature of damage and prescribe control measures of major insect and mite pests of stored grains and other agricultural produce | **Storage pests:** Bio-ecology, nature of damage and control measures of major insect and mite pests of stored products | Lecture<br>Visual presentation<br>Discussion,<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Classify and describe vertebrate pests and assess their damage<br>• Prescribe control measures of rodent pests | **Vertebrate pests:** Important vertebrate pests of field crops and stored products, population dynamics, rodent damage assessment, control measures of rodent pests | Lecture<br>Visual presentation<br>Discussion,<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain types and mechanisms of insect borne disease transmission in plants<br>• Prescribe control plant disease vectors | **Transmission of insect borne plant diseases**: Insects in relation to plant diseases, role of insects in plant disease development, methods of transmission of pathogens by insects, | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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|---|---|---|---|
| | toxicoses and cecidium | | |
| • Elucidate rearing and management of silkworm, honey bee, and lac insect with their importance and scope | **Industrial Entomology:** Sericulture, apiculture and lac culture | Lecture<br>Visual presentation<br>Discussion,<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Attain latest research findings and information regarding Pest Management and Economic Entomology. | Latest research findings and information regarding agro-meteorology, irrigation and drainage, crop nutrition and fertilizer management and organic matter management in relation to Pest Management. | Assignment | Report |

**Reference Books**


1. A.S. Atwal and B. Singh. 1995. Pest population and assessment of crop losses. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi, India.
2. A.S. Atwal. 2007. Agricultural Pests of South Asia and Their Management. Kalyani Publishers, Ludhiana, India.
3. D. S. Hill. 1987. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York, USA.
4. D.S. Hill. I990. Pests of stored products and their control. CBS Publishers and Distributors, Delhi, India.
5. E.H. Smith and D. Pimentel. 1978. Pest Control Strategies. Academic Press Inc., New York.
6. G.A. Mathews. 1984. Pest Management. Longman Inc., New York.
7. J.C.F. Freyer. 2005. Insect pests of fruit crops. 2nd Edition, Biotech Books, Delhi, India.
8. J.G.Leach. 1997. Insect transmission of plant diseases. Biotech Books, New Delhi, India.
9. L.K. Jha and P.K. Sensarma. 2008. Forest Entomology. APH Publishing Corporation, New Delhi, India.
10. M.R. Ghosh. 1989. Concepts of Insect Control. Wiley Eastern Ltd., New Delhi, India.

| Course Code: ENTO 460<br>Course Title: Pest Management and Economic Entomology (Practical) | Credit Hours: 03 | Level: 4 | Semester: II |
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**Rationale:** This course is designed to provide practical knowledge on major crop pests, their nature of damage and control measures, integrated pest management (IPM) program, apiculture, sericulture and lac culture

**Course Objectives**

- Understand pest management methods for major agronomic and horticultural crops, forest plants, storage products
- Acquire knowledge on establishment and maintenance of apiary, sericulture and lac culture
- Develop and implement IPM program for insect and mite pests of important crops and stored products
- Obtain knowledge on mass rearing technique of predators, parasitoids and industrial insects

| Intended Learning Outcomes (ILOs)<br><br>Students will be able to - | Course Content | Teaching-Learning Strategies | Assessment Strategies |
|---|---|---|---|
| • Recognize and describe nature of damage of major insect and mite pests of field crops, horticultural crops, forest plants and stored products and prescribe their control measures | Survey of major insect and mite pests of field and horticultural crops, forest plants and stored products | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Exercise<br>Practical notebook<br>Viva-voce |
| • Recognize and describe nursery pests and prescribe their control measures | Identification of nursery pests | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Practical notebook<br>Viva-voce |
| • Develop integrated pest management (IPM) program for major crop pests | Development of IPM program for a cereals, fibers, vegetables and fruit plants | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Practical notebook<br>Viva-voce |

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| • Demonstrate and describe mass rearing technique of predators and parasitoids for biological control | Mass culture of bio-control agents | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Lab exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Practical notebook<br>Viva-voce |
| • Recognize and describe plant disease vectors of major crops and prescribe their control measures | Identification of insects carrying disease organisms of major crops of Bangladesh | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Lab exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Practical notebook<br>Viva-voce |
| • Demonstrate and maintain apiary, rearing of silkworm and lac insects | Rearing techniques of industrial insects | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Lab exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Practical notebook<br>Viva-voce |
| • Recognize and utilize different traps and poison baits used in pest monitoring and IPM | Study on commonly used traps and poison baits for monitoring and management insect pests | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Field visit<br>Lab exercise<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Report<br>Practical notebook<br>Viva-voce |
| • Acquaint with organizations related to entomological research | Field visit to different research institute to survey major insect and mite pests of crops | Lecture<br>Visual presentation<br>Discussion<br>Lab and field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Report<br>Viva-voce |

**Reference Books**


1. D.S.Hill. 2008. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York, USA.
2. D.S. Hill. I990. Pests of stored products and their control. CBS Publishers and Distributors, Delhi, India.
3. M.V. Singerland and C.R. Richard. 2000. Manual of fruit insects. Biotech books, Delhi, India.
4. M.Z. Alam. 1969. Insect pests of vegetables and their control in East-Pakistan. Agric. Res. Inst., Dacca Farm. Dacca.
5. K.K. Nayar, T.N. Ananthakrishnan and B.V. David. 1993. General and Applied Entomology. Tata McGraw Hill Publ. Co., New Delhi, India.
6. H. Singh. 1984. Household and kitchen garden pests: principles and practices. Kalyani Publishers, New Delhi, India.

# Department of Genetics and Plant Breeding

## Course Layout

| Sl. No. | Course Code and Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1. | GEPB 203. Cytology and Cytogenetics (Theory) | | 02 | 2 | I |
| 2. | GEPB 204: Cytology and Cytogenetics (Practical) | | 02 | 2 | I |
| 3. | GEPB 305: Genetics (Theory) | | 03 | 3 | I |
| 4. | GEPB 306: Genetics (Practical) | | 02 | 3 | I |
| 5. | GEPB 381: Heterosis Breeding (Theory- Elective) | | 02 | 3 | II |
| 6. | GEPB 455: Plant Breeding (Theory) | | 03 | 4 | II |
| 7. | GEPB 456: Plant Breeding (Practical) | | 02 | 4 | II |
| | | Theory | 08 | | |
| | | Practical | 06 | | |
| | | Elective | 02 | | |
| | | **Total** | **16** | | |

| **Course Code: GEPB 203**<br>**Course Title**: **Cytology and Cytogenetics (Theory)** | **Credit Hours: 02** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide basic and applied knowledge on Cytology and Cytogenetics in relation to agricultural crops. | | | |
| **Course Objectives:**<br>• Acquire knowledge on plant cell and cell organelles, cell division, chromosome: different forms, structure, karyotype, effects of different types of physical and chemical agents, and functions<br>• Enrich knowledge about structural and numerical changes of chromosome, genetic material and genetic code, chromosome identification techniques, cytogenetics of various crop species<br>• Gain knowledge on different cytogenetic tools used in crop improvement | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Write the names of famous Cytologists.<br>• Describe their works and major contributions to the field. | **Historical events:**<br>Historical events of cytology | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type<br>Report |
| • Describe the compare and contrast prokaryotic and eukaryotic cells.<br>• List their similarities and differences.<br>• Compare and contrast gamete, zygote, somatic cells, and germ cells. | **Cell and cell organelles:**<br>classification of cells, cell organelles of genetic importance | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe different stage of the mitosis and meiosis and chromosomal movement and behavior in each stage.<br>• Differentiate between different stages of mitosis and meiosis.<br>• Identify cells undergoing mitosis and meiosis.<br>• List down the functions and the significance of cell divisions in plant growth and development. | **Cell division:**<br>Mitosis and Meiosis in diploid and triploid organism and their significance | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Write down the different parts and compounds of prokaryotic and eukaryotic chromosomes.<br>• State the morphology features of prokaryotic and eukaryotic chromosomes.<br>• List down the functions of prokaryotic and eukaryotic chromosomes. | **Chromosome structure:**<br>Prokaryotic- viral chromosome, bacterial chromosome and eukaryotic chromosome, general morphology of eukaryotic chromosome | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Write the names and types of physical and chemical agents.<br>• Explain the mechanism and effects of different types of physical and chemical agents on chromosome. | **Physical and chemical agents:**<br>Effects of different types of physical and chemical agents on chromosome | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Name of different types of special chromosomes<br>• Explain their functional significance.<br>• Write down the structure and morphological features of different special types of chromosomes. | **Different forms of chromosomes and their functional significance:**<br>Lampbrush chromosome, polytene chromosome, B-chromosome, diplo-chromosome, sex chromosome and iso-chromosome | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State the different types of chromatins.<br>• Describe and explain the functions of chromatins.<br>• Compare and construct the structures of euchromatin, heterochromatin, allocyclic and heteropycnosis. | **Chromatin and others:**<br>Euchromatin, heterochromatin, allocyclic and heteropycnosis | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define karyotype and ideotype.<br>• List down the characteristics of karyotype.<br>• Describe the karyotype of different crop species and their role in speciation. | **Karyotype:**<br>Karyotype, its characteristics, variation and role in speciation | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • List down different Cytogeneticists and their major contributions in the fields. | Historical review of cytogenetics | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Define the roles of DNA and RNA and can differentiate between DNA and RNA.<br>• State the components and types of DNA.<br>• Describe the chemical structure of DNA and RNA.<br>• Describe the conversion of DNA packages into chromosomes.<br>• State and describe Watson and Crick's three--dimensional model. | **Chemical structure of chromosome:**<br><br>Chemical structure of nuclear chromosome and organelle chromosome | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define the terminologies related to variations in chromosome structure.<br>• State the principles associated with variations in chromosome structure.<br>• Write down the effects of chromosomal changes on the phenotype of the organism.<br>• Explain the processes of mitotic and meiotic non-disjunction, and chromosome loss. | **Structural changes of chromosome:**<br><br>Classification, meiotic behaviour and cytogenetic consequences | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define the principles and terminology associated with variations in chromosome numbers.<br>• State the effects of chromosomal changes on the phenotype of the organism.<br>• Write down the application of polyploidy in agriculture. | **Numerical changes of chromosomes:**<br><br>Classification, meiotic behaviour and cytogenetic consequences | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Summarize the evolution of major crops.<br>• List down the name of wild species, ecological races of respective corps.<br>• Explain the pathways of evolution of the crops. | **Cytogenetics of crops:**<br><br>Wheat, rice and mustard | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Explain the theory and conclusions associated with the Griffith and Avery experiments using *Pneumococcus* and mice.<br>• Describe the DNA replication in prokaryotes and eukaryotes.<br>• Explain the "central dogma" of protein synthesis.<br>• Define the genetic code<br>• Write down the major characteristics of genetic code.<br>• Describe the processing of nucleotide sequence into amino acid. | **Genetic material and genetic code:**<br><br>Evidence, deoxyribonucleic acid and its replication ribonucleic acid | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Name of different techniques used in Cytogenetic study.<br>• Explain the mechanism of different techniques.<br>• Write down the technical advantage and disadvantages of the methods. | **Chromosome identification:**<br><br>Banding pattern, in-situ hybridization and auto-radiography | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Name of different cytological tools used in cytogenetic lab.<br>• Write down the technical aspects and mechanism of operational activities of different tools.<br>• Describe the uses of different tools and their applications. | **Cytogenetic tools:**<br>Use of cytogenetic tools in crop improvement | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Elucidate the latest research findings and information of Cytology and Cytogenetics | Latest research findings and information regarding Cytology and Cytogenetics | Assignment | Report |

**Reference Books**


1. P.S. Verma and V.K. Agarwal. 2005. Cytology. S. Chand & Company ltd., New Delhi
2. G.B. Wilson and J.H. Morrison. 1961. Cytology. Reinhold Publishing Corporation, NewYork.
3. P.K. Gupta. 2007. Cytogenetics. 2nd Edn. Rastogi Publications, *New Delhi*.
4. J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levine and R. Lesick.2004. *Molecular Biology of the Gene*. *5th Edn.*Benjamin Cummings, San Francisco.
5. R.J. Singh. 2002. Plant Cytogenetics.2nd Edn. CRC Press, Tailor & Francis Group, USA.
6. R.S. Shukla and P.S. Chandel. 1977. Cytogenetics and Evolution. 2nd Edn. S. Chand & Company ltd., New Delhi.
7. M.L. Gupta and M.L. Jangir. 1998. Cell Biology: Fundamentals and Applications. Agro Botanika, New Delhi.
8. G. Khush. 1973. Cytogenetics of Aneuploids. 1st Edn. Academic Press, New York.
9. R. Tyagi. 2009. Understanding Cytogenetics. Discovery Publishing House Pvt. Lid., New Delhi.
10. U. Sinha. 1998. Cytogenetics, Plant Breeding and Evolution. Vikas Pub. Ho. Pvt. Ltd., New Delhi.
11. P.N. Bahl and Saimath. 1996. Genetics, Cytogenetics and Breeding of Crop Plants: Pulses and Oilseeds. Science Pub. Inc., USA.
12. D.M. Moore. 1976. Plant Cytogenetics. Chapman and Hall. London.
13. M. Akhtaruzzaman. 1997. Koshbidhya. 3rd Edn. Hassan Book House, Dhaka.
14. A. Sharma. 1976. The Chromosomes. Oxford & IBH Pub. Co., New Delhi.

| Course Code: GEPB 204<br>Course Title: Cytology and Cytogenetics (Practical) | Credit Hours: 02 | Level: 2 | Semester: I |
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| **Rationale:** This course is designed to provide applied knowledge and hands on training on different techniques and tools to study Cytology and Cytogenetics in relation to agricultural crops. | | | |
| **Course Objectives:**<br>• Obtain theoretical and practical knowledge on different chemicals, reagents, and equipments to study different techniques of Cytology and Cytogenetics in lab.<br>• Get hands on training in preparing different chemicals and reagents to use in studying of Plant Cytology and Cytogenetics.<br>• Provide practical and hands on training the students to study plant cell division and the phenomenon.<br>• Gain practical and hands on training to study chromosomes and karyotypes. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching learning Strategies** | **Assessment Strategies** |
| • Name of different strains used in study of chromosomes.<br>• Show different parts of microscope and demonstrate how to operate it.<br>• Prepare aceto-carmine and aceto-orcein strains.<br>• Describe the safety measures, rules and regulation of the lab and lab working. | **Preparation of stains:**<br>Preparation of stains such as aceto-carmine and aceto-orcein. | Lecture<br>Discussion<br>Demonstration<br>Handling microscope | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • State the general procedure and schedule for cytological preparation.<br>• Describe the background information on cytological preparation.<br>• Explain the tissue selection, pretreatment, fixation, staining and squashing.<br>• Demonstrate treatment, fixation, staining and squashing the tissues. | **Cytological preparation:**<br>General schedule for cytological preparation, selection of tissue, pre-treatment, fixation, staining and squashing. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Name different kinds of tissues and cells used in lab for practical study of Cytology and Cytogenetics.<br>• State the advantages and disadvantages of using such cells or | **Cell types:**<br>Study of cell types such as root cell, pollen mother cell, | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce |

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| tissues.<br>• Draw and label thus tissue and point out the importance of such cells of tissues. | pollen grain etc. | | Practical notebook |
| • Demonstrate the preparation of temporary slides.<br>• Describe the procedure of preparing temporary slides.<br>• Demonstrate the preparation of the temporary slide of different stages of mitosis.<br>• Identify the different stages of mitosis.<br>• Underline the key features of each stage of mitosis. | **Preparation of temporary slide :**<br><br>Preparation of temporary slide to study mitosis in onion root tip cell. | Lecture<br>Discussion<br>Demonstration<br>Microscope handling<br>Assignment | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Demonstrate the preparation of the temporary slide of different stages of meiosis.<br>• Identify the different stages of meiosis.<br>• State the key features of each stage of meiosis. | **Study of meiosis:**<br><br>Study of meiosis in onion and maize. | Lecture<br>Discussion<br>Demonstration<br>Handling microscope | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Demonstrate how to prepare the permanent slide.<br>• Describe the procedure of preparing permanent slides.<br>• Show the preparation of the permanent slides of different stage of meiosis. | **Preparation of permanent slides:**<br><br>Preparation of permanent slides for meiosis. | Lecture<br>Discussion<br>Demonstration<br>Handling microscope | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Demonstrate the preparation of the C-metaphase in root-tips of onion<br>• State the key features of the morphology chromosome of C-metaphase in root-tip cells. | **C-metaphase:**<br><br>Study of C-metaphase in root-tips of *Allium cepa.* | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Demonstrate the preparation of karyotype in Onion cells.<br>• Count the chromosome numbers in onion root tip cells. | **Karyotype:**<br><br>Study of karyotype of *Allium cepa.* | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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| • Count the chiasma frequency in the PMCs of *Allium cepa*.<br>• State the factors in variation in chiasma frequency in the PMCs cells. | **Study of chiasma:**<br><br>Study of chiasma frequency in the PMCs of *Allium cepa*. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Count the chromosome numbers.<br>• State the key features of mitosis and meiosis<br>• Draw and label the different stages of mitosis and meiosis.<br>• Define the karyokinensis, cytokinensis etc. | **Commenting on cytological permanent slides:**<br><br>Commenting on cytological permanent slides of mitosis, meiosis, SAT-chromosome, multivalent, inversion loop and bridge, heterozygous translocation etc. | Lecture<br>Discussion<br>Demonstration<br>Handling microscope | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

**Reference Books**


1. S.S. Choudhary and P. Choudhary.1989. Laboratory Techniques in Cytogenetics and Plant Breeding. Kalyani Publishers, New Delhi
2. R.K. Raguvanshi, A.K.S. Cahuhan, B.A. Siddiqi. 1995. Practical exercises in Cytology, Genetics, Plant Breeding and Biostatistics. CBC Publishers, New Delhi.
3. P.S. Verma and V.K. Agarwal. Cytology. 2005. S. Chand and Company ltd., New Delhi.
4. G.B. Wilson and J.H. Morrison. Cytology. 1961. Reinhold Publishing Corporation, New York.
5. R.S. Shukla and P.S. Chandel. 1977. Cytogenetics and Evolution. 2nd Edn. S. Chand & Company ltd., New Delhi.
6. D.M. Moore. 1976. Plant Cytogenetics. Chapman and Hall. London
7. G. Khush. Cytogenetics of Aneuploids. 1973. 1st Edn. Academic Press, New York.
8. R. Tyagi. Understanding Cytogenetics. 2009. Discovery Publishing House Pvt. Lid., New Delhi.
9. U. Sinha. Cytogenetics, Plant Breeding and Evolution. 1998. Vikas Pub. Ho. Pvt. Ltd., New Delhi.

| **Course Code: GEPB 305**<br>**Course Title: Genetics (Theory)** | **Credit Hours: 03** | **Level: 3** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide basic knowledge of genetics which will provide information in plant breeding for crop improvement. | | | |
| **Course Objectives:**<br>• Acquire knowledge on basic genetics such as Mendelian and pre-Mendelian inheritance, modifications of Mendelian inheritance, gene and chromosome, sex determination and sex linkage, linkage and crossing over, gene and genotype frequency, maternal effect, mutation and quantitative genetics.<br>• Obtain knowledge about molecular genetics such as, genetic material, DNA, RNA, protein, genetic code, gene function, gene transcription, translation and regulation of gene expression in eukaryotes. | | | |
| **Intended Learning Outcomes (ILOs)**<br><br>The students will be able to – | **Course Content** | **Teaching learning Strategies** | **Assessment Strategies** |
| • State of different pre-Mendelian concepts of heredity.<br>• Write the name of famous Geneticists.<br>• Describe their works and major contribution to the agricultural field. | **Historical resumes:**<br>History of Genetics and pre-Mendelian concepts of heredity | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State Mendel's two *laws of inheritance.*<br>• Write different examples of the laws.<br>• Explain ratio of the laws. | **Mendel's laws of inheritance:**<br>Law of segregation and law of independent assortment | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Classify and illustrate the other patterns of inheritance<br>• Explain about modification of monohybdid and dyhybrid ratios through intra and interaction of genes. | **Modification of monohybrid and dihybrid ratios:**<br><br>Intra and inter allelic interaction of genes. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the gene behavior that matches the chromosome behavior.<br>• Explain the location of genes in chromosomes.<br>• Constitute the physical basis of | **Chromosome theory of heredity:**<br><br>Parallel behavior of genes and chromosomes, location | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| heredity. | of genes in chromosomes | | |
| • State linkage, crossing over and linear arrangement of genes.<br>• Explain recombination results from crossing over.<br>• Describe different theories of recombination and its different mechanisms. | **Linkage and crossing over:**<br><br>Linkage and linear arrangement of genes, crossing over, genetic recombination and mechanism. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the multiple allele with examples.<br>• State pseudo alleles. | **Multiple alleles:**<br><br>Multiple allelism, examples of multiple alleles with special reference to plants, pseudo alleles. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain Quantitative traits and its genetic determination**.**<br>• Describe the multiple factor hypothesis.<br>• State heritability | **Quantitative inheritance:**<br><br>Quantitative traits and its genetic determination, multiple factor hypothesis, heritability | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe mechanism of sex determination.<br>• State sex linked genes<br>• Explain sex limited and sex influenced characters. | **Sex determination and sex linkage:**<br><br>Mechanism of sex determination with particular to plants, sex linked genes, sex limited and sex influenced characters. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State mutation, gene mutation and mutagen.<br>• Describe permanent alteration in the DNA sequence.<br>• Explain effect of physical and chemical agent on mutation. | **Mutation:**<br><br>Gene mutation, mutagen and mutagenesis. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Describe extra-nuclear genes and their inheritance.<br>• Explain reciprocal differences and material effects. | **Genetic determination in cytoplasm:**<br><br>Extra-nuclear genes and their inheritance, reciprocal differences and material effects. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the basic physical and functional unit of heredity.<br>• State the set of rules by which information encoded within genetic material (DNA or mRNA sequences).<br>• Explain steps of gene expression.<br>• Decode of mRNA by a ribosome to produce a specific amino acid chain, or polypeptide. | **Gene and protein synthesis and genetic code:**<br><br>Genetic code, genes, gene function, gene transcription, translation, regulation of gene expression in eukaryotes. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the *genetic* variation in populations<br>• State their analysis and quantification by the *frequency* of alleles.<br>• Explain Hardy-Weinberg law. | **Population genetics and evolution:**<br><br>Gene and genotypic frequency, Hardy-Weinberg law. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Elucidate the latest research findings and information of Genetics | Latest research findings and information regarding Genetics | Assignment | Report |

**Reference Books:**


1. B.D. Singh. 2007. Fundamentals of Genetics, Kalyani Publishers, New Delhi.
2. P. K. Gupta. 2015. Genetics. 4th Rev.Ed (3rd Reprint) 2014-15. Rastogi Publications. New Delhi.
3. P.S. Verma, and Agarwal, Agarwal, V.K. (1989). Genetics.
4. A.J.F., Griffiths. Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. 2000. An introduction to Genetic analysis.
5. J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levine and R. Lesick.2004. *Molecular Biology of the Gene*. *5$^{th}$Edn.*Benjamin Cummings, San Francisco.
6. M.L. Gupta and M.L. Jangir. 1998. Cell Biology: Fundamentals and Applications. Agro Botanika, New Delhi.

| **Course Code: GEPB 306**<br>**Course Title: Genetics (Practical)** | **Credit Hours: 02** | **Level: 3** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide applied genetic study by working out different problems from field data related to agricultural crops. | | | |
| **Course Objectives:**<br>• Work out and solve the problems of Mendelian and non-Mendelian inheritance.<br>• Work out and solve the problems on linkage and crossing over.<br>• Work out and solve the problems on sex determination, chi-square test, gene and genotypic frequency. | | | |
| **Intended Learning Outcomes (ILOs)**<br><br>The students will be able to – | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Define different genetic terminologies<br>• Solve the different problems on monohybrid, dihybrid and trihybrid crosses. | **Problems on Mendelian inheritance:**<br><br>Working out genetic problems on monohybrid, dihybrid and trihybrid crosses | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Solve the different problems on intra and inter-allelic interactions<br>• Explain of gene expression which is altered by the influence of the other genes.<br>• Figure out the phenotype of the offspring of a cross.<br>• Find out genotypic and phenotypic ratios by calculation of different gene interaction. | **Problems on non-Mendelian inheritance:**<br><br>Working out problems on intra and inter-allelic interaction | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Assess the goodness of fit between a set of observed values and those expected theoretically from large samples. | **Problems on Chi-square test**:<br><br>Working out problems on Chi-square test of various genetic ratios | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Construct genetic linkage map using the data from two point and | **Problems on linkage and** | Lecture<br>Discussion | Quiz/MCQ<br>Short answer |

| | | | |
|---|---|---|---|
| three point test-cross progeny.<br>• Determine the distance between the genes on the chromosome and recombination value between them.<br>• Calculate the single cross over recombinants and double cross over recombinants from three loci.<br>• Determine the proper gene order by examination of the relative frequencies of the $F_2$ phenotypes. | **crossing over:**<br>Working out problems on $F_2$ and testcross progeny-two point and three point. | Demonstration<br>Problem solving | Demonstration<br>performance<br>Viva-voce<br>Practical notebook |
| • Solve the problems on sex determination and sex linked inheritance. | **Problems on sex determination and sex linked inheritance:**<br><br>Working out problems on sex determination and sex linked inheritance. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Viva-voce<br>Practical notebook |
| • Determine the gene and genotype frequency using the Hardy-Weinberg formulas.<br>• Detect any changes in the gene frequencies in the population over time. | **Problem on gene and genotypic frequency:**<br><br>Calculation of gene and genotypic frequency | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Viva-voce<br>Practical notebook |
| • Extract nucleic acid from plant materials.<br>• Show DNA band on agarose gel.<br>• Recognize the specific restriction digestion site on the DNA.<br>• Show the restriction digestion reaction set-up.<br>• Amplify particular gene from the gDNA or cDNA by PCR.<br>• Analyze the data | DNA extraction, Gel Electrophoreses and visualization, digestion and PCR amplification | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Viva-voce<br>Practical notebook |

**Reference Books:**

1. R.K. Raguvanshi, A.K.S. Cahuhan and B.A. Siddiqi. 1995. Practical exercises in Cytology, Genetics, Plant Breeding and Biostatistics. CBC Publishers, New Delhi.
2. B.D. Singh. 2007. Fundamentals of Genetics, Kalyani Publishers, New Delhi.
3. P. K. Gupta. 2015. Genetics. 4th Rev. Ed (3rd Reprint) 2014-15. Rastogi Publications. New Delhi.
4. A. Rani. 2015. Plant Biotechnology and Genetics. New Delhi Publication agency.
5. M.W. Stricberger. Genetics. 3rdEdn. Prentice Hall College Division.
6. P.J. Russel. Foundation of Genetics. 2ndEdn. Longman Publishing Group.
7. J. Ringo. Fundamental Genetics. Cambridge University Press.

| **Course Code:GEPB-381**<br>**Course Title: Heterosis Breeding (Theory-Elective)** | **Credit Hours: 02** | **Level: 3** | **Semester: II** |
|---|---|---|---|
| **Rationale:** The course is designed to provide applied knowledge about heterosis to develop of different hybrids of field crops and vegetable crops and basic principles of hybrid seed production and its management. | | | |
| **Course Objectives:**<br>• Acquire knowledge on history of heterosis.<br>• Obtain knowledge about genetic, biochemical, physiological, plasmatic or organelle, molecular and biometrical aspects of heterosis.<br>• Understand of different methods of hybrid development of field crops and vegetables crops.<br>• Gain knowledge on basic principles of hybrid seed production and its management. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching Strategies** | **Assessment strategies** |
|---|---|---|---|
| • Describe the history of heterosis<br>• Explain the evolutionary concept of heterosis, types and measurement of heterosis. | **History of heterosis**: evolutionary concept of heterosis, types and measurement. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain different pollination control mechanisms in crops.<br>• State genetic, cytoplasmic and cytoplasmic genetic male sterility system.<br>• Explain self incompatibility.<br>• Describe procedure of hybrid seed production. | **Pollination control mechanisms and reproductive system:**<br>Pollination control mechanisms in crops, reproductive systems with particular reference to cytoplasmic male sterility and self incompatibility, hybrid seed production. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain inbreeding, inbreeding depression and hybrid vigour. | Inbreeding, inbreeding depression and hybrid vigour. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Write different types of genetic basis of heterosis.<br>• Describe the dominance and over dominance hypothesis and their assumptions, objections and clarification.<br>• Explain biochemical, physiological, plasmatic or organelle, molecular and biometrical aspects of heterosis. | **Basis of heterosis:**<br>Genetic, biochemical, physiological, plasmatic or organelle and molecular, biometrical aspects of heterosis. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain development procedure of inbreed.<br>• Write combining ability and their types.<br>• State genetic improvement of hybrid<br>• Demonstrate fixation of heterosis. | **Development of hybrid variety:**<br>Development of inbreed, types of combining ability, genetic improvement of hybrid, fixation of heterosis. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Demonstrate development procedure of hybrids of different field crops. | **Development of hybrid varies in field crops:**<br>Rice, Maize, Cotton, Mustard. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Demonstrate development procedure of hybrids of different vegetable crops. | **Hybrid variety development in vegetable crops:**<br>Tomato, Cucurbits and Onion. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain various basic principles of hybrid seed production and its management. | **Basic principles of hybrid seed production and its management** | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the latest research findings and information of Heterosis Breeding | Latest research findings and information regarding Heterosis Breeding | Assignment | Report |

**Reference Books:**


1. B.D. Singh. Plant Breeding-Principles and Methods. 7th Edn. Kalyani Publishers., New Delhi
2. B.D. Singh. Objectives of Plant Breeding. 1st. Edn. Kalyani Publishers., New Delhi
3. R.L. Ararwal. Fundamental of plant breeding and hybred seed production. Science Publication.
4. M. Krishnan. Plant breeding and hybrid seed production. Dominant publishers.

| Course Code: GEPB 455<br>Course Title: Plant Breeding (Theory) | Credit Hours: 03 | Level: 4 | Semester: II |
|---|---|---|---|

**Rationale:** The course is designed to provide applied knowledge about Plant Breeding in relation to improvement of characteristics of plants so that they can be more desirable agronomically and economically.

**Course Objectives:**

- Acquire knowledge on crop evolution and conservation of genetic resources, modes of reproduction and pollination control and continuous variation and gene action.
- Obtain knowledge about plant introduction and acclimatization, breeding of self pollinated, cross-pollinated and asexual propagated crops.
- Understand of special breeding methods like polyploidy breeding, mutation breeding, breeding for disease resistance, insect resistance and breeding for other stress factors.
- Gain knowledge on use of biotechnology in the improvement of crops, release of variety, seed production and maintenance of crop varieties.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching Strategies** | **Assessment strategies** |
|---|---|---|---|
| • Name of eminent Plant Breeders<br>• Write down their works and major contribution to the field<br>• Describe the scope and goal of Plant Breeding. | **Historical events in Plant Breeding:**<br><br>Scope and goal of plant breeding. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe pattern of evolution in crop plants.<br>• Define of genetic resources (germplasm) and their types.<br>• Describe the concept of gene pool and their classification.<br>• Describe the genetic erosion and main causes.<br>• Explain different activities of germplasm conservation like exploration and collection, *in situ* and *ex situ* conservation, evaluation, germplasm cataloguing and data storage. | **Crop evolution and conservation of genetic resources:**<br><br>Decay of variability, types of genetic resources, gene pool and gene sanctuary, genetic erosion, activities of germplasm conservation-, exploration and collection, conservation, evaluation and documentation | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Describe modes of asexual and sexual reproduction.<br>• Explain self and cross pollination, their mechanisms and genetic consequences. | **Modes of reproduction and pollination control:**<br>Modes of reproduction, modes of pollination, mechanism of pollination control in crop plants and their consequences. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain polygenes, multiple factor hypothesis, polygenic inheritance and continuous variation.<br>• Name the components of genetic variance.<br>• Describe concept of combining ability, broad sense and narrow sense heritability and genetic advance. | **Continuous variation and gene action:**<br>Polygenes and polygenic inheritance, nature of gene action, components of genetic variance, concept of combining ability, heritability and genetic advance. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Write down the concept of plant introduction.<br>• Describe the procedure of plant introduction.<br>• Explain acclimatization, purpose and importance of plant introduction. | **Plant introduction and acclimatization:**<br>The concept, procedure of plant introduction, acclimatization, purpose and importance of plant introduction. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe procedure of mass selection, pure line selection, pedigree breeding, bulk breeding, single seed descent method, doubled haploid method and back cross method.<br>• Write advantages and disadvantages of these procedures. | **Breeding self pollinated crops:**<br>Mass selection, pure line selection, pedigree breeding, bulk breeding, single seed descent method, doubled haploid method and back cross method. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Describe heterosis and inbreeding depression<br>• Explain different procedures of population improvement,<br>• Write development procedures of hybrid variety, synthetic and composite variety | **Breeding cross-pollinated crops:**<br><br>Heterosis and inbreeding depression, population improvement, hybrid variety. synthetic variety and composite variety, | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain characteristics of asexually propagated crops.<br>• State the definition, characteristics, origin of genetic variation within clones and clonal degeneration.<br>• Describe selection procedure and hybridization of clonal crops.<br>• Explain problems in breeding and achievements of asexually propagated crops. | **Breeding asexual propagated crops:**<br><br>Clonal selection, hybridization of clonal crops, problems and achievements of asexual propagated crops. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define genome, haploid, monoploid, diploid, aneuploid and euploid.<br>• Explain classification of aneuploid and euploid.<br>• Describe origin and production of aneuploid and their application in crop improvement.<br>• Explain origin, production, morphological and cytological feature, limitations and role of autopolyploid in evolution.<br>• Explain origin, production, morphological and cytological feature, limitations and role of allopolyploid in evolution. | **Polyploid breeding:**<br><br>Autopolyplids and allopolyploids in crop improvement. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Define the mutation, gene or point mutation, chromosome mutation, spontaneous mutations, mutator genes and induced mutations.<br>• Describe general characteristics of mutation and effect of mutation on survival.<br>• Explain mutation breeding for oligogenic and poly genic traits and their applications and limitations. | **Mutation breeding:** Mutation breeding for oligogenic and polygenic traits, application its limitations. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State the definition of disease, host and pathogen.<br>• Explain disease development procedure.<br>• Describe stages of development of fungal diseases.<br>• Explain host-pathogen reaction.<br>• Describe methods of breeding for disease resistance, limitations and advantages of disease control. | **Breeding for disease resistance:**<br>Breeding strategy for disease resistance, limitation and prospects of disease control. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State the definition of polyphagous, biotypes etc.<br>• Describe the losses due to insects and nature of insect resistance.<br>• Explain the genetics of insect resistance and sources of insect resistance.<br>• Describe breeding methods for insect resistance and their screening.<br>• State applications and limitations of insect resistance. | **Breeding for insect resistance:**<br>Breeding for insect resistance, Application and limitation of insect resistance. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Explain breeding approaches for drought resistance.<br>• Describe problems in breeding for drought resistance.<br>• Explain breeding approaches for salinity resistance.<br>• Describe problems in breeding for salinity resistance. | **Breeding for other stress factors:**<br><br>Concepts, application and limitation of abiotic stress breeding– drought/ salt. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the various techniques of biotechnology in crop improvements. | **Use of biotechnology in the improvement of crops:** | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe varieties and cultivars.<br>• Explain procedure of release of notified and non-notified crops. | **Release of variety:**<br>Varieties and cultivars, Procedure of release of notified and non-notified crop. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe different kinds of seeds and seed production practices.<br>• Explain control of seed quality, seed processing, storage, distribution and maintenance of crop varieties. | **Seed production and maintenance of crop varieties:**<br><br>Kinds of seeds and seed production practices, control of seed quality, seed processing, storage and distribution, maintenance of crop varieties. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Elucidate the latest research findings and information of Plant Breeding<br>• | Latest research findings and information regarding Plant Breeding | Assignment | Report |

**Reference Books:**

1. B.D. Singh. Plant Breeding-Principles and Methods. 7th Edn. Kalyani Publishers., New Delhi
2. B.D. Singh. Objectives of Plant Breeding. 1st. Edn. Kalyani Publishers., New Delhi
3. Puhundan Singh. Essentials of Plant Breeding. Kalyani Publishers., New Delhi
4. J.R. Sharma. Tata McGraw-Hill Publishing Company Limited, New Delhi
5. B.D. Singh.Plant Biotechnology. Kalyani Publishers., New Delhi
6. R.W. Allard. Principles of Plant Breeding. 3rd Edn.. Wiley India Ptv. Ltd.
7. Singh. Essential of Plant Breeding. 6th Edn. Kalyani Publication.

| Course Code: GEPB 456<br>Course Title: Plant Breeding (Practical) | Credit Hours: 02 | Level: 4 | Semester: II |
|---|---|---|---|

**Rationale:** The course is designed to provide practical knowledge about Plant Breeding in relation to improvement of characteristics of plants so that students become more skill during their research works.

**Course Objectives:**

- Acquire knowledge on determination of the modes of pollination, demonstration of pollination and determination of the amount of cross pollination
- Obtain knowledge about floral biology, anthesis, emasculation and hybridization techniques of rice, wheat, maize, pea, mustard.
- Understand of estimation of heterosis and inbreeding depression.
- Gain knowledge on correlation and regression analysis using simple measures of variability, estimation of heritability, genetic advance and no. of genes controlling quantitative character
- Obtain knowledge on demonstration of parental, hybrid and segregating populations of the crops
- Analyze of data for testing of varieties using RCB design with test of significance and mean separation.
- Gain knowledge on induction of artificial of polyploidy.
- Gather ideas on research activities of different research institutes by physical visit.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching Strategies** | **Assessment strategies** |
|---|---|---|---|
| • Determine of the mode of pollination. | Determination of the mode of pollination of a species. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Demonstrate of pollination procedure of different crops. | Demonstration of pollination. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| • Determine of the amount of cross pollination. | Determination of the amount of cross pollination | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain floral biology and anthesis of different crops<br>• Demonstrate emasculation and hybridization techniques of different crops. | Floral biology, anthesis, emasculation and hybridization techniques of rice, wheat, maize, pea, mustard. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Estimate of heterosis and inbreeding depression. | Estimation of heterosis and inbreeding depression. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Measure correlation and regression analysis. | Correlation and regression analysis using simple measures of variability. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Estimate of heritability genetic advance and no. of genes controlling quantitative character. | Estimation of heritability genetic advance and no. of genes controlling quantitative character. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Demonstrate of parental, hybrid and segregating populations of the crops. | Demonstration of parental, hybrid and segregating populations of the crops. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Analyze of data for testing of varieties using RCB design with test of significance and mean separation. | Data analysis for testing of varieties | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| • Demonstrate of the induction of artificial polyploidy. | Artificial induction of polyploidy. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Illustrate breeding procedures used in different research institutes<br>• Describe the practical experience of research activities of different research institutes. | Field visit of public and private Plant Breeding stations. | Lecture<br>Discussion<br>Demonstration<br>Assignment | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1. B.D. Singh. Plant Breeding-Principles and Methods. 7thEdn. Kalyani Publishers., New Delhi
2. B.D. Singh. Objectives of Plant Breeding. 1st. Edn. Kalyani Publishers., New Delhi
3. Puhundan Singh. Essentials of Plant Breeding. Kalyani Publishers., New Delhi
4. S.S. Narayan & Phundan Singh. 23015. Biometrical Techniques in Plant Breeding. 5thEdn. Kalyani Publishers.
5. K.A. Gomez and A.A. Gomez. 2ndEdn. Statistical procedures for Agricultural Research. John Wiley and sons.

# Department of Horticulture

## Course Layout

| Sl. No | Course code & Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | HORT 151. Introduction to Floriculture & Landscaping (Theory) | | 02 | 1 | II |
| 2 | HORT 152. Introduction to Floriculture & Landscaping (Practical) | | 02 | 1 | II |
| 3 | HORT 201. Vegetable Production (Theory) | | 03 | 2 | I |
| 4 | HORT 202. Vegetable Production (Practical) | | 02 | 2 | I |
| 5 | HORT 281. Nursery Management of Horticultural Crops (Theory- Elective) | | 02 | 2 | II |
| 6 | HORT 301. Vegetable Seed Production and Spices (Theory) | | 02 | 3 | I |
| 7 | HORT 302. Vegetable Seed Production and Spices (Practical) | | 02 | 3 | I |
| 8 | HORT 453. Fruit production & Orchard Management (Theory) | | 03 | 4 | II |
| 9 | HORT 454. Fruit Production & Orchard Management (Practical) | | 02 | 4 | II |
| | | Theory | 10 | | |
| | | Practical | 08 | | |
| | | Elective | 02 | | |
| | | **Total** | **20** | | |

| **Course Code: HORT 151**<br>**Course Title: Introduction to Floriculture & Landscaping (Theory)** | **Credit Hours: 02** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide introductory concepts of floriculture and landscaping. | | | |
| **Course Objectives:**<br>• Conceptualize horticulture and floriculture<br>• Acquire knowledge on propagation and tissue culture technique of ornamental plants.<br>• Acquaint with flower and ornamental plants production practices<br>• Understand about gardening and postharvest management of cut flowers | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Compare about horticulture and their branches | **Introduction to Horticulture:**<br>Definition and classification of horticulture, scope and importance of flowers, ornamental and plantation crops in Bangladesh. Nomenclature and classification of ornamental plants and plantation crops. | Lecture<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Generalize about propagation technique and introductory concept about tissue culture methods. | **Propagation of horticultural crops:**<br>Sexual & asexual methods of propagation, introduction to tissue culture. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Discriminate the production procedure and their management of flowers and ornamental plants | **Production and management:**<br>**a. Bedding flowers:** Antirrhinum, cosmos, calendula, dianthus, globe-amaranth, phlox, zinnia, aster<br>**b. Commercial flowers:**<br>Rose, tuberose, carnation, chrysanthemum, dahlia, gladiolus, lilies, lotus, marigold<br>**c.** Ornamental shrubs, trees, orchid, fern, cacti. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Narrate the different gardening practices in landscaping. | **Features of gardening:**<br>Water garden, rock garden, japanese garden, bonsai, topiary. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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|---|---|---|---|
| Describe the postharvest management of cut flowers | **Postharvest management of cut flowers:** Postharvest loses of flowers and flower products. Packaging, transportation and marketing of cut flowers. Flower design. | Lecture Discussion Visual presentation Assignment | Quiz/MCQ Short answer Essay type answer Report |
| Define landscaping and their different components | **Landscape Horticulture:** Definition, objectives, classification of Landscape. Development & maintenance of lawn, turf, home & institutional garden, City Park. | Lecture Discussion Visual presentation Assignment | Quiz/MCQ Short answer Essay type answer Report |
| • Describe the production, management and processing of plantation crops. | **Plantation crops:** Production, management and processing of plantation crops: Rubber, oil palm, betel leaf, betel nut, bamboo. | Lecture Discussion Visual presentation Assignment | Quiz/MCQ Short answer Essay type answer Report |
| • Accomplish latest research findings and information regarding floriculture & landscaping techniques | Latest research findings and information regarding propagation of horticultural crops, production and management various types of flower, postharvest management of cut flowers and landscape Horticulture | Assignment Visual presentation | Report |

**Reference Books:**


1. M.R. Amin. 1999. Names of Garden plants. B. Akter, 154, Aga-Sadek Road, Dhaka-2.
2. R. A. Larson. 2004. Introduction to Floriculture, 2nd edition, North Carolina State University, North Carolina.
3. T. K. Bose, R. Maiti, S. Dhua and P. Das. 1999. Floriculture & Landscaping. Naya prokash, Calcutta.
4. C. Hefferman. 2005. Flowers A to Z: Buying, Growing, Cutting, Arranging- A Beautiful Reference Guide to Selecting and Caring for the Best from Florist and Garden (Paperback).
5. M.F. Mondal. 2000. Nursery and plant propagation (in Bangla) Mrs. Afia Mondal, BAU campus, Mymensingh.
6. T. K. Bose and B. Chowdhury. 1991. Tropical Garden plants in Color. Horticulture & Allied publishers, Calcutta, India.
7. C.C. Webster and W.J. Baulkwill. 1989. Rybber. Longman Scientific and Technical, NY, USA.

| **Course Code: HORT 152**<br>**Course Title: Introduction to floriculture & landscaping (Practical)** | **Credit Hours: 02** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge about floriculture and landscaping. | | | |
| **Course Objectives:**<br>• Identify the different flowers and ornamental plants<br>• Acquire practical knowledge on different propagation practices of flower & ornamental plants.<br>• Acquaint with flower and ornamental plants and their various uses<br>• Understand about gardening and postharvest management of cut flowers | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Identify all flowers and ornamental plants seed | Identification of common flowers, ornamental plants and their seeds. | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Differentiate to all common garden tools | Identification of common garden tools. | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Recognize to all vegetative propagating materials of flowers and ornamental plants | Vegetative propagating materials of flowers and ornamental plants. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Justify the different asexual propagation practices of flowers and ornamental plants. | Propagation practices of flowers and ornamental plants. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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| Acquire knowledge about flower bouquet and garland preparation | Preparation of bouquet and garland. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Acquaint about cut flowers packaging system practically | Packaging of cut flowers. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Demonstrate the orchard management practices | Pruning and training of selected flowers and ornamental plants. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Construct the design of garden & park | Modeling of home garden, institutional garden and city park. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Acquire effective knowledge about flower cultivation | Cultural practices and management of important flowers and ornamental plants. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Identify different problems & suggest appropriate remedial measures | Field visit: Flower garden | Discussion<br>Demonstration | Report |

**Reference Books:**


1. R. A. Larson. 2004. Introduction to Floriculture, 2nd edition, North Carolina State University, North Carolina.
2. T. K. Bose and B. Chowdhury. 1991. Tropical Garden plants in Color. Horticulture & Allied publishers, Calcutta, India.
3. H. T. Hartmann, E. Kester and F. T. Davis. 1990. Plant propagation principle and practices. Prentice-Hall, International Editions.
4. M.F. Mondal. 2000. Nursery and plant propagation (in Bangla) Mrs. Afia Mondal, BAU campus, Mymensingh.
5. M.R. Amin. 1999. Names of Garden plants. B. Akter, 154, Aga-Sadek Road, Dhaka-2.
6. T. K. Bose, R. Maiti, S. Dhua and P. Das. 1999. Floriculture & Landscaping. Naya prokash, Calcutta.

| **Course Code: HORT 201**<br>**Course Title:**<br>**Vegetable production (Theory)** | **Credit Hours: 03** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide introductory concepts of traditional and nontraditional vegetable production. | | | |
| **Course Objectives:**<br>• Conceptualize horticulture and olereculture<br>• Acquire knowledge on vegetables and their nomenclature.<br>• Acquaint with traditional and nontraditional vegetable production<br>• Understand about vegetable farming | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Know actual scenery of vegetable production in Bangladesh | **Vegetable production in Bangladesh:**<br>Present status, distribution, scope, importance, problems and solution. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Acquire effective knowledge about vegetables nomenclature | **Classification and morphology of vegetable crops:**<br>Classification, nomenclature and morphology. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Discriminate environmental factors which influenced on vegetable production | **Factors influencing vegetable production:**<br>Environmental and cultural factors. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Explain the nutritional requirements and irrigation system for vegetable farming | **Nutrition and irrigation of Vegetable crops:**<br>Role of plant nutrients and water. Determining factors, methods and application of nutrients and water. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Narrate the different vegetable farming practices. | **Vegetable farming:**<br>Kitchen and commercial garden, organic farming, polytunnel farming, intercropping, relay cropping, multiple | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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| | cropping and hydroponic farming. | | |
| Describe the production technology of common vegetables in Bangladesh. | **Production technology**: Potato, sweet potato, tomato, brinjal, cole crops, sweet gourd, cucumber, watermelon, okra, pointed gourd and aroids. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br><br>Report |
| Demonstrate nontraditional vegetable production | **Nontraditional vegetable crops:** Mushroom, baby corn, chinese leck, asparagus, drum stick etc. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Attain latest research findings and information regarding modern vegetable production | Latest research findings and information regarding vegetable production in Bangladesh, nutrition and irrigation of vegetable crops, production technology of different vegetables and nontraditional vegetable crops. | Assignment | Report |

**Reference Books:**


1. M. D. Garrett. 2016. Gardening: The essential Beginner's Guide to Organic Vegetable Gardening.
2. E. C. Edward. 2009. The vegetable Gardener's Bible, 2nd edition.
3. H. T. Hartmann, D.E. Kester and F.T. Davies. 1990. Plant propagation: principle and practices. Prentice- Hall, International Editions.
4. S. L. Katyal and K. L. Chadha. 1996. Vegetable growing in India. Oxford & IBH Pub. Co. pvt. Ltd New Delhi.
5. P. Work and J. Carew. 1955. Vegetable production and Marketing (2nd edition). Usha printers. 6 Tulloch road. Bombay.
6. K. G. Sanmugavelu. 1989. Production Technology of Vegetable Crops. Oxford & IBH Pub. Co. Pvt. Ltd, New Delhi.
7. T. K. Bose and M.G Som.1990.Vegetable crops in India. Naya prokash, Calcutta.
8. T. K. Bose, S. k Mitra and M.K. Sadhu. 1986. Propagation of Tropical and Sub-tropical Horticultural crops. Naya prokash, Calcutta.

| **Course Code: HORT 202**<br>**Course Title: Vegetable Production (Practical)** | **Credit Hours: 02** | **Level: 2** | **Semester: I** |
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| **Rationale:** This course is designed to provide practical knowledge about traditional and nontraditional vegetable production. | | | |
| **Course Objectives:**<br>• Conceptualize about vegetable seeds and seedlings<br>• Acquire practical knowledge on vegetables and their nomenclature.<br>• Acquaint with traditional and nontraditional vegetable production practices<br>• Understand about vegetable farming and their management practices | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| Categorize vegetables seed and seedling | Identification of seeds, seedlings and plants of common vegetable crops. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Acquire effective knowledge on different planting methods of vegetable crops | Planting methods of common vegetable crops. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Perform seed bed preparation and raising of seedlings | Preparation of seedbed and raising of common vegetable seedlings. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Differentiate about healthy and quality seedling for vegetable farming | Seedling evaluation test of common vegetable crops. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Acquire effective knowledge about vegetables | Studies on morphological features of common vegetable crops (Amaranth, brinjal, | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce |

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| | common gourds, carrot, cabbage, cauliflower, okra, spinach etc) | | Practical notebook |
| Estimate about manuring systems for vegetable farming | Manuring of vegetable crops. | Lecture Discussion, Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Estimate the seed rate, seedlings and fertilizer requirement for vegetable farming | Estimation of seed rate, seedlings and fertilizer. | Lecture<br>Discussion<br>Demonstration<br>Problem solving in the class room | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Compare total economic analysis for vegetable farming | Estimation of cost of production and economic return of important vegetable crops. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Justify the vegetable cultivation schedule | Making of crop calendar for common vegetable crops. | Lecture<br>Discussion<br>Visual presentation<br>Demonstration by student | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Identify the problem and suggest the suitable remedial activities to solve them | Field visit: Vegetable farm | Demonstration<br>Discussion | Report |

**Reference Books:**


1. L. O. Copeland.1988. Principle of Seed Science and Technology. First Indian Report. Burgen Publishiering Company, USA.
2. M. M. Hussain.1995. Seed Production and Storage Technology (in Bangla). Meer Imtaiz Hussain, Dhaka.
3. M. A. Rashid and D. P. Singh. 2000. A Manual on Vegetable Seed production in Bangladesh. ABRDC-USAID-Bangladesh project, BARI, Joydebpur.
4. A. A. Khan. 1978. The physiology andn Biochemistry of Seed Dormancy and Germination. Elsiviers, North Holland. Bomedical prog, Amsterdam, The Netherlands.
5. FAO.1978. Agricultural and Horticultural Seeds.
6. J. W. E. Purseglove, G. Brown, C. L. Green and S.R.J. Robbins. 1981. Spices, Boll & Longman Group Uk Ltd. London.
7. E. H. Roberts. 1974. Viability to Seeds. Chapman and Hall Ltd, London.

| **Course Code : HORT 281**<br>**Course Title:**<br>**Nursery Management of Horticultural Crops (Theory-Elective)** | **Credit Hours: 02** | **Level: 2** | **Semester: II** |
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| **Rationale:** This course is designed to provide introductory concepts about nursery management of horticultural crops | | | |
| **Course Educational objectives:**<br>• Conceptualize about nursery<br>• Acquire knowledge on different nursery structures and establishment.<br>• Acquaint the nursery seedling production techniques<br>• Enrich understanding about asexual propagation of horticultural plants in a nursery | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Acquire introductory knowledge about nursery | **Introduction to nursery:** Definition, objectives, types, parts of commercial nursery. | Lecture<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Discuss the different components of nursery | **Structures in nursery:**<br><br>Green house, cold frame, lath house, net house, polytunnel, mist propagating unit, pots, polybag & frames for raising seedling in nursery, equipment's of nursery. | Lecture<br>Discussion<br>Visual presentation<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Acquaint different seedling or sapling growing media theoretically | **Growing media for raising seedlings /saplings:** Types, component, preparation of growing media, compost. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| Explain about nursery management | **Establishment & management of nursery:** Site selection, steps, layout. | Lecture Discussion Visual presentation | Quiz/MCQ Short answer Essay type answer |
| Describe the procedure of raising seedling and their management theoretically | **Raising of seedlings and saplings:** Seedbed, nursery bed, soil management, soil treatment, characteristics of good seedling | Lecture Discussion Visual presentation | Quiz/MCQ Short answer Essay type answer |
| Acquaint potting, depotting of saplings in nursery | **Uprooting and planting of seedling/sapling:** Selection of seedling/ sapling for planting, methods of planting, potting, depotting, repotting and aftercare. | Lecture Discussion Visual presentation | Quiz/MCQ Short answer Essay type answer |
| Discriminate the different propagation procedures of horticultural crops | **Propagation of horticultural crops:** Sexual & asexual propagation of horticultural crops with their merits & demerits. | Lecture Discussion Visual presentation | Quiz/MCQ Short answer Essay type answer |
| Perform organic fertilizer preparation for nursery management | **Preparation of organic fertilizers for nursery:** Water hyacinth, row cowdung, green leaves and inert materials, etc. | Lecture Discussion Visual presentation | Quiz/MCQ Short answer Essay type answer |
| Acquaint the mother plant management system in nursery | **Stock plant management:** Selection, raising and management. | Lecture Discussion Visual presentation | Quiz/MCQ Short answer Essay type answer |

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| Illustrate the production and marketing procedure of nursery plant | Collection, production management and marketing of nursery plant | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Obtain latest research findings and information regarding nursery management of horticultural crops | Latest research findings and information regarding nursery management, growing media for raising seedlings /saplings, organic fertilizers for nursery and stock plant management | Assignment | Report |

**Reference Books:**


1. G. E. Welbaum. 2015. Vegetable Production and Practices. CABI Publication.
2. M. M. Hussain.1995. Seed Production and Storage Technology (in Bangla). Meer Imtaiz Hussain, Dhaka.
3. K. K. De.1992. An Introduction to Plant Tissue Culture. New Central Book Agency, Calcuttta, India.
4. T. K. Bose, S.K. Mitra and Sadu, 1990, Propagation of Tropical and Subtropical Horticultural crops. Naya prokash, Calcutta- India.
5. R. A. T. George. 1980. Technical Guidelines for Vegetable Seeds Technology. Food & Agriculture Organization of the United Nations, Rome.
6. P. D. Hebblethwite. 1980. Seed production. Butlerworths, London.
7. M. N. Islam. 1990. “Bij Shanrakhan prajukti” (in Bangla) Misses Jahura Islam, 47/A, Ram Babu Road. Mymensingh.

| **Course Code: HORT 301**<br>**Course Title:**<br>**Vegetable Seeds Production and Spices (Theory)** | **Credit Hours: 02** | **Level: 3** | **Semester: I** |
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| **Rationale:** This course is designed to provide applied knowledge about Spices and vegetable seed production. | | | |
| **Course Objectives:**<br>• Acquire knowledge on vegetable seed physiology, production and their postharvest management.<br>• Acquaint the Spices and their various uses<br>• Understand about spices production and their postharvest management | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| Describe the vegetable seed production status in Bangladesh including its scope, production, business, demand, supply, problems and solutions | **Vegetable seeds in Bangladesh:** Present status, demand and supply, import and export, seed business and seed industries, importance, scope, problems and solution. | Lecture<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Explain the physiological and quality parameters of vegetable seeds | **Vegetable seed physiology and quality:** Seed kinds and classes, purity, seed vigor, seed viability, seed dormancy, seed germination and factors influencing seed production. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Discriminate about vegetable seed production and their postharvest management | **Vegetable seeds production, processing, packaging and storing:** Potato, brinjal, cauliflower, bottle gourd and okra storage methods, factors affection seed quality and storage life of seeds. | Lecture, discussion, visual presentation | MCQ<br>Short answer<br>Essay type answer |
| Generalize about important spices and condiments in Bangladesh | **Spices and condiments of Bangladesh:** Present status, importance, scope, problems and solution. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Perform management practices of spices and condiments to obtain better production of spices and condiments | **Principle and practices of spices and condiments:**<br><br>Methods of propagation, planting materials, planting methods, manuring and irrigation. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| Demonstrate the modern production technology of important spices and condiments | **Production technology of spices and condiments:**<br>Onion, garlic, turmeric, zinger, chilli, black pepper, and cinnamon. | Lecture<br>Discussion<br>Visual presentation<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Explain the processing and storage technique of important spices and condiments in Bangladesh | **Processes and storage of spices and condiments:**<br>Onion garlic, turmeric, zinger, chilli, black pepper, and cinnamon. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Acquire latest research findings and information regarding vegetable seeds production and spices in Bangladesh | Latest research findings and information about production technology of vegetable, spices and condiments and their seed production. | Assignment | Report |

**Reference Books:**


1. A. Farooqi, B.S. Sreeramu and K. N. Srinivasappa. 2005. Cultivation of Spice Crops. University press.
2. L. Herman. 2015. Herb & Spice Companion: The Complete Guide to Over 100 Herbs & Spices. Quarto Publishing Group, USA Inc.
3. M. M. Hussain. 1995. Seed Production and Storage Technology (in Bangla). Meer Imtaiz Hussain, Dhaka.
4. M. A. Rashid and D. P. Singh. 2000. A Manual on Vegetable Seed production in Bangladesh. ABRDC-USAID-Bangladesh project, BARI, Joydebpur.
5. P. D. Hebblethwite. 1980. Seed production. Butlerworths, London.
6. J. S. Pruthi. 1986. Spices and condiments. National Book Trust, New Delhi.
7. D. K. Sallunkhe and B.B.D. Bhat. 1987. Vegetable and flower Seed production. Agricole publishing Academy, New Delhi, India.
8. R. A. T. George. 1980. Technical Guidelines for Vegetable Seeds Technology. Food & Agriculture Organization of the United Nations, Rome.

| **Course Code: HORT 302:**<br>**Course Title: Vegetable Seeds Production and Spices (Practical)** | **Credit Hours: 02** | **Level: 3** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge about spices and vegetable seed production. | | | |
| **Course Objectives:**<br>• Acquire practical knowledge on vegetable seed physiology, seed germination and seedling production.<br>• Acquaint the Spices and their various uses practically.<br>• Apprehend about spices production and their postharvest management practically | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Identify almost all common spices and condiments of Bangladesh | Identification of common spices and condiments. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Distinguish the different economic part and management practices of particular spices and condiments | Study of morphological features of important spices and condiments (Onion, garlic, turmeric, zinger, cardamom, cinnamon, coriander, mint, bay leaf & clove) | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Report<br>Practical notebook |
| Estimate the fertilizer doses for commercial production of vegetable seeds and spices | Estimation of manure and fertilizer doses for common vegetable and spice crops. | Lecture<br>Discussion<br>Visual presentation<br>Problem solving in the class room | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| Apply vegetative propagating materials of vegetables and spices | Study of vegetative propagating materials of | Lecture<br>Discussion<br>Visual | Quiz/MCQ<br>Short answer<br>Demonstration |

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| | vegetable and spices crop (Bulb, corm, rhizome, sucker, stolon and tuberous root). | presentation<br>Handling of practical work | performance<br>Viva-voce<br>Practical notebook |
| Recognize about processing techniques of some spices crops | Processing techniques of some selected spice crops. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Discriminate knowledge about seed extraction techniques of some vegetable crops | Seed extraction process of selected vegetables. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Spread over manure and fertilizer application system in the vegetable and spices field | Method of application of manure and fertilizers in common vegetable seed and spices crops. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Discriminate about seed quality and identify the good quality seed | Test of germination and purity percentage of seeds. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| Analyze the profitability of the production of vegetable seeds and spices | Estimation of cost of production and economic return of some important vegetable seeds and spices. | Lecture<br>Discussion<br>Problem solving in the class room | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| Comprehend the management schedule of spices crops | Crop calendar for spices crops | Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Demonstration performance |

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| | | | Viva-voce<br>Practical notebook |
| Physically observe the vegetable seed and spices production in the growers field | Field visit. | Demonstration<br>Interactive discussion | Report |

**Reference Books:**


1. J. S. Pruthi. 1986. Spices and condiments. National Book Trust, New Delhi.
2. J. W. E. Purseglove, G. Brown, C. L. Green and S.R.J. Robbins. 1981. Spices, Boll & Longman Group Uk Ltd. London.
3. M. A. Rashid and D. P. Singh. 2000. A Manual on Vegetable Seed production in Bangladesh. AVRDC-USAID-Bangladesh project, BARI, Joydebpur.
4. A. M. Mayer.and A. poijakoff- Mayber. 1975. The. Germination of Seeds. Pergamon press.
5. E. H. Roberts.1974. Viability to Seeds. Chapman and Hall Ltd, London.
6. D. K. Sallunkhe and B.B.D. Bhat. 1987. Vegetable and flower Seed production. Agricole publishing Academy, New Delhi, India.

| **Course code: HORT 453**<br>**Course Title: Fruit Production & Orchard Management (Theory)** | **Credit Hours: 03** | **Level: 4** | **Semester: II** |
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| **Rationale:** This course is designed to provide applied knowledge about fruit and orchard management. | | | |
| **Course Objectives:**<br>• Conceptualize horticulture and pomology<br>• Acquire knowledge on propagation techniques of fruit plants.<br>• Acquaint the establishment and proper management of orchard<br>• Understand about fruit production and their postharvest management | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Discriminate about fruits, its importance and production status | **Introduction to pomology and general aspects of fruit production in Bangladesh:** Definition and classification of fruit, scope, importance, area and production of common fruits | Lecture<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Explain fruit distribution over the world, best fruit growing region and environmental factors of fruit production | **Environmental physiology and geographical distribution of fruit crops:** Effect of environmental factors on production of fruit. Major fruit growing regions of the world, their climatic feature and distribution of fruit plants. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Illustrate different propagation practices of fruit plants with their merits and demerits | **Propagation of fruit crops:** Methods of propagation - seedage & polyembryony, cuttage, layerage, and graftage. Stionic relationship and incompatibility, top working and micro propagation. | Lecture<br>Discussion<br>Visual presentation<br>Group work | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Recommend soil nutritional management of fruit plants by using irrigation and fertilization | **Soil nutrition & irrigation of fruit crops:** Fertilizing & manuring of fruit crops, irrigation & drainage. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Recognize the orchard and its management practices | **Establishment & management of fruit orchard:** Site selection, land development and planting plant, bearing habit, | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| | unfruitfulness, pruning and training, controlling soil erosion | | |
| Know the plant growth regulators and its uses for the improvement of fruit plant<br><br>Describe the method of plant growth regulators application for fruit crops | **Use of growth regulators in fruit production:** Classification, importance, preparation& use of growth regulators in fruit production. Methods of plant growth application in different fruit crops. | Lecture, discussion, Visual presentation | MCQ<br>Short answer<br>Essay type answer |
| Describe the modern production technology of fruit plants of Bangladesh | **Production technology of fruit crops:**<br>Banana, papaya, pineapple, mango, jackfruit, litchi guava jujube, coconut, citrus fruits and important minor and exotic fruits. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Explain the postharvest practices of fruits | **Postharvest management of fruits:**<br>Postharvest physiology of fruits, factors affecting shelf life of fruits, causes of spoilage of fruits and its remedies, grading, packaging, transporting and marketing of fruits. | Lecture<br>Discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| Discriminate the advanced and new techniques of fruit production in Bangladesh | Advanced techniques in fruit production. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| Attain latest research findings and information regarding Fruit production & orchard management in Bangladesh | Latest research findings and information regarding general aspects of fruit production in Bangladesh, production technology and postharvest management of fruit crops. | Assignment | Report |

**Reference Books:**


1. R. S. Martin and C. Schultz. 2013. How to Prune Fruit Trees, Twentieth Edition.
2. B. Pike. 2011. The Fruit Tree Handbook.
3. L. Hill and L. Perry. 2011. The Fruit Gardener's Bible: A complete Guide to Growing Fruits and Nuts in the Home Garden.
4. T. K. Bose and S. K. Mitra, 1995. Fruits: Tropical and Subtropical. Naya prokash, Calcutta- India.
5. T. K. Bose, S. K. Mitra and M. K. Sadu, 1990. Propagation of Tropical and Subtropical. Horticultural Crops. Naya Prokash, Calcutta- India.
6. K. K. De. 1992. An Introduction to plant Tissue Culture. New Central Book Agercy, Calcutta.
7. H. T. Hartmann, D.E. Kester and F.T. Davis Jr. 1990. Plant propagation principle and practices. Prentice –Hall, International Editions.
8. M. F. Mondal. 2000. Nursery and plant propagation (in Bangla). Afia Mondal, BAU campus, Mymensingh.

| **Course Code: HORT 454**<br>**Course Title: Fruit Production & Orchard Management (Practical)** | **Credit Hours: 02** | **Level: 4** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide practical knowledge about fruit production. | | | |
| **Course educational objectives:**<br>• Acquire practical knowledge on fruit seed physiology, seed germination and seedling production.<br>• Acquaint the fruit propagation techniques practically.<br>• Apprehend about fruit production and their postharvest management practically | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to - | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| Identify all common fruit plants in Bangladesh by leaf or flower or other parts | Identification of common fruit plants in Bangladesh. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Describe the morphological features of important fruit plants | Morphological features of some important fruit plants (Mango, jackfruit, litchi, jujube, guava, custard apple, banana, pine and coconut). | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Demonstrate the planting system of fruit plants in the orchard | Practices on different layout system of fruit plants in orchard (Square, rectangular, triangular & hexagonal planting system) | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| Know the nutritional management of fruit plants in the orchard | Methods of manuring and fertilizing practices in common fruit crops. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

| | | | |
|---|---|---|---|
| Perform different propagation practices of fruit plants | Practicing vegetative propagation of common fruit plants of Bangladesh (Budding, grafting & layering). | Lecture<br>Discussion<br>Demonstration<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Operate the important management practices to improve fruit bearing of plant like pruning, training and other cultural operations in the orchard | Practices on pruning, training and other cultural operations of orchards. | Lecture<br>Discussion<br>Visual presentation<br>Handling of practical work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| Analyze the profitability of the orchard | Economic analysis on mango, banana, pineapple and other important fruit crops. | Lecture<br>Discussion<br>Demonstration<br>Problem solving in the class room | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| Observe the orchard and fruit Processing industry | Field visit. | Demonstration<br>Interactive discussion | Report |

**Reference Books:**


1. R. E. Paull and O. Duarte. 2011. Tropical Fruits (Crop Production Science in Horticulture)
2. V. G. Sauco and J. C. Robinson. Bananas and Plantains (Crop Production Science in Horticulture) 2nd Edition
3. T. Radha and M. Mathew. 2007. Fruit Crops. New India Publishing Agency, New Delhi
4. D. K. Salunkhe and S. S. Kadam. 1995. Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing (Food Science and Technology) 1st Edition
5. M. Rieger. 2006. Introduction to Fruit Crops. Taylor & Francis
6. P. K. Yadav. 2007. Fruit Production Technology. International Book Distribution Company

# Department of Language

## Course Layout

| Sl. No. | Course Code and Title | Credit Hours | Level | Semester |
|---|---|---|---|---|
| 1 | ENGL 131: Advanced English Language Skills (Theory-Elective) | 02 | 1 | I |
| | **Total** | **02** | | |

| **Course Code: ENGL 131**<br><br>**Course Title: Advanced English Language Skills (Theory-Elective)** | **Credit Hours: 02** | **Level: 1** | **Semester : I** |
|---|---|---|---|
| **Rationale:** This course is designed to make students develop their communicating skills in English language in both academic and practical life. | | | |
| **Course Objectives:**<br><br>• Make students attain basic competence in English language that includes all the four skills i.e. listening, speaking, reading and writing<br>• Improve grammatical knowledge and vocabulary<br>• Emphasize particular focus on writing skills<br>• Prepare students competent in communicative skills | | | |

| **Intended Learning Outcomes (ILOs)**<br><br>The students will be able to - | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Communicate with English speakers' speech correctly and contact without inhibition<br>• Learn the technique of listening | **Listening -** Listening to isolated words, utterances; listening to connected speech | Lecture<br>Discussion<br>Group works<br>Pair works<br>using audio cassettes of pronunciation regarding course book | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Oral test |
| • Communicate fluently with correct pronunciation and without grammatical mistakes<br>• Learn how to frame W/H questions<br>• Perform better in speech delivery | **Speaking -** W/H questions, functions (practical usage e.g. agreement, disagreement, order, request, apology); place and manner of articulation of IPA symbols; dialogues; story telling; presentation on current issues; extempore speech | Lecture<br>Discussion<br>Multimedia presentation<br>Group works<br>Pair works | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Oral test |

| | | | |
|---|---|---|---|
| • Join sentences and construct sentences according to different grammatical context<br>• Explain both academic and nonacademic reading in time constraint<br>• Predict information by using different types of reading strategy | **Reading -** Reading for specific information, general information, text organization, grammar in context, subject-verb agreement, sentence structures, modals, conditionals, degree of comparison, knowing vocabulary items: technical words, confusing foreign words and phrases, British and American words, apostrophes, prefix, suffix, preposition, phrasal verbs, conditional sentences, homophones, homograph | Lecture<br>Discussion<br>Multimedia presentation<br>Group works<br>Pair works | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain different techniques of creative writing<br>• Demonstrate knowledge of writing skill in formal as well as informal way<br>• Interpret data and graphics text<br>• Summarize broad version of writing piece within limited sentences | **Writing -** Writing paragraphs using different techniques, summary writing, story writing; letters: formal letter, informal letter, inquiry letter, cover letter, CV, resume; report: report to newspaper, writing agendas, press release, memorandum; writing essays: argumentative, expository, descriptive, narrative, creative writing; story completing, describing picture, interpret data | Lecture<br>Discussion<br>Multimedia presentation<br>Group works<br>Pair works<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

**Reference Books**


1. D. Hopkins and P. Cullen. 2007. Cambridge Grammar for IELTS. Cambridge University Press, Cambridge.
2. A. Mountford. 1995. English in Agriculture. 8th Edn. Oxford University Press, Oxford.
3. M. Maniruzzman. 2002. Basic English Language Skills. Friends Book Corner, Dhaka.
4. J. Seely. 2005. Oxford Guide to Effective Writing and Speaking. 2nd Edn. Oxford University Press, Oxford.
5. A.M. Pyle and M.E. Munoz. 1995. CLIFFS TOEFL Preparation Guide. 4th Edn. Cliffs Cassettes Publication.
6. R.R. Jordan. 1986. Academic Writing Course. Collins Publication.
7. Q.M. Billah, G.S. Chowdhury and M. Alam. 2005. Foundation English for Undergraduates. 2nd Edn. Friends Publication, Dhaka.
8. Sheikh Mujibor Rahman. 2016. The Unfinished Memoirs. 2nd Edn. University Press Limited, Dhaka.
9. A.S. Hornby. 2010. Oxford Advanced Learners Dictionary. 7th Edn. Oxford University Press, Oxford.
10. D. Hopkins and M. Nettle. 2006. Passport to IELTS. New Revised Edn. Pearson Education Limited.
11. Barry and S. MaCarter. 2007. Improve your IELTS: Listening and Speaking Skills. Macmillan Education, Towns Road, Oxford.
12. J.D. O'Conner. 1980. Better English Pronunciation. 2nd Edn. Cambridge University Press, Cambridge.
13. A. Baker. 2006. Ship or Sheep? An Intermediate Pronunciation Course. 3rd Edn. Cambridge University Press, Cambridge.

# Department of Plant Pathology

## Course Layout

| Sl. No. | Course Code and Title | | Cr. Hr | Level | Semester |
|---|---|---|---|---|---|
| 1 | PLPA 205: Introduction to Plant Pathology and Microbiology (Theory) | | 02 | 2 | I |
| 2 | PLPA 206: Laboratory Techniques in Plant Pathology and Microbiology (Practical) | | 02 | 2 | I |
| 3 | PLPA 353: Principles of Plant Pathology and Seed Pathology (Theory) | | 03 | 3 | II |
| 4 | PLPA 354: Diagnosis and Management of Field Crop Diseases and Seed Health Test (Practical) | | 02 | 3 | II |
| 5 | PLPA 457: Diseases of Horticultural Crops and Post-Harvest Pathology (Theory) | | 03 | 4 | II |
| 6 | PLPA 458: Diagnosis and Management of Horticultural and Cash Crops Diseases (Practical) | | 02 | 4 | II |
| 7 | PLPA 431: Clinical Plant Pathology (Theory-Elective) | | 02 | 4 | I |
| | | Theory | 08 | | |
| | | Practical | 06 | | |
| | | Elective | 02 | | |
| | | **Total** | **16** | | |

| **Course Code: PLPA 205**<br>**Course Title: Introduction to Plant Pathology and Microbiology (Theory)** | **Credit Hours: 02** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:**This course is designed to provide fundamental concept on Plant Pathology and microbes causing diseases of agricultural crops. | | | |
| **Course Objectives**<br>• Acquire knowledge on different microbes causing diseases of agricultural crops<br>• Understand the etiology of different plant diseases<br>• Gather knowledge on infection processes of different plant pathogens<br>• Acquire knowledge about plant parasitic phanerogamae<br>• Gain knowledge on mycorrhizae and its importance as protein sources | | | |
| **Intended learning Outcomes (ILOs)**<br>The student will be able to- | **Course content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Define Plant Pathology and plant diseases<br>• Describe the historical background of Plant Pathology | Concept of Plant Pathology, Plant diseases and history | Lecture<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the crop losses due to plant diseases in Bangladesh and the world context. | Significance of Plant diseases with special reference to Bangladesh. | Lecture<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss the contribution of plant pathologists in food security and safety | Food Security and Safety in relation to crop diseases in Bangladesh. | Lecture<br>Multimedia presentation<br>Interactive discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the biotic and abiotic causes of plant diseases | Causes of Plant diseases: Biotic and abiotic causes. | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Differentiate between sign and symptom of plant diseases.<br>• Diagnose the plant diseases based on signs and symptoms | Symptomology: General symptoms and sign of plant diseases. | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and characterize the fungi based on their morphological and reproductive features<br>• Explain the nutrition uptake behavior of fungi | Fungi: General characteristics of fungi including morphology, reproduction and nutrition | Lecture<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Illustrate the international system of nomenclature of fungi<br>• Classify fungi based on their key characteristics | Nomenclature and classification of fungi | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the key characteristics of representative genera of Mastigomycotina and their economic importance<br>• Illustrate the life cycles of Mastigomycotina fungi | Study of the representative genera of each sub-division of fungi-Mastigomycotina. | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the key characteristics of representative genera of Zygomycotina and their economic importance<br>• Illustrate the life cycles of Zygomycotina fungi | Study of the representative genera of each sub-division of fungi-Zygomycotina | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the key characteristics of representative genera of Ascomycotina and their economic importance<br>• Illustrate the life cycles of Ascomycotina fungi | Study of the representative genera of each sub-division of fungi-Ascomycotina | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the key characteristics of representative genera of Basidiomycotina and their economic importance.<br>• Illustrate the life cycle of Basidiomycotina fungi | Study of the representative genera of each sub-division of fungi-Basidiomycotina | Lecture<br>Visual presentation | Quiz/MCQ,<br>Short answer<br>Essay type answer |
| • Classify genera belongs to the sub-division Deuteromycotina<br>• Characterize the orders, family and genus of Deuteromycotina<br>• Illustrate the life cycles of Deuteromycotina fungi | Study of the classes, orders, families and genera of Deuteromycotina | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State the key characteristics of plant pathogenic bacteria<br>• Describe the morphology, reproduction and nutrition of bacteria | Bacteria: General morphology, reproduction and nutrition | Lecture<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Classify plant pathogenic bacteria under different taxa | Classification of plant pathogenic bacteria on their variation | Lecture<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and describe the infection process of bacteria.<br>• Diagnose the bacterial diseases of crops based on signs and symptoms | Infection process of Bacteria, symptomology of bacterial diseases | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and characterize viruses, viroids and mycoplasma<br>• Describe the physio-chemical properties of viruses, viroids and mycoplasma<br>• Classify plant pathogenic viruses | Viruses, viroids and mycoplasma: General characteristics, physical and chemical properties, classification and identification | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the transmission mechanisms of viruses, viroids and mycoplasma<br>• Describe the symptoms of viral and mycoplasmal diseases of crop plants | Transmission of viruses, viroids and mycoplasma and their disease symptoms in crop plants | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and classify plant parasitic nematodes<br>• Discuss the feeding behviour of plant parasitic nematodes.<br>• Illustrate the life cycle of root knot nematodes | Plant parasitic nematode: Morphology, classification, feeding behavior and reproduction | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the entry of endoparasitic nematodes into the host plant<br>• Explain the ectoparasitic behaviour of plant parasitic nematodes<br>• Describe the symptoms of nemic diseases of crop plants | Infection process of nematode and symptom of nemic diseases | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define mycorrhizae and explain the importance of mycorrhizae in agriculture<br>• Discuss the association-behaviour of mycorrhizae with the roots of crop plants | Mycorrhizae: Definition, types of association and importance in Agriculture | Lecture<br>Visual presentation<br>Interactive discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Define Plant Pathology and plant diseases<br>• Describe the historical background of Plant Pathology | Concept of Plant Pathology, Plant diseases and history | Lecture Multimedia presentation | Report |

**References Books**


1. C.J. Alexopoulos, C.W. Mims and M. Blackwell. 2007. Introductory Mycology. John Wiley & Sons: New York
2. G.N. Agrios. 2005. Plant Pathology. 5th Edition. Academic Press, New York.
3. H.C. Dube. 1996. A text book of fungi, bacteria and viruses. Vikas Publication India.
4. M.H. Ashrafuzzaman. 1991. A Text Book of Plant Pathology. Bangladesh Agricultural Research Council.
5. J. Webster. 1991. Introduction to Fungi, Second Edition, Cambridge University Press, Cambridge.
6. M.B. Ellis. 2001. Dematiacious Hyphomycetes. CAB International Pub.
7. M. Goto. 1996. Fundamental of Bacterial Plant Pathology. Academic Press Inc. Tokyo.
8. R.E.F. Mathews. 1991. Plant Virology. 3rd Edition. Academic Press, INC. 1250 Sixth Avenue, San Diego, California, USA.
9. G.L. Schumann and C.J. D'Arcy. 2010. Essential Plant Pathology. APS press, USA.
10. R.N. Trigiano. 2007. Plant Pathology concept and laboratory exercise, CRC press, India.

| **Course Code: PLPA 206**<br>**Course Title: Laboratory Techniques in Plant Pathology and Microbiology (Practical)** | **Credit Hours: 02** | **Level: 2** | **Semester: I** |
|---|---|---|---|
| **Rationale:** The course is designed to provide knowledge about different laboratory equipments and techniques related to Plant Pathology and Microbiology. | | | |
| **Course Objectives**<br>• Introduce with the lab equipments for identification of plant pathogens<br>• Acquire knowledge about technical know how for the handling of lab equipments<br>• Gather knowledge about different lab techniques for microbiological works<br>• Identify and characterize the plant pathogens through detail studies | | | |
| **Intended learning Outcomes (ILOs)**<br>The student will be able to- | **Course content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Identify the lab equipments for microbiological study<br>• Exercise the safety rules for plant pathological lab studies | Introduction of equipments, Safety rules in Plant Pathology laboratory | Lecture<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |
| • Identfy different types of microscopes and the parts of microscopes<br>• Handle microscopes for visual observation and photography | Microscopy: Compound, Stereo and microphotography | Lecture<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |
| • Identify different culture media.<br>• Prepare different culture media and describe their uses.<br>• Sterilize instruments and culture media | Preparation of culture media and sterilization | Lecture<br>Demonstration<br>Exercise<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |
| • Explain different procedure / protocol to isolate plan pathogens<br>• Isolate fungi, bacteria and nematodes from diseased plant parts and soil | Isolation of fungi, bacteria, viruses and nematode from diseased plant materials and soils. | Lecture<br>Demonstration<br>Exercise<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |
| • Describe the different techniques for slide preparation.<br>• Prepare semi-permanent and permanent slide for microscopic study | Techniques involved in preparation of slides for microscopic study | Lecture<br>Demonstration<br>Exercise<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |

| | | | |
|---|---|---|---|
| | **Study of the following genera:** | | |
| • Describe the key characteristics of important fungi<br>• Identify the pathogenic fungi by visual<br>• Figure out the fruiting structures of fungal pathogens | Phytophthora, Pythium, Rhizopus, Aspergillus, Penicillium, Alternaria, Cercospora, Colletotrichum, Bipolaris, Pyricularia, Curvularia, Fusarium, Sclerotium, Rhizoctonia, Botrytis, Ascochyta and Trichoderma, Agaricus | Lecture<br>Multimedia presentation<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |
| • Identify and describe the different phanerogamic plant parasites and their parasitic behaviour | Phanerogamic plant parasite | Lecture<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Exercise<br>Practical notebook<br>Viva Voce |

**Refrencee Books**


1. C. J. Alexopoulos, C.W. Mims and M. Blackwell. 2007. Introductory Mycology. Wiley student Edition. New York.
2. G. N Agrios. 2005. Plant pathology. 5th edition. Academic Press, New York.
3. H. C. Dube. 1996. A text book of fungi, bacteria and viruses. Vikas Publication India.
4. M. H. Ashrafuzzaman. 1991. A Text Book of Plant Pathology, Bangladesh Agricultural Research Council.
5. R. N. Trigiano. 2007. Plant Pathology concept and laboratory exercise. CRC press, India.
6. D. K. Jha. 2007. Laboratory Manual on Plant Pathology. Pointer Publishers.
7. A. B. Baudoin. 1990. Laboratory exercise in Plant Pathology. Scientific Publishers.
8. R. B. Streets. 1982. The diagnosis of Plant Diseases, The University of Arizona Press. Tucson.
9. C. J. Alexopoulos and E. S. Beneke. 1972. Laboratory Manual for Introductory Mycology. Bargees Publishing Co.

| **Course Code: PLPA 353**<br>**Course Title: Principles of Plant Pathology and Seed Pathology (Theory)** | **Credit Hours: 03** | **Level: 3** | Semester: II |
|---|---|---|---|
| **Rationale:** This course is designed to provide knowledge on principles of Plant Pathology and Seed Pathology emphasis on development of plant diseases and strategies & tools for their management. | | | |
| **Course Objectives**<br>• Acquire knowledge on the host-pathogen interactions in plant disease development<br>• Gain knowledge about the impact of different factors for epidemic disease development<br>• Gather knowledge on management strategies and tactics for plant disease management<br>• Provide knowledge on seed health, seed borne diseases and their transmission mechanisms<br>• Acquire knowledge on seed health management by seed crop management and seed storage management | | | |
| **Intended learning Outcomes (ILOs)**<br>The students will be able to- | **Course content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Describe the plant parasites and their interactions with the host<br>• Explain the host-pathogen interaction for plant disease development | Plant parasite interaction and disease development; Parasitism, pathogenicity and pathogenesis | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the chronological phases of plant disease development<br>• Describe the ways and means of survival of plant in the environment | Disease cycle emphasizing fungal, bacterial and viral diseases of field crops | Lecture<br>Multimedia presentation<br>Interactive discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define toxin, enzyme & growth regulators<br>• Discuss the roles of toxins, enzymes and growth regulators in disease development | Physiological interaction between plant and pathogen- role of enzyme, toxins and growth regulators in disease development | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain biochemical interactions between host & pathogen in molecular level | Molecular aspects of plant-microbe interactions; Overview of the biology of host-microbe interventions at | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| | molecular level | | |
| • Define epidemiology and epidemic disease<br>• Describe the types of epidemic diseases<br>• Explain the interactions of epidemic components for plant disease development<br>• Represent the schematic diagrams of disease triangle and disease tetrahedron | Plant disease epidemiology: Concept and components (factors) of epidemics, Types of epidemic diseases, interaction of factors for development of epidemic diseases, Disease triangle and disease tetrahedron | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss the predisposing factors for disease development | Epidemics as the change in disease intensity on a host population over time and spaces, predisposition | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and describe the disease incidence and disease severity<br>• Estimate the crop losses due to plant disease | Epidemics and crop loss assessment | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define production, liberation and dissemination of plant pathogens<br>• Describe the pathogenic inocula and their production devices<br>• Discuss the liberation theory of plant pathogenic inocula | Dissemination of pathogens; Production and liberation of pathogen propagules, liberation theory of inocula | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the ways and means of dissemination of pathogens<br>• Control the spreading of pathogenic inocula for disease management | Factors and mechanisms of dissemination of pathogen propagules | Lecture<br>Interactive discussion<br>Multimedia presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • State the principles of plant disease management<br>• Explain the principles of plant disease management | Principles and methods of plant disease management: Cultural methods, Chemical and Biological methods Legislative measures: | Lecture,<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Prescribe the cultural, chemical and eco-friendly methods of plant disease management<br>• State and describe the principles of qurantine regulations and categories of qurantine pathogens | Plant quarantine acts and principles, | | |
| • Explain the reasons for global warming and climate change<br>• Discuss the impact of climate change on plant disease development | Impact of global warming and climate change on crop disease and strategy for mitigation | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define host resistance, immunity, tolerance and horizontal & vertical resistance<br>• Explain the self defense mechanisms of host plants<br>• Describe the tecniques for developing resistant varieties/ transgenic varieties | Host resistance: Defense mechanisms of host plants against pathogens, Horizontal and Vertical resistance. Conventional breeding and *Agrobacterium* mediated gene transfer to make transgenic resistant plant | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define integrated disease management<br>• State the environment friendly components<br>• Describe the integrated approach for the disease management | Integrated approach; concepts, components and economics of application. | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define plant disease forecasting<br>• Discuss the methods of preparation of plant disease forecasting models | Disease forecasting: Concept, basic consideration of plant disease forecasting, monitoring and evaluation, Forecasting models | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define Seed Pathology and review its history | Seed Pathology: Introduction to Seed Pathology, importance / | Lecture<br>Interactive discussion | Quiz/MCQ<br>Short answer<br>Essay type |

| | | | |
|---|---|---|---|
| • Explain the importance / significance of seed borne diseases, Distingush between seed borne and seed transmitted pathogens<br>• Describe the entry and transmission mechanism of seed borne pathogen<br>• Draw and describe the categories of transmission cycles of seed borne diseases. | significance of seed borne diseases in relation to food security. Mechanism of transmission of seed borne pathogens from seed to plant to seed | Multimedia presentation<br>Assignment | answer<br>Report |
| • Describe the features of quality seed<br>• Exercise the production technology of quality seed<br>• Describe the seed health testing methods and seed storage management<br>• Describe the storage principles for seed storage management<br>• Prescribe seed treatment for management of seed borne pathogens | Seed health management: Quality seed production, seed health testing methods, seed storage management for quality control, seed treatments | Lecture<br>Interactive discussion<br>Multimedia presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the plant parasites and their interactions with the host<br>• Explain the host-pathogen interaction for plant disease development | Plant parasite interaction and disease development; Parasitism, pathogenicity and pathogenesis | Assignment | Report |

## Reference Books:


1. G. L. Schumann and J. D'Arcy Cleora. 2010. Essential Plant Pathology. 2nd Edition.
2. G. N. Agrios. 2005. Plant Pathology, Fifth edition. Academic press, New York.
3. P. Neergaard. 2005. Seed Pathology Vol.-1. S. Chand & Company, New Delhi.
4. G. Rangashwami and A. Mahadevan. 2004. Diseases of Crop plants in India. Prentice-Hall of India, New Delhi-110001.
5. S. Nehra, 2005. Plant Disease bio-control management. Aaviskar publisher.
6. Trivedi. 2003. Plant Protection: a biocontrol approach. Aaviskar publisher.
7. R. S. Singh. 2006. Introduction to Principles of Plant Pathology. 4th Edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
8. R. S. Singh. 2001. Plant Disease Management. Oxford and IBH Publishing Co., New Delhi.
9. S. B. Chattopadhyay. 1991. Principles and Procedures of Plant Protection. Oxford and IBH Publishing Co., New Delhi.
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| Course Code: PLPA 354<br>Course Title: Diagnosis and Management of Field Crop Diseases and Seed Health (Practical) | Credit Hours: 02 | Level: 3 | Semester: II |
|---|---|---|---|

**Rationale:** This course is designed for diagnosis of major field crops diseases, seed borne diseases and their management.

**Course Objectives**

- Diagnose major field diseases and seed borne diseases of crop plants
- Identify the pathogens isolated from diseased specimens of infected plant/plant parts
- Acquire practical knowledge and skill for evaluation of seed health
- Introduce with technical know how for formulation and application of pesticides
- Equip with knowledge for prescription for controlling plant diseases

| Intended learning Outcomes (ILOs)<br>The students will be able to- | Course content | Teaching - Learning Strategies | Assessment Strategies |
|---|---|---|---|
| | **Details study on:** | | |
| • Identify blast and brown spot diseases of rice<br>• Prepare slide from the diseased specimen to identify the causal pathogen.<br>• Prescribe the control measures | Rice diseases:<br>Blast and brown spot of rice | Lecture<br>Workout<br>Demonestration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva- voce |
| • Identify leaf blight, leaf rust and loose smut disease of wheat based on typical symptoms<br>• Prepare slide from the diseased specimen and identify the causal pathogen.<br>• Prescribe the bicontrol measures | Wheat diseases:<br>Leaf blight, leaf rust and loose smut of wheat | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |
| • Identify stem rot, black band and anthracnose disease of jute based on typical symptoms<br>• Prepare slide from the diseased specimen and identify the causal pathogen.<br>• Prescribe the control measures | Jute diseases:<br>Stem rot, black band and anthracnose of jute | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Preparation of Practical Notebook and Disease Album<br>Viva Voce |

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| • Identify Cercospora leaf spot of mungbean based on typical symptoms<br>• Prepare slide from the diseased specimen and identify the causal pathogen.<br>• Prescribe the control measures | Pulse diseases:<br>Cercospora leaf spot of Mungbean | Lecture<br>Workout<br>Demonestration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease- album<br>Viva -voce |
| • Identify grey leaf spot/blight of mustard and tikka disease of groundnut based on typical symptoms<br>• Prepare slide from the diseased specimen and identify the causal pathogen.<br>• Prescribe the control measures | Oil seed crops:<br>Grey leaf spot/ blight of Mustard, Tikka disease of Groundnut | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |
| | **Brief study on:** | | |
| • Identify BLB, BLS, sheath blight, stem rot, sheath rot, false smut, bakanae, ufra and tungro disease of rice based on typical symptoms<br>• Identify the causal pathogen observing under microscope.<br>• Prescribe the control measures | Rice diseases:<br>BLB & BLS of Rice, Sheath blight, Stem rot, Sheath rot,False smut, Bakanae, Ufra disease and tungro disease | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |
| • Identify Leaf rust and loose smut of wheat and covered smut of Barley based on typical symptoms.<br>• Identify the causal pathogen observing under microscope.<br>• Prescribe the control measures | Wheat and barley diseases:<br>Leaf rust and loose smut of wheat and covered smut of Barley. | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |
| • Identify Leaf spot, soft rot and Mosaic of Jute based on typical | Jute diseases:<br>Leaf spot, soft rot and Mosaic of | Lecture<br>Workout<br>Demonstration | Quiz/MCQ<br>Work out<br>Practical |

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| symptoms.<br>• Identify the causal pathogen observing under microscope.<br>• Prescribe the control measures | Jute | Field visit<br>Preparation of practical notebook | notebook<br>Disease album<br>Viva -voce |
| • Identify Foot and root rot, mosaic, rust, wilts and blights of pulse and oilseed crops based on typical symptoms<br>• Identify the causal pathogen observing under microscope.<br>• Prescribe the control measures | Pulse and oilseed diseases:<br>Foot and root rot, mosaic, rust, wilts and blights of pulse and oilseed crops | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |
| • Identify Red rot, smut, wilt and SCMV of sugarcane based on typical symptoms.<br>• Identify the causal pathogen observing under microscope.<br>• Prescribe the control measures | Sugarcane diseases: Red rot, smut, wilt and SCMV of sugarcane | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |
| • Identify Angular leaf spot and ball rot of cotton based on typical symptoms.<br>• Identify the causal pathogen observing under microscope.<br>• Prescribe the control measures | Cotton diseases: Angular leaf spot and ball rot of cotton | Lecture<br>Workout<br>Demonstration<br>Field visit<br>Preparation of Practical Notebook | Quiz/MCQ<br>Work out<br>Practical Notebook<br>Disease album<br>Viva-voce |
| • Explain Koch's postulates regarding etiology of plant diseases.<br>• Exercise the principles of Koch's postulates.<br>• Demonstrate the Koch's postulates for confirmation of causal pathogens | Koch's postulates; The principles of confirmation of disease causing organisms | Lecture<br>Demonstration net house exercise<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-Voce |
| • Detect seed infection by naked eye or watch glass. | Seed health testing;Dry | Lecture<br>Demonestration | Quiz/MCQ<br>Work out |

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| • Exercise Blotter method as a routine seed health testing program.<br>• Determine viral infection by indicator plant test | inspection method, Blotter and agar plate method and indicator plant test | Multimedia presentation<br>Lab excrcise<br>Preparation of practical notebook | Practical notebook<br>Disease album<br>Viva-voce |
| • Mention the methods of seed treatment<br>• Prepare pesticide solution with proper doses<br>• Apply fungicides and other pesticides<br>• Familiar with fungicides and other pesticides available in Bangladesh | Seed treatment methods: Application of fungicides and fungicidal calculation, Fungicides available in Bangladesh | Lecture<br>Demonstration exercise<br>Pesticide company visit<br>Preparation of practical notebook | Quiz/MCQ<br>Work out<br>Practical notebook<br>Disease album<br>Viva-voce |

**Reference Books:**


1. G. L.Schumann and J. D'Arcy Cleora. 2010. Essential Plant Pathology. 2nd Edition.
2. G. N. Agrios. 2005. Plant Pathology, Fifth edition. Academic press, New York.
3. P. Neergaard. 2005. Seed Pathology Vol.-1. S. Chand & Company, New Delhi.
4. G. Rangashwami and A. Mahadevan. 2004. Diseases of Crop plants in India. Prentice-Hall of India, New Delhi-110001.
5. R. N. Trigiano. 2007. Plant Pathology concept and laboratory exercise, CRC press, India.
6. D. K. Jha. Laboratory Manual on Plant Pathology. 2007. Pointer Publishers.
7. R.T.V. Fox. 1996. Principles of diagnostic techniques in Plant Pathology. International Mycological Institute.
8. A. B. Baudoin. 1990. Laboratory exercise in Plant Pathology. Scientific Publishers.
9. D. R. Rubert. 1982. The diagnosis of Plant diseases, The University of Arizona Press. Tucson.
10. B. E. J. Wheeler. 1969. An introduction to Plant Diseases, John Wiley and Sons Ltd.

| **Course Code: PLPA 457**<br>**Course Title: Diseases of Horticultural Crops and Post-Harvest Pathology (Theory)** | **Credit Hours: 03** | **Level: 4** | **Semester: II** |
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| **Rationale:**The course is designed to provide knowledge on the causes, diagnosis, epidemiology of vegetables, spices and fruits crops diseases and their post-harvest technology for food security and safety. | | | |
| **Course Objectives:**<br>• Acquire knowledge on different plant pathogens of vegetables, spices & fruits crops diseases<br>• Gain knowledge on post harvest deterioration of vegetables, spices and fruits<br>• Gather knowledge on the management of field and post harvest diseases of vegetables, spices & fruits crops | | | |
| **Intended learning Outcomes (ILOs)**<br>The students will be able to | **Course content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Describe the biotic and abiotic causes of vegetables diseases<br>• Diagnose the diseases of vegetables on the basis of sign and symptoms<br>• Explain the disease cycles of vegetables disease<br>• Prescribe major vegetables diseases | Diseases of Vegetables; Potato, Tomato, Cabbage, Cauliflower, Brinjal, Lady's finger, Amaranth, Cucurbits and Beans | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the biotic and abiotic causes of vegetables diseases<br>• Diagnose the diseases of vegetables on the basis of sign and symptoms<br>• Explain the host - pathogens interactions for disease development<br>• Manage vegetables diseases | Diseases of spices; Chili, Onion, Garlic, Zinger and Turmeric | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the biotic and abiotic causes of fruit diseases.<br>• Diagnose the diseases of fruits on the basis of sign and symptoms<br>• Explain the host - pathogens interactions for disease | Diseases of Fruits; Mango, Banana, Papaya, Coconut, Citrus, Jackfruit, Pine apple, Guava, Litchi and Ber (Jujube) | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| development<br>• Manage vegetables diseases<br>• Manage fruit diseases with eco-friendly approaches | | | |
| • Describe the biotic and abiotic causes of flowers diseases<br>• Diagnose the diseases of flowers on the basis of sign and symptoms.<br>• Explain the host - pathogens interactions for disease development<br>• Manage flowers diseases | Diseases of Flowers**;** Rose, Marigold, Dalia, Tuberose and Gladiolus. | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • List the important forest and nursery diseases<br>• Explain the host – pathogen interactions for diseases development<br>• Manage forest and nursery diseases | Forest and nursery diseases and their management. | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Mention the most important diseases and pests of cash crops<br>• Explain the host- pathogen interaction for disease development<br>• Manage cash crops diseases | Disease of cash crops; Tea, Tobacco, Betelvine | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the economic important of mushroom.<br>• Identify mushroom diseases and their causal organisms.<br>• Manage mushroom diseases for its quality production | Mushroom diseases and their management. | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe post-harvest damage by microorganisms<br>• Diagnose the important postharvest diseases of vegetables, species and fruits<br>• Manage postharvest diseases of fruits, vegetables and spices | Post-harvest Pathology**;** Introduction to post harvest pathology, post-harvest losses in Bangladesh and food security, causes of post-harvest losses, key process during | Lecture<br>Multimedia presentation<br>Interactive discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| | post-harvest life, their effect and management. Post-harvest diseases management, cold chain, reduction of transpiration rates and manipulation of environment | | |
| • Attain latest research findings and information regarding diseases of horticultural crops and post-harvest pathology | Latest research findings and information regarding diseases of vegetables, fruits, cereal , pulse, oil yielding, sugar crops and their management. | Assignment | Report |

**References Books**


1. G. L. Schumann and J. D'ArcyCleora 2010. Essential Plant Pathology. 2nd Edition.
2. G.N.Agrios. 2005. Plant Pathology, Fifth edition. Academic press, New York.
3. P. Neergaard. 2005. Seed Pathology Vol.-1. S. Chand & Company, New Delhi.
4. G.Rangashwami, and A. Mahadevan. 2004. Diseases of Crop plants in India. Prentice-Hall of India, New Delhi-110001.
5. S. Tribhuwar and A. Kailash. 2001. Seed technology and Seed Pathology. Pointer publication, Jaipur 302003 (Raj.) India.
6. Charl Eschapp. 1998. Manual of vegetable plant diseases. Discovery pub. New Delhi.
7. R. B. Sr. Streets. 1982. The diagnosis of Plant diseases. The University of Arizona Press. Tucson.
8. H.N. Anderson. 1979. Diseases of Fruit Crop. McGraw Hill Book Co.
9. R. S.Singh. 1978. Plant Diseases, 3rd Edition, Oxford & IBH Publishing Co. New Delhi.
10. B. E. J. Wheeler. 1969. An introduction to plant Diseases, John Wiley and Sons Ltd.
11. J. G.Manners, 1990. Principles of Plant Pathology. Cambridge University Press.

| **Course Code: PLPA 458**<br>**Course Title: Diagnosis and Management of Horticultural and Cash Crops (Practical)** | **Credit Hours: 02** | **Level: 4** | Semester: II |
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| **Rationale:** This course is designed to provide knowledge on diagnosis of major horticultural and cash crops diseases, identification of their causal organisms, preservation procedures of diseased specimens and management options | | | |
| **Course Objectives:**<br>• Gather practical knowledge on major diseases of horticultural and cash crops.<br>• Gain knowledge on diagnosis of plant pathogens isolated from disease specimens of horticultural and cash crops.<br>• Acquire practical knowledge on microscopic measurement of plant pathogens.<br>• Gather knowledge on different options of plant disease management. | | | |
| **Intended learning Outcomes (ILOs)**<br>The student will be able to | **Course content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Identify the diseased specimens<br>• Exercise the preservation procedures of diseased specimens | Study on collection and preservation of disease specimens | Lecture<br>Field visit<br>Demonstration<br>Slide preparation<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Workout<br>Viva voce<br>Practical notebook |
| | **Detailed study on:** | | |
| • Diagnose anthracnose disease based on typical symptoms and signs<br>• Identify the causal pathogen of anthracnose of Chili, Lady's finger and Amaranth | Anthracnose of Chilli, Lady's finger and Amaranth | Lecture<br>Field visit<br>Demonstration<br>Slide preparation<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Workout<br>Viva voce<br>Practical notebook |
| • Diagnose *Alternaria* leaf spot disease based on typical symptoms and signs<br>• Identify the causal pathogen of *Alternaria* leaf spot of Cabbage and Cauliflower | *Alternaria* leaf spot of Cabbage and Cauliflower | Lecture<br>Field visit<br>Demonstration<br>Slide preparation<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Workout<br>Viva voce<br>Practical notebook |

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| • Diagnose *Stemphylium* blight and purple blotch disease based on typical symptoms and signs<br>• Identify the causal pathogen of *Stemphylium* blight and purple blotch of Onion | *Stemphylium* blight and purple blotch of Onion | Lecture<br>Field visit<br>Demonstration<br>Slide preparation<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Workout<br>Viva voce<br>Practical notebook |
| • Diagnose powdery mildew disease based on typical symptoms and signs<br>• Identify the causal pathogen of powdery mildew of Cucurbits | Powdery mildew of Cucurbits | Lecture<br>Field visit<br>Demonstration<br>Exercise<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Workout<br>Viva voce<br>Practical notebook |
| • Diagnose fruit rot/inflorescence rot of Jack based on typical symptoms and signs<br>• Identify the causal pathogen of fruit rot/inflorescence rot of Jack | Fruit rot/inflorescence rot of Jack fruit | Lecture<br>Field visit<br>Demonstration<br>Slide preparation<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Workout<br>Viva voce<br>Practical notebook |
| | **Brief study on: (Study of symptoms aided by permanent slides of the pathogen)** | | |
| • Identify the diseases on the basis of typical symptoms and signs | Dry rot, hollow heart, Black heart, Scab and soft rot of potato | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |
| • Identify the diseases on the basis of typical symptoms and signs | Little leaf and foot rot of Brinjal | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |

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| • Identify the diseases on the basis of typical symptoms and signs | Yellow vein clearing mosaic of lady's finger | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |
| • Identify the diseases on the basis of typical symptoms and sign | Papaya mosaic, leaf curl and foot rot | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |
| • Identify the diseases on the basis of typical symptoms and signs | Leaf spot of banana and coconut | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |
| • Identify the diseases on the basis of typical symptoms and signs | Scab, Canker and Die-back of Citrus | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |
| • Identify the diseases on the basis of typical symptoms and signs | Powdery mildew, Anthracnose and Sooty mould of mango | Lecture<br>Field visit<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Identification<br>Viva voce<br>Practical notebook |
| • Count reproductive units/spores of plant pathogens | Spores counting methods | Lecture<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook |
| • Measure the structural size/ dimension of plant pathogens. | Microscopic measurement of plant pathogen | Lecture<br>Demonstration<br>Practical notebook preparation | Quiz/MCQ<br>Short answer<br>Viva voce<br>Practical notebook |
| | **Comprehensive report on** | | |
| • Prepare plant disease herbarium | a. Herbarium | Lecture<br>Field visit<br>Demonstration | Quiz/MCQ<br>Short answer<br>Viva voce |

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| • Write a comprehensive report on fields disease problems | b. Field excursion | Lecture<br>Group discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva voce<br>Report |
| • Prescribe control measures for plant diseases | Prescription for controlling of important crop diseases | Lectures<br>Calculation<br>Assignment | Quiz/MCQ<br>Short answer<br>Viva voce<br>Report |

**Reference Books**


1. G. L. Schumann and J. D'ArcyCleora 2010. Essential Plant Pathology. 2nd Edition.
2. G. N. Agrios. 2005. Plant Pathology, Fifth edition. Academic press, New York.
3. P. Neergaard. 2005. Seed Pathology Vol.-1. S. Chand & Company, New Delhi.
4. G. Rangashwami and A. Mahadevan. 2004. Diseases of Crop plants in India. Prentice-Hall of India, New Delhi-110001.
5. R. N. Trigiano. 2007. Plant Pathology concept and laboratory exercise, CRC press, India.
6. D. K. Jha. 2007. Laboratory Manual on Plant Pathology. Pointer publishers, Jaipur 302003 (Raj.) India.
7. P. Neergaard. 2005. Seed Pathology. S. Chand & Company, New Delhi.
8. Charl Eschapp. 1998. Manual of vegetable plant diseases. Discovery pub. New Delhi
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10. C.J. Alexopoulos and E. S. Beneke. 1972. Laboratory Manual for Introductory Mycology, Bargees Publshing Co.
11. B. E. J. Wheeler. 1969. An introduction to Plant Diseases, John Wiley and Sons Ltd.

| **Course Code: PLPA 431**<br>**Course Title: Clinical Plant Pathology (Theory-Elective)** | **Credit Hours: 02** | **Level : 4** | Semester: I |
|---|---|---|---|
| **Rationale:** This course is designed to provide knowledge on diagnosis process of plant pathogens in plant clinic through culturing and microscopic study. | | | |
| **Course Objectives**<br>• Gain concept on ideal plant clinic, its required equipments and chemicals<br>• Acquire technical knowledge for using an ideal plant clinic<br>• Gather knowledge on culturing, preservation and diagnosis of plant pathogens<br>• Understand epidemic outbreak of plant diseases, monitoring and disease dynamics | | | |
| **Intended learning Outcomes (ILOs)**<br>The students will be able to- | **Course content** | **Teaching - Learning Strategies** | **Assessment Strategies** |
| • Explain about an ideal plant clinic.<br>• Describe the necessity of a plant clinic | The Plant clinic; Introduction to plant clinic and clinical Plant Pathology | Lecture<br>Clinic visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Familiar with equipments and chemicals necessary for a plant clinic<br>• Able to use and maintain the equipments and accessories for clinical purposes | Equipment and chemicals; their use and maintenance | Lecture<br>Demonstration<br>Clinic visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| | **Plant disease diagnosis** | | |
| • Familiar with the different disease diagnostic tools<br>• Diagnose the different plant diseases by observing sign and symptoms | The basis of plant disease diagnosis, Symptomology | Lecture<br>Field visit<br>Lab. visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the steps of diagnosis of plant diseases<br>• Acquire knowledge on collection, preservation and documentation of diseased samples in a plant clinic.<br>• Isolate and identify the disease causing organisms based on identifying keys | The diagnostic process, collection, preservation, documentation, surface sterilization, isolation, identification and identifying keys | Lectures<br>Lab. visit<br>Demonstration | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Identify the epidemic diseases in field condition | Detection of disease outbreak | Lectures<br>Field visit | Quiz/MCQ<br>Short answer |

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| • Exercise the survey and monitoring of plant diseases<br>• Estimate disease incidence & severity | in the field. Survey and field observation of plant diseases and their measurement (disease incidence and severity) | Demonstration | Essay type answer |
| • Familiar with different types of microscopes<br>• Describe the uses of different types of microscope<br>• Prepare permanent and semi-permanent slides from diseased samples<br>• Exercise micro-photography for observation and detection of plant pathogens | **Microscopy:** General techniques, Slide cultures, Fixing / clearing/staining of tissue to detect the presence of pathogens within plant materials and Photography | Lecture<br>Demonstration<br>Lab. visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Familiar with different types of culture media and lab tools for microbiological study<br>• Use of selective growing media for culturing microorganisms | Culture of plant pathogenic organisms; Culture media, Sterilization of culture media; principle and techniques, Selective media for growth and sporulation of plant pathogens. | Lecture<br>Demonstration<br>Lab. visit | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Operate moist chamber for microbial studies<br>• Inoculate and incubate microorganisms for growth and sporulation | Incubation in Moist chamber | Lecture<br>Demonstration<br>Lab visit | Quiz/MCQ<br>Short answer<br>Essay type |
| • Explain about an ideal plant clinic.<br>• Describe the necessity of a plant clinic | The Plant clinic; Introduction to plant clinic and clinical Plant Pathology | Lecture<br>Clinic visit | Quiz/MCQ<br>Short answer<br>Essay type answer |

**Reference Books:**


1. R.T.V. Fox. 1996. Principal Diagnostic Techniques in Plant Pathology. CAB International
2. D. R. Rubert. 1982. The diagnosis of Plant diseases. The University of Arizona Press. Tucson.
3. C. J. Alexopoulos and E. S. Beneke. 1972. Laboratory Manual for Introductory Mycology, Bargees Publishing Co**.**
4. R. B. Sr. Streets, 1982. The diagnosis of Plant diseases. The University of Arizona Press. Tucson.
5. R. S. Singh. 1978. Plant Diseases, 3rd Edition, Oxford & IBH Publishing Co. New Delhi.
6. B. E. J. Wheeler. 1969. An introduction to plant Diseases, John Wiley and Sons Ltd.

# Department of Soil Science

## Course Layout

| Sl. No. | Course Code and Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | SOIL 105**:** Introductory Soil Science (Theory) | | 02 | 1 | I |
| 2 | SOIL 106**:** Elementary Soil Experiments (Practical) | | 02 | 1 | I |
| 3 | SOIL 255**:** Soil Classification, Survey and Conservation (Theory) | | 02 | 2 | II |
| 4 | SOIL 256: Field and Laboratory Study of Soil (Practical) | | 02 | 2 | II |
| 5 | SOIL 303: Soil Physics and Soil Chemistry (Theory) | | 02 | 3 | II |
| 6 | SOIL 304: Physical and Chemical Analysis of Soils (Practical) | | 02 | 3 | II |
| 7 | SOIL 403: Soil Fertility and Soil Microbiology (Theory) | | 03 | 4 | I |
| 8 | SOIL 404:Experiments on Plant Nutrition and Soil Microbiology (Practical) | | 02 | 4 | I |
| 9 | SOIL 481: Soil Pollution and Environmental Degradation (Theory- Elective) | | 02 | 4 | 1 |
| | | Theory | 09 | | |
| | | Practical | 08 | | |
| | | Elective | 02 | | |
| | | **Total** | **19** | | |

| **Course Code: SOIL 105**<br>**Course Title : Introductory Soil Science (Theory)** | **Credit Hours: 02** | **Level: 1** | **Semester: I** |
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| **Rationale:** This course is designed to provide fundamental concept of soil and its formation | | | |
| **Course Objectives**<br>• Acquire knowledge about fundamental concepts of soil, its formation mechanisms and their roles on soil fertility and productivity<br>• Develop understanding of rocks and minerals and their weathering processes for soil formation<br>• Gain knowledge on physico-chemical properties of soils and their impacts on soil fertility and productivity<br>• Understand soil forming factors and processes of soil profile formation<br>• Gather knowledge on essential plant nutrients and their role in crop production<br>• Know about soil macro and microorganisms and their roles on soil fertility and crop productivity | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Define soil<br>• Describe scope and branches of Soil Science | **Concept of soil-** Definition, scope and branches of Soil Science | Lecture<br>Interactive discussion | Quiz/MCQ<br>Short answer<br>Essay type |
| • Describe the major components of soil and their importance in relation to soil fertility and crop productivity | **Major components of soil-** Mineral matter, organic matter, air and water | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss soil forming minerals, their chemical composition and their properties<br>• Explain the mineralogical sources of nutrient in soil for plant nutrition | **Soil forming minerals-**Chemical composition and properties | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Classify different types of rocks<br>• Describe rocks, soil forming rocks, their chemical composition and properties | **Rocks-** Types, classification and properties | Lecture<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss weathering processes of rocks and minerals and their roles in soil fertility and productivity<br>• Explain the changes of rocks and minerals in weathering processes | **Weathering-**Physical and chemical weathering of rocks and minerals | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe soil forming factors<br>• Explain the importance of soil forming factors | **Factors of soil formation-**Climate, biosphere, relief, parent material and time | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Describe different soil forming processes and their role in different soil formation and characterization | **Soil forming processes-** Laterization, podzolization, calcification and salinization | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Illustrate soil profile formation and study an ideal soil profile<br>• Explain the causes of differences in horizons of a soil profile<br>• Discuss the causes of profile differences at different places of land scape | **Soil profile-** **F**ormation**,** description of an ideal soil profile | Lecture<br>Visual presentation<br>Discussion<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Discuss the properties of soil particles and their classification<br>• Explain the composition of soil particles in relation to plant nutrition and soil productivity | **Soil particles-** Concept, properties and classification | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Narrate different soil textural classes, their importance in soil fertility, crop suitability and productivity. | **Soil texture-** Textural classes, properties and importance | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Define and classify soil structure<br>• Explain the causes and mechanisms of soil structure formation<br>• Describe importance of soil structure in crop production<br>• Explain management of soil structure for crop production | **Soil structure-** Genesis, types, grades, classes and importance | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Discuss importance of soil density, porosity and their role in crop production<br>• Explain the causes of variability of soil density and porosity | **Soil density -** Particle density, bulk density and porosity | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type |
| • Describe fundamental concepts of soil pH<br>• Discuss importance of soil pH in agriculture | **Soil pH –** Concept, grading of soils according to pH values | Lecture<br>Discussion<br>Exercise | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe criteria of essential plant nutrients, their sources and available forms in soil<br>• Discuss roles of essential nutrients in plants | **Essential plant nutrients -** Criteria of essentiality, sources and available forms in soil | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Classify soil microorganisms<br>• Discuss roles of soil microorganisms in soil fertility and productivity | **Soil microorganisms-** Classification and protists concept, occurrence, classification and functions of bacteria, algae, fungi and actinomycetes | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Classify soil macroorganisms<br>• Explain functions of soil macroorganisms in soil fertility and productivity | **Soil macroorganisms-** Classification, occurrence and functions of earthworms | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the latest research findings and information of Introductory Soil Science | Latest research findings and information regarding Introductory Soil Science | Assignment | Report |

**Reference Books**


1. N.C. Brady and R.R. Weily. 2014. The Nature and Properties of Soils. 14th Edn. Macmillan Pub. Co., New York.
2. M. Alexander. 1977. Introduction to Soil Microbiology. John Wiley and Sons, New York.
3. T.D. Biswas and S.K. Mukherjee. 1989. Text Book of Soil Science. Tata McGraw-Hill Pub. Co., New Delhi, India.
4. D.K. Das. 2014. Introductory Soil Science. Kalyani Publishers, India.
5. R.L. Donahue, R.W. Miller and J.C. Shickluna. 1992. Soils : An Introduction to Soils and Plant
   a. Growth, 5th Edn. Prentice Hall of India Pvt. Ltd., New Delhi.
6. H.D. Foth. 1984. Fundamentals of Soil Science, 7th Edn., John Wiley and Sons, New York.
7. J.A. Daji. 1992. A Textbook of Soil Science.
8. ISSS. 2000. Fundamentals of Soil Science. Indian Society of Soil Science.

| Course Code: SOIL 106<br>Course Title: Elementary Soil Experiments (Practical) | Credit Hours: 02 | Level: 1 | Semester: I |
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**Rationale:** This course is designed to provide applied knowledge on elementary soil experiments in field and laboratory study in relation to soil fertility and productivity.

**Course Objectives:** The prime objectives of this course are to-

- Acquire knowledge on laboratory use, soil sample preparation and preservation for subsequent analysis.
- Apply the techniques and methods of determining some physical properties of soils in relation to crop production.
- Identify physico-chemical properties of soil forming rocks and minerals in relation to soil fertility and crop production.
- Acquire knowledge about techniques of sterilization and media preparation for bacterial cultures.
- Perform microscope handling and identify the bacteria by different methods in the laboratory.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
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| • Describe precaution measures while working in the laboratory<br>• Apply the roles in using glassware, chemicals and lab instruments | Precautions to be taken while working in the laboratory. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Describe the process of soil sample collection, preparation and preservation for analysis<br>• Collect, prepare and preserve soil samples for subsequent analysis | Collection, preparation and preservation of soil samples. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain the variability of bulk density of different soils<br>• Determine bulk density of soil and its importance in crop production | Determination of bulk density of soil by core sampler method. | Lecture<br>Discussion<br>Demonstration<br>Group work | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine particle density of soil<br>• Describe the causes of variation of particle density of different soils | Determination of particle density of soil by volumetric/ pycnometer method | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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| • Estimate porosity of soil<br>• Evaluate the porosity values in relation to soil properties and crop production | Estimation of soil porosity. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Describe important characteristics of soil forming minerals.<br>• Identify soil forming minerals | Study and identification of some important soil forming minerals | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe the important characters of some important rocks<br>• Identify soil forming rocks | Study and identification of some important rocks | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Identification<br>Viva-voce<br>Practical notebook |
| • Demonstrate methods and techniques of sterilization processes in the laboratory<br>• Sterilize the samples by using different methods | Methods and techniques of sterilization | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain functions of different parts of a compound microscope<br>• Operate microscope for specifying the object | Study and handling of a compound microscope. | Lecture<br>Discussion<br>Demonstration<br>Handling microscope | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe the use and preparation procedure of bacterial media in the laboratory<br>• Prepare solid and liquid bacterial media for culturing bacteria | Preparation of bacterial media | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain the use and preparation techniques of culturing bacteria.<br>• Prepare bacteria culture. | Techniques for culturing bacteria | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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| • Describe the gram staining method for identifying the bacteria<br>• Identify the bacteria by Gram staining method | Identification of bacteria by Gram staining method. | Lecture,<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe the cause of motility and techniques for motility test of bacteria.<br>• Demonstrate the motility of bacteria | Motility test of bacteria by hanging drop method. | Lecture,<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1. ISSS. 2000. Fundamentals of Soil Science. Published by Indian Society of Soil Science.M. A. Sattar and M. M. Rahman. 1987. Techniques of Soil Analysis. Mymensingh, Bangladesh
2. N. S. Subba Rao. 1988. Bio-fertilizers in Agriculture. Oxford and IBH Pub., Co., Ltd., New Delhi.
3. R. A. Singh. 1989. Soil Physical Analysis. Kalyani Pub., New Delhi.
4. R. L. Donahue, R. W. Miller and J. C. Shickluna. 1990. Soil: An Introduction to Soils and Plant Growth, 5$^{th}$Edn. Prentice hall of Ind. Pvt. Ltd. New Delhi.
5. S. P. Majumdar and R. A. Singh. 2002. Analysis of Soil Physical Properties. Agrobios, India.

| **Course Code: SOIL 255**<br>**Course Title: Soil Classification, Survey and Conservation (Theory)** | **Credit Hours: 02** | **Level: 2** | **Semester: II** |
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| **Rationale:** The course is designed to provide applied knowledge on survey, classification and conservation of soil in relation to agriculture. | | | |
| **Course Objectives:** The course will help the students to-<br>• Acquire knowledge on soil classification, soil taxonomy, soil formation, and geology and geomorphology of Bangladesh soils.<br>• Enrich knowledge on soil survey, land evaluation and soil mapping.<br>• Gather knowledge on soil organic matter, soils of Bangladesh, problem soils of Bangladesh & soil erosion and conservation. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Describe concept and objectives of soil classification.<br>• Evaluate different systems of soil classification. | **Soil Classification-** concept, objectives and different systems of soil classification. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Illustrate different diagnostic horizons in a soil profile.<br>• Differentiate between different horizons in a soil profile.<br>• Explain the categories of taxonomy classification<br>• Describe different soil orders of the world and identify the equivalent soils in Bangladesh | **Soil Taxonomy-** diagnostic horizons, soil moisture and temperature regimes; categories and nomenclature; Soil Orders and their equivalent soils in Bangladesh. | Lecture<br>Discussion<br>Visual presentation<br>Field visit<br>Report writing | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the concept and use of soil survey in agriculture.<br>• Describe different types of soil survey and prepare soil maps | **Soil survey-** concept, importance and types, soil mapping. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Evaluate land by using different land criteria and land evaluation methods<br>• Describe different land types and land capability classification of Bangladesh soils | **Land Evaluation-** objectives, criteria and methods. Land types and land capability classification of Bangladesh soils. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Discuss the concept and branches of geology.<br>• Describe the geological formation and formation time of | **Geology-** concept and branches, Geological Time Scale. Geology and Geomorphology of | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| Bangladesh soils.<br>• Differentiate between geology and geomorphology of Bangladesh | Bangladesh. | | |
| • Describe the general soil types of Bangladesh, their formation, geological make up, agricultural and socioeconomic constraints<br>• Discuss the criteria of AEZ classification in Bangladesh<br>• Explain the 30 AEZs of Bangladesh, their location, extent, present land use, crop productivity, ecological hazard and socioeconomic constraints | **Soils of Bangladesh-** General Soil Types. Agro Ecological Zones (AEZ)- concept and criteria. Different agro-ecological zones- Location, extent, present land use and crop productivity constraints. | Lecture<br>Discussion<br>Visual presentation<br>Field visit<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report presentation |
| • Describe the different problem soils of Bangladesh, their location, cause of formation, their extent and management practices<br>• Apply appropriate reclamation measures for amelioration of problem soils for successful crop production | **Problem soils-** Acid Sulphate, Strongly acidic soil, Saline, Alkali, Peat, Hill soils, Char land, Organic matter and nutrient depleted soils. Calcareous and Degraded rice soils**:** characteristics, location, extent and management. | Lecture<br>Discussion<br>Visual presentation<br>Field visit | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Elucidate the concept, types, causes of soil erosion, universal soil loss equation and control measures of soil erosion<br>• Explain different types of erosion and their impact on crop production | **Soil erosion-** Concept, types and factors affecting soil erosion. Universal Soil Loss Equation, control of soil erosion. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the concept, importance and methods of soil conservation<br>• Apply suitable conservation measures to reduce soil erosion | **Soil Conservation-** concept, importance and methods. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the sources and composition of soil organic matter and its effects on physico-chemical and biological properties of soil | **Soil organic matter-** sources, composition and effects on soil properties. Organic matter decomposition | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Differentiate between decomposition of organic matter in aerobic and anaerobic conditions of soil<br>• Explain humus formation, C:N ratio and their importance in soil fertility and productivity | in aerobic and anaerobic soils. Formation and characteristics of humus. C: N ratio. | | |
| • Explain the latest research findings and information of Soil Classification, Survey and Conservation | Latest research findings and information regarding Soil Classification, Survey and Conservation | Assignment | Report |

**Reference Books:**


1. N. C. Brady and R. R. Weil. 2014. The Nature and Properties of Soils. 14th Edn. Macmillan Pub. Co., New York.
2. H. Brammer. 2000. Agro ecological Aspects of Agricultural Research in Bangladesh. University Press Ltd., Dhaka.
3. H. Brammer. 1996. The Geography of the Soils of Bangladesh. University Press Ltd. Dhaka.
4. FAO. 1988. Agro ecological Regions of Bangladesh, Report No.2, UNDP-FAO, Rome.
5. M. M. Hassan. 1999. Soils of Bangladesh: Their genesis, classification and use potential.
6. M. S. Hussain. 1992. Soil Classification with special reference to the soils of Bangladesh.
7. M. Idris. 1987. Erosion Hazard Areas in Bangladesh. Report on Soil Conservation, SRDI, Dhaka.
8. Soil Survey Staff. 1951. Soil Survey Manual, USDA No. 18, US Govt. Printing Office, Washington, D.C.
9. Soil Survey Staff. 1978. Soil Taxonomy-A basic System of Soil Classification. Agricultural Handbook No. 456, Soil Conservation Service, USDA.

| Course Code : SOIL 256<br>Course Title : Field and Laboratory Study of Soil (Practical) | Credit Hours: 02 | Level: 2 | Semester: II |
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**Rationale:** The course is designed to provide applied knowledge on physical and chemical properties of soils, soil profile study, soil survey and mapping, study of Agro ecological zone and problem soils of Bangladesh.

**Course Objectives:** The objectives of this course are to-

- Gather practical knowledge on soil texture, structure, soil color, soil profile, soil map, soil survey and Agro ecological Zones study of Bangladesh soils.
- Know the analysis of soil organic carbon, soil pH, electrical conductivity and their application.
- Study of Agro ecological Zones of Bangladesh.
- Study of problem soils of Bangladesh and their amelioration for successful crop production and other use.

| **Intended Learning Outcomes (ILOs)**<br>The student will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
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| • Assess soil texture in the field by finger feel method | Assessment of soil texture by finger feels method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Examine and identify spheroidal, platelike, prismlike and blocklike structures of soil in the field | Identification and examination of soil structure. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Study a soil profile in the field.<br>• Demonstrate, separate and describe the horizons of a soil profile | In-situ study of soil profile. | Lecture<br>Discussion<br>Demonstration<br>Field visit and pit open | MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook<br>Report |
| • Determine the actual strength of the secondary standard substance and its use in the determination of organic carbon of soil.<br>• Explain the criteria of secondary standard substances | Standardization of approximately normal ferrous sulphate solution with the help of normal potassium dichromate solution. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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| • Determine organic carbon and organic matter of soil<br>• Evaluate the values of SOM content for making plan to maintain soil fertility | Determination of soil organic carbon by wet oxidation method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain the causes, use and significance of soil color<br>• Determine different colors of soil using Munsell's color chart | Determination of soil color by Munsell'scolor chart. | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration<br>Performance<br>Viva-voce<br>Practical notebook |
| • Explain the methodology of pH determination<br>• Determine soil pH by colorimetric method using a pH kit | Determination of soil pH by colorimetric method using a pH kit. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Prepare and study of a soil map.<br>• Explain and use of soil map in agriculture | Preparation and study of soil map. | Lecture<br>Discussion<br>Demonstration of map | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Survey the soils of selected area and prepare soil survey report | Preparation of soil survey report. | Lecture<br>Discussion<br>Demonstration<br>Field visit and survey | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook<br>Survey report |
| • Determine electrical conductivity of soil by using an EC meter<br>• Evaluate EC values for reclamation and crop selection | Determination of electrical conductivity of soil. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Elucidate the effect of sodium on crop production<br>• Determine the level of sodium in soil | Determination of sodium in salt affected soil | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |

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| • Illuminate the effect of calcium on crop production<br>• Determine the level of sodium in soil | Determination of calcium in different soil | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Describe the area, location, extent, agricultural productivity, present land use and agricultural and socio-economic constraints of different Agroecological Zones of Bangladesh.<br>• Identify location, extent of different AEZ of Bangladesh | Study of AEZ map. | Lecture<br>Discussion<br>Demonstration<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook<br>Report |
| • Describe the causes of differences in soil profiles of different Agroecological Zones of Bangladesh<br>• Identify and describe the soil horizons in different soil profiles of different Agroecological Zones of Bangladesh | Field trip for soil profile study in different AEZs of Bangladesh. | Lecture<br>Discussion<br>Demonstration<br>Presentation<br>Field visit and pit open | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook<br>Report |
| • Evaluate and explain the problem soils of Bangladesh at different places of the country and their extent<br>• Explain the causes of development of different problem soils and their probable reclamation processes | Study of problem soils in the field. | Lecture<br>Discussion<br>Demonstration<br>Presentation<br>Field visit | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook<br>Report |

**Reference Books:**


1. N. C. Brady and R R. Weily. 2014. The Nature and Properties of Soils. 14thEdn. Macmillan Pub. Co., New York.
2. A. L. Sparks, A. L. Page, P. A. Helmke. 1996. Methods of Soil Analysis. Patr-3., Amer. Soc. Agron. Inc., Wisconsin, USA.
3. R. L. Donahue, R. W. Miller and J .C. Shickluna. 1992. Soils : An Introduction to Soils and Plant Growth. Prentice Hall of Ind. Pvt. Ltd., New Delhi.
4. Munsell Soil Colour Charts. 1988. U. S. Dept. of Agriculture Handbook 18- Soil Survey Manual.
5. H. Brammer. 2000. Agro ecological Aspects of Agricultural Research in Bangladesh. University Press Ltd., Dhaka.
6. H. Brammer. 1996. The Geography of the Soils of Bangladesh. University Press Ltd. Dhaka.
7. FAO. 1988. Agro ecological Regions of Bangladesh, Report No.2, UNDP-FAO, Rome.
8. M. M. Hassan. 1999. Soils of Bangladesh: Their genesis, classification and use potential.

| **Course Code: SOIL 303**<br>**Course Title: Soil Physics and Soil Chemistry (Theory)** | **Credit Hours: 02** | **Level: 3** | **Semester: II** |
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| **Rationale:** The course is designed to provide applied knowledge on soil physics and soil chemistry in relation to agriculture. | | | |
| **Course Objectives:** The main objectives of this course are to help students to-<br>• Acquire knowledge on Stokes law, clay mineralogy, soil water, soil air, soil temperature and their impact in agriculture.<br>• Obtain knowledge about soil reaction, liming, soil solution, ion exchange, and their effect on plant nutrition.<br>• Understand the water-logged soils and their management for crop production. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Describe the particle size analysis of soil and Stokes law | **Particle size analysis**- Dispersion and fractionation. Stokes' law- its assumptions and limitations. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Discuss the soil consistency, swelling, shrinkage, compaction and their importance in agriculture<br>• Explain the effects of consistency, swelling, shrinkage and compaction on soil management and plant growth | **Soil consistency**- Forms, Atterberg limits, sticky point, swelling and shrinkage. Soil compaction. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Classify and illustrate the structure of clay minerals.<br>• Describe the characteristics of different types of clay minerals<br>• Explain the cause of cation anion and water adsorption on the surface of clay | **Clay mineralogy**- Classification, structure and characteristics of different clay minerals. Development of charges in clay minerals. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss the soil water classification, factors affecting retention, availability for plant uptake and importance of soil water in crop production<br>• Explain the soil water potential in relation to plant water uptake and water movement in soil<br>• Describe the different processes of | **Soil water**- Importance, classification and factors affecting soil water retention. Infiltration- Factors affecting infiltration, infiltration equations and curves. Methods | Lecture<br>Discussion<br>Visual presentation<br>Problem solving<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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| movement of soil water and loss of water from soil.<br>• Explain the methods of soil water and evapotranspiration measurement and irrigation scheduling for crops | of soil water measurement, Soil water constants, Soil water potentials. Hydraulic conductivity- Darcy's law. Methods of measuring hydraulic conductivity. Concept of ET, PET and Kc. Factors affecting ET; methods of measuring ET; application of ET values for irrigation scheduling. | | |
| • Explain the composition, importance of soil air, factors affecting soil air composition in relation to different agricultural management practices<br>• Distinguish between soil air and atmospheric air | **Soil air-** Importance, composition, factors affecting soil air composition and management of soil air. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Discuss the soil temperature, thermal properties of soil and factors affecting soil temperature<br>• Explain the importance of soil temperature for crop production<br>• Manage soil temperature for crop production | **Soil temperature-** Importance, factors affecting soil temperature, thermal properties of soils, management of soil temperature. | Lecture<br>Discussion<br>Visual presentation<br>Problem solving | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the importance of soil color and effects of soil properties on the variability of soil color | **Soil color-** Origin and importance. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the causes of soil acidity and effects of soil acidity on nutrient availability and crop production | **Soil reaction-** Types and causes of soil acidity. Soil pH affecting nutrient availability. Suitable pH range for major | Lecture<br>Discussion<br>Visual presentation<br>Problem solving | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Select suitable crops for acidic and alkaline soils.<br>• Explain the buffering capacity of soil and its importance in agriculture | crops. Buffering capacity of soil. Importance of buffering in agriculture. | | |
| • Describe the effects of lime for improving soil properties<br>• Estimate the lime requirement of soil | **Liming-** Liming materials, factors affecting liming of soil, effects of liming on soil properties, lime requirement of soil. | Lecture<br>Discussion<br>Visual presentation<br>Problem solving | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Calculation |
| • Illustrate the ion-exchange phenomena and their importance in plant nutrient availability in soil<br>• Explain the cation exchange capacity, base saturation, sodium saturation and soil salinity in relation to plant nutrition | **Ion exchange-** Cation and anion exchange. Factors affecting ion exchange, Importance of ion exchange in agriculture. Exchangeable bases, ESP and SAR. | Lecture<br>Discussion<br>Visual presentation<br>Problem solving | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the composition of soil solution and its importance in plant nutrition | **Soil solution-** Composition and importance. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Illustrate the characteristics of submerged soil<br>• Describe redox potential, sequential reduction and nutrient transformation and availability in submerged soil<br>• Differentiate between flooded soil and upland soil and their management for crop cultivation | **Submerged soils-** Concept, characteristics, effects of submergence on redox potential, pH and availability of P and Zn in soil. Transformations of Fe, Mn, S and N in submerged soil. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the latest research findings and information of Soil Physics and Soil Chemistry | Latest research findings and information regarding Soil Physics and Soil Chemistry | Assignment | Report |

**Text Books:**


1. N. C. Brady and R. R. Weily. 2014. The Nature and Properties of Soils. 14thEdn. Macmillan Pub. Co., New York.
2. J. L. Havlin, J. D. Beaton, S. L. Tisdale and W.L. Nelson. 2006.Soil Fertility and Fertilizers, 7$^{th}$Edn. Prentice-Hall of India
3. B. P. Ghildyal and R. P. Tripathi. 1987. Soil Physics. Wiley Eastern Ltd. New Delhi, India.
4. F. N. Ponnamperuma. 1972. Chemistry of submerged soils. In : Advances in Agronomy. Ed. N.C. Brady. Vol.24. Academic Press, New York.
5. D. K. Das. 2014. Introductory Soil Science. Kalyani Publishers, India
6. K. H. Tan. 2013. Principles of Soil Chemistry. CRC Press, Boca Raton, New York.
7. D. Hillel. 1980. Applications of Soil Physics. Acad. Press, New York.
8. L. D. Baver. 1985. Soil Physics. John Wiley and Sons, Inc., New York.
9. T. D. Biswas and S. K. Mukherjee. 1997. Text Book of Soil Science. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

| **Course Code: SOIL 304**<br>**Course Title : Physical and Chemical Analysis of soils (Practical)** | **Credit Hours: 02** | **Level: 3** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course provides practical knowledge on physical and chemical analyses of soils | | | |
| **Course Objectives:** The course will help students to-<br>• Acquire practical knowledge and determining techniques of physical properties of soil.<br>• Apply acquired knowledge in irrigation scheduling for different crops.<br>• Acquire practical knowledge and experience on soil chemical properties and its analyzing techniques.<br>• Apply chemical analytical knowledge for management of problem soils. | | | |
| **Intended Learning Outcomes (ILOs)** The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Determine the percent sand, silt, clay and soil textural classes<br>• Explain and apply Stokes law in particle size analysis of soil | Particle-size analysis of soil by Hydrometer method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the weight basis and volume basis soil moisture content | Determination of soil moisture by gravimetric method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the maximum water holding capacity of soil and its use in water management for crop production<br>• Compare the data of MWHC of different soils and explain the causes of variation of maximum water holding capacity of soil | Determination of maximum water holding capacity of soil. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine soil moisture at field capacity level for maintaining suitable moisture level in the field for crop production<br>• Assess field capacity level in the field | Determination of soil moisture at field capacity. | Lecture<br>Discussion<br>Demonstration<br>Field study | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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| • Estimate the percentage of macro and micro pore present in soil and their importance in crop production.<br>• Compare the data of soil porosity and identify the causes of variation | Estimation of pore size distribution of soil. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Use tensiometer for moisture determination and irrigation scheduling for crop production | Determination of soil moisture by tensiometer method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Find out the rate of infiltration by infiltrometer method in different soil<br>• Apply rate of infiltration for selecting irrigation practices | Determination of soil water infiltration by infiltrometer method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the hydraulic conductivity of soil and its application | Determination of hydraulic conductivity of saturated soil by constant head method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine soil pH by glass electrode pH meter<br>• Use the data of soil pH for crop selection and fertilizer management in soil | Determination of soil pH by glass electrode method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Calculate lime requirement of soil by soil analysis | Determination of lime requirement of soil. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine cation exchange capacity of soil<br>• Apply CEC value for soil improvement. | Determination of CEC of soil. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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|---|---|---|---|
| • Determine the calcium carbonate content in soil | Determination of free carbonate in soil by rapid titration method. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Analyze the carbonate and bicarbonate in soil<br>• Explain importance of carbonate and bicarbonate level in agriculture | Determination of carbonate and bicarbonate in soil by differential titration method. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1. A. L. Page, R. H. Miller and D. R. Keeney. 1982. Methods of Soil Analysis. Part-2., Amer. Soc. Agron. Inc., Wisconsin, USA.
2. A. L. Sparks, A. L. Page, P. A. Helmke. 1996. Methods of Soil Analysis. Patr-3., Amer. Soc. Agron. Inc., Wisconsin, USA.
3. H. L. S. Tandon.1999. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Binny Printers, New Delhi.
4. P. R. Hesse. 1994. A Text Book of Chemical Analysis. CBS Publishers, New Delhi.
5. R. A. Singh. 1989. Soil Physical Analysis.2nd Edn., Kalyani Publishers, India
6. J. L. Havlin, J. D. Beaton, S. L. Tisdale and W. L. Nelson. 2006.Soil Fertility and Fertilizers, 6th Edn., Prentice-Hall of India

| **Course Code: SOIL 403**<br>**Course Title: Soil Fertility and Soil Microbiology (Theory)** | **Credit Hours: 03** | **Level: 4** | **Semester: I** |
|---|---|---|---|
| **Rationale:** This course is designed to develop student knowledge on soil fertility, plant nutrition and microbial activity in soil. | | | |
| **Course Objectives:** The aim of the course is helping the learners to-<br>• Enrich understanding about the nutritional deficiency symptoms in different plants.<br>• Gain knowledge about the sources, transformation and factors affecting availability of nutrient for plant uptake.<br>• Acquire knowledge about biological nitrogen fixation, mycorrhizae and biofertilizer.<br>• Develop knowledge on soil fertility evaluation, fertilizer recommendation and fertilizer transformation.<br>• Know the problem soils of Bangladesh and their management.<br>• Solve soil organic matter depletion problem by integrated plant nutrient management for sustainable crop production. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to – | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Explain the sources, forms and deficiency symptoms of N regarding crop production<br>• Describe N mineralization and immobilization processes and their importance in crop production<br>• Illustrate mechanism of N loss from and gain in soil | **Nitrogen-** sources and forms in soil; mineralization and immobilization; fates of available nitrogen in soil; $NH_4^+$- N fixation; mechanisms of N loss; N-Cycle. Deficiency symptom in major crops | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe deficiency symptoms of P in major crops and occurrence of P in soil.<br>• Explain the factors affecting P availability and its fixation in soil | **Phosphorus-** Occurrence and fixation in soil. Factors affecting P availability in soil; P-cycle. Deficiency symptom in major crops | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe occurrence, forms and availability of K in soil<br>• Explain factors affecting K fixation in soil<br>• Illustrate the K fixation and release mechanism in soil<br>• Describe K cycle and deficiency symptom of K in major crop | **Potassium-** Occurrence, forms, availability and fixation in soil. Factors affecting K fixation and availability, K- cycle. Deficiency symptom in major crops | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Describe occurrence and forms of S in soil.<br>• Explain mineralization and immobilization along with S availability in soil.<br>• Describe S oxidation and reduction and its availability in soil for crop uptake<br>• Elucidate S deficiency symptoms in major crops | **Sulphur-** Occurrence, forms, mineralization and immobilization in soil. Factors affecting S availability, oxidation and reduction of S in soil. S-cycle. Deficiency symptom in major crops | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the occurrence and factors affecting availability of Zn in soil<br>• Describe the causes of Zn deficiency in soil | **Zinc-**Occurrence and factors affecting availability of Zn in soil. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Mention the occurrence and factors affecting availability of B in soil.<br>• Explain the causes of B deficiency in soil | **Boron-** Occurrence and factors affectingavailability of B in soil. | Lecture<br>Discussion<br>Visual presentation | MCQ<br>Short answer<br>Essay type answer |
| • Evaluate soil fertility by using different methods<br>• Explain the critical limits, soil test value interpretation and fertilizer recommendation.<br>• Use National Fertilizer Recommendation Guide for fertilizer recommendation in major crops<br>• Calculate the dose of fertilizers for major crops | **Soil Fertility Evaluation-** Soil fertility and productivity. Methods of soil fertility evaluation, critical limits and fertilizer recommendation. Use of National Fertilizer Recommendation Guide. | Lecture<br>Discussion<br>Visual presentation<br>Problem solving | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Calculation |
| • Explain the source, quality and classification of irrigation water regarding crop production<br>• Describe the effects irrigation water<br>on soil properties | **Irrigation water-** Quality, classification and effects on soil properties. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the sources, nutrient content, transformation and fate of N, P, K,S and Zn fertilizers in soil | **Chemical fertilizers-** Transformation of N, P, K, S and Zn fertilizers in soil. | Lecture<br>Discussion<br>Presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Describe biological N fixation and its different types and their importance in soil fertility<br>• Explain symbiotic & non-symbiotic nitrogen fixation | **Biological Nitrogen Fixation (BNF**)- Symbiotic nitrogen fixation:- Legume-Rhizobium symbiosis; Azolla – Anabaena symbiosis. Non- symbiotic nitrogen fixation- Azotobacter, Clostridium, Azospirillium, Cyanobacteria. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe mycorrhizal symbiosis and its types and importance in plant nutrition | **Mycorrhiza-** Types and importance in plant nutrition. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the concept and types of bio-fertilizer<br>• Explain the production technology of bio-fertilizers and their importance in agricultural production | **Biofertilizers-**Concept, types, production technology and importance. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain soil fertility problems in Bangladesh<br>• Explain causes and extent of organic matter depletion in Bangladesh<br>• Describe nutrient mining and imbalance use of fertilizers regarding soil fertility problems and their management in Bangladesh | **Soil fertility problems and management-** Soil fertility problems in Bangladesh: organic matter depletion - causes and extent, nutrient mining, imbalanced use of fertilizers. | Lecture<br>Discussion<br>Presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Gather knowledge about different types of organic matter like FYM, compost, vermicompost, green manure etc<br>• Prepare and improve the quality of compost,vermicompost, FYM and green manure for increasing soil fertility and productivity<br>• Explain integrated nutrient management (INM) and its importance in eco-friendly crop production. | **Improvement of soil organic matter**- FYM, compost, green manure, organic wastes. Integrated nutrient management. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Explain the latest research findings and information of Soil Fertility and Soil Microbiology | Latest research findings and information regarding Soil Fertility and Soil Microbiology | Assignment | Report |

**Reference Books:**


1. N. C. Brady and R. R. Weily. 2014. The Nature and Properties of Soils. 14thEdn. Macmillan Pub. Co., New York.
2. J. L. Havlin, J. D. Beaton, S. L. Tisdale and W. L. Nelson. 2006. Soil Fertility and Fertilizers, 7thEdn., Prentice-Hall of India
3. D. K. Das. 2014. Introductory Soil Science. Kalyani Publishers, India
4. E. A. Paul.2007. Soil Microbiology,Ecology and Biochemistry. 3rdEdn., Academic Press of Elsevier. USA
5. K. Mengel, E.A.Kirkby. 1987. Principles of Plant Nutrition. International Potash Institute, Switzerland
6. R. L. Donahue, R. W. Miller and J. C. Shickluna. 1992. Soils: An Introduction to Soils and Plant Growth. Prentice Hall of Ind. Pvt. Ltd., New Delhi.
7. Fertilizer Recommendation Guide, Bangladesh Agricultural Research Council

| **Course Code: SOIL 404**<br>**Course Title: Experiments on Plant Nutrition and Soil Microbiology (Practical)** | **Credit Hours: 02** | **Level: 4** | **Semester: I** |
|---|---|---|---|
| **Rationale:** The course provides knowledge about soil and plant nutrient analysis and microbiological experiments. | | | |
| **Course Objectives:** The prime objectives of this course are to-<br>• Develop students' practical knowledge and skill on soil and plant analysis for fertilizer recommendation and nutritional problem detection.<br>• Gain practical knowledge about the nutrient status of different soils of Bangladesh.<br>• Provide students experiences and applied knowledge in isolating, identifying and culturing beneficial bacteria and BGA.<br>• Apply the isolated microorganism and algal inoculum for biofertilizer preparation. | | | |

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Analyze the plant and soil samples for N, P and K by using soil testing kit<br>• Interpret the data and make fertilizer recommendation | Determination of N, P and K in soil and plant samples by soil testing kit. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine total N in soil and plant by Kjeldahl's method<br>• Recommend the amount N required for successful crop production | Determination of total N in soil and plant samples by Kjeldahl's method. | Lecture<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine available P in soil by Olsen method.<br>• Estimate the need of phosphatic fertilizer for crop production | Determination of available P in soil by Olsen method. | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine available K in soil by ammonium acetate extraction method<br>• Use analytical data for K management in soil | Determination of available K in soil by ammonium acetate extraction method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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|---|---|---|---|
| • Analyze the available S in soil by calcium chloride extraction method<br>• Apply analytical value of S forfertilizer recommendation | Determination of available S in soil by calcium chloride extraction method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the total P, K and S concentration in plant sample<br>• Evaluate plant nutritional value in relation to soil fertility and fertilizer management | Total analysis of plant sample for P, K and S. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the available Zn in soil by DTPA extraction method<br>• Explain Zn availability and soil properties for Zn fertilizer recommendation | Determination of available Zn in soil by DTPA extraction method. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Isolate and identify *Rhizobium* from root nodules.<br>• Use isolated *Rhizobium* in the preparation of biofertilizer | Isolation and identification of *Rhizobium* from root nodules. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Authenticate *Rhizobium culture* by different techniques.<br>• Compare different techniques of Rhizobium authentication. | Authentication of *Rhizobium* cultures. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Isolate and identify Azotobacter from soil.<br>• Describe benefits and use of Azotobacter in soil. | Isolation and identification of *Azotobacter* from soil. | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |

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|---|---|---|---|
| • Isolate and identify blue-green algae from soil.<br>• Explain use and benefits of blue-green algae in soil. | Isolation and identification of blue-green algae from soil. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Prepare bacterial and blue- green algal inoculants and biofertilizers.<br>• Use bacterial and blue-green algal inoculants in agriculture. | Preparation of bacterial and blue- green algal inoculants. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Count bacteria and blue-green algae in inoculants<br>• Assess the quality of bacterial and blue-green algal inoculants. | Total count of bacteria and blue-green algae in inoculants. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the microbial biomass content in soil | Determination of microbial biomass in soil. | Lecture<br>Discussion<br>Demonstration | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain the deficiency symptoms in different crop plants<br>• Identify nutrient deficiency symptoms in different crop plants | Study on nutrient deficiency symptoms in crop plants | Visual presentation<br>Demonstration<br>Assignment | Short answer<br>Identification<br>Viva-voce<br>Practical notebook<br>Report |
| • Recommend fertilizer for successful crop production in different location of Bangladesh | Recommendation of fertilizer for location specific crops based on soil test basis and AEZ basis | Visual presentation<br>Problem solving | Quiz/MCQ<br>Short answer<br>Calculation<br>Viva-voce |

**Reference Books:**


1. A. L. Page, R. H. Miller and D. R. Keeney. 1982. Methods of Soil Analysis. Patr-2., Amer. Soc., Agron., Inc., Wisconsin. USA.
2. D. L. Sparks, A. L. Page, P. A. Helmke. 1996. Methods of Soil Analysis. Patr-3., Amer. Soc., Agron., Inc., Wisconsin. USA.
3. H. L. S. Tandon.1999. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Binny Printers, New Delhi.
4. P. R. Hesse.1994. A Text Book of Chemical Analysis. CBS Publishers,
   N. S. Subba Rao. 1988. Biofertilizers in Agriculture. Oxford and IBH Pub., Co., Ltd., New Delhi.

| **Course Code: SOIL 481**<br>**Course Title : Soil Pollution and Environmental Degradation (Theory-Elective)** | **Credit Hours: 02** | **Level: 4** | **Semester: I** |
|---|---|---|---|
| **Rationale:** The course is designed to develop students' knowledge about soil pollution and environmental degradation. | | | |
| **Course Objectives:** The main objectives of this course are to-<br>• Acquire knowledge about the concept of soil pollution and its impact on environmental degradation.<br>• Understand the soil-water-plant system pollution by heavy metal, fertilizer and pesticide application.<br>• Obtain knowledge about the causes of climate change.<br>• Gather knowledge about the sources of methane, nitrous oxide and carbon dioxide, and their effects on environmental degradation. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Describe the concept of environment and soil environment<br>• Elucidate the soil pollution in relation to environmental degradation | **Soil environment-** Concept and its pollution in relation to environmental degradation. | Lecture<br>Discussion<br>Presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe the causes of soil pollution<br>• Explain different soil pollutants and their effects on soil pollution<br>• Describe the effects of soil pollution on crop production and food quality | **Soil pollution-** Pollution and pollutants; sources of soil pollution. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer answer<br>Essay type |
| • Describe the sources of heavy metal in soil-water-plant system<br>• Mention the permissible limits of heavy metals in soil, water and plants<br>• Elucidate the impact of heavy metal on soil, crop and human.<br>• Explain the favorable condition for toxic heavy metal accumulation in soil and plant and their remediation | **Heavy metals-** Sources, content and permissible limits of heavy metals in soils, water and plants; impact of heavy metals on soils, crops and humans. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |

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|---|---|---|---|
| • Explain the hazardous effects of chemical fertilizers and pesticides on environment and the biodegradation<br>• Describe the effects of fertilizers & pesticides on the ground water pollution and health hazards<br>• Apply techniques of fertilizer and pesticide application for reducing soil and water pollution | **Chemical fertilizers and Pesticides-** Impact on soil and water ecosystems; biodegradation of pesticides; ground water pollution; health hazards due to fertilizers and pesticides. | Lecture<br>Discussion<br>Visual presentation<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the causes of acid rain and its impact on soils and plants<br>• Recommend the measures and ways for reducing causes of acid rain | **Acid rain-** Causes and its impact on soils and plants. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the effects of greenhouse gases on climate change<br>• Explain the effects of climate change on the soil fertility and crop productivity<br>• Apply suitable crop management measures for reducing climate change | **Green house effects-** Concept of greenhouse effects and climate change; response of soils and crops to global climate change. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe source and sink of methane gas<br>• Explain methane production from paddy fields and wet lands<br>• Recommend suitable water management for reducing methane emission in rice production | **Greenhouse gases-**<br><br>i) **Methane:** Source and sink, methane fluxes in rice paddies and natural wetlands. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the process of nitrous oxide production and its impact on ozone layer<br>• Solve the problem of nitrous oxide emission by using judicious application of fertilizer and water management | ii) **Nitrous oxide:** Processes of nitrous oxide formation in soils; impact of nitrous oxide emission on ozone layer. | Lecture<br>Discussion<br>Visual presentation | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe the sources and sink of carbon dioxide production | iii) **Carbon dioxide:** Source and sink of | Lecture<br>Discussion | Quiz/MCQ<br>Short answer |

| | | | |
|---|---|---|---|
| • Explain the effects of deforestation and afforestation on the $CO_2$ emission<br>• Apply suitable crop management practices for reducing carbon dioxide emission | $CO_2$, consequences of $CO_2$ emission, effects of deforestation and afforestation. | Visual presentation Assignment | Essay type answer Report |
| • Express latest research findings and information of Soil Pollution and Environmental Degradation | Latest research findings and information regarding Soil Pollution and Environmental Degradation | Assignment | Report |

**Reference Books:**


1. R. S. Ambasht and P. K. Ambasht. 1999. Environment and Pollution. CBS Pub. and Distributors, New Delhi.
2. S. S. Dara. 1998. A Text Book of Environmental Chemistry and Pollution Control. S. Chand and Co., New Delhi.
3. Krishnan Kannan. 1997. Fundamentals of Environmental Pollution. S. Chand and Co., Ltd. New Delhi.
4. S. S. Purohit and K. A. Agrawal.2006.Environmental Pollution: Causes, Effects and Control. Agrobios, New Delhi.
5. P. Narayanan. 2007. Environmental Pollution: Principles, Analysis and Control.CBS Pub., New Delhi.
6. S. Manahan. Environmental Chemistry, 7th Edn.
7. P. Shrivastava. Environmental Pollution and its Management.
8. Aswathanarayan. Soil Resources and the Environment.
9. A. K. Tripathi, Advances in Environmental Sciences.

# Department of Agricultural Economics

## Course Layout

| Sl. No. | Course Code and Course Title | Credit Hours | Level | Semester |
|---|---|---|---|---|
| 1. | AGEC 109. Agricultural Economics (Theory) | 03 | 1 | I |
| | **Total:** | **03** | | |

| **Course Code: AGEC 109**<br>**Course Title: Agricultural Economics (Theory)** | **Credit Hours: 03** | **Level: 1** | **Semester: I** |
|---|---|---|---|

**Rationale:** The course is designed to understand the optimal resource utilization for profit maximization, efficient and effective farm management, and agricultural policy initiatives as well as other economic concepts related to agricultural sector.

**Course Objectives:**

- Introduce students with the basics of agricultural economics' concepts.
- Develop the students' understanding about optimal utilization of scares resources and profit maximization in the field of agricultural sector.
- Improve students' understanding regarding agricultural market and different market behavior.
- Introduce knowledge on different macroeconomics variables such as money and financial market, inflation, national income, etc., and their relation to the agricultural sector.
- Understand agricultural project planning and policy implications.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching Strategy** | **Assessment Strategy** |
|---|---|---|---|
| • Recall the definition, scope and theories of economics as well as their practical implications | Basic concepts of economics, approaches to the study of economics | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain demand and supply curve through Marshallian analysis as well as indifference curve technique<br>• Assess elasticity of demand and supply, and consumer's equilibrium as well as interpret the result | Marginal utility exposition versus indifference curve analysis, laws of demand and supply, measurement of elasticity, elasticity of demand and supply, consumer's surplus | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe production function, laws of return, factors of productions and their application, and importance in agriculture | Production function, laws of returns, iso-product curve, factors of production: Land, labour, capital and organization | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Assess the output level for profit maximization under different market structure through cost and revenue analysis | Cost and revenue analysis, markets and its types, determination of price under perfect and imperfect competition. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Describe the concept of money, its evolution and functions, different theories of money, and the concept, causes and consequences of inflation | Definition and functions of money, value of money, inflation: its causes and consequences | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Discuss about capital market and financial institutions through their functions | Different types of banking and their functions, specialized banking | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the concept of national income, different techniques of its computation with constrains of each technique | Basic concept of national income, methods and problems of its computation | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Illustrate the concepts and scopes of agricultural Economics and agricultural marketing channel<br>• Describe the importance of agricultural insurance and credit in sustainable development of agricultural sector<br>• Develop and manage agricultural project<br>• Demonstrate farm management practices and policy initiatives in agricultural sectors followed by their implications | Concepts and scopes of agricultural economics, agricultural marketing, marketing channel, problems and solutions of agricultural marketing, farm size and productivity, agricultural insurance, agricultural credit, agricultural project management, decision making process, concepts of land reforms, role of agriculture in the economy | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Explain the concepts of public revenue, public finance and budget, sources of revenue, and objectives of taxation system<br>• Explain the characteristics and importance of a good tax system in developing economies.<br>• Describe the roles and effects of public expenditure in a developing economy | **Public Revenue**<br>Sources of revenue, social and economic objectives of taxation, characteristics of a good tax system, role of taxation in developing economies<br>**Public Expenditure**<br>Characteristics of the under develop country, concepts of public expenditure, causes of | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

| | | | |
|---|---|---|---|
| • Narrate the concept, types and importance of budget. | increase in public expenditure, effects of public expenditure, role of public expenditure in a developing economy.<br>**Budget**<br>Concepts and types of budget. | | |
| • Explain the latest research findings and information of Agricultural Economics | Latest research findings and information regarding Agricultural Economics | Assignment | Report |

**Reference Books:**


1. P.A. Samuelson and W.D. Nordhaus. 2009. Economics. 19th Edition. McGraw-Hill Publishers' Pvt. Ltd., New Delhi, India.
2. K.K. Dewett and M.H. Navalur. 2006. Moodern Economic Theory. S.chand and Co. Ltd. Newdelhi, India.
3. H.L. Ahuja. 2004. Modern Microeconomics-Theory and Applications. S.Chand and Company Pvt. Ltd., New Delhi, India.
4. R.K. Lekhi and J. Singh. 1999. Agricultural Economics. Kalyani Publishers, New Delhi, India.
5. A.N. Sadhu and A. Singh. 1989. Fundamentals of Agricultural Economics. Himalaya Publishing House, Mumbai, India.
6. Anderson, J.R., Dillon, J.L. and Hardaker, J.B. 1977. Agricultural Decision Analysis, Iowa State University Press, Ames.
7. Baumol, W.J. 1978. Economic Theory and Operations Analysis. Fourth edition, Prentice-Hall, New Delhi.
8. Doll, J.P. and Orazem, F. 1984. Production Economics - Theory with Applications, 2nd edn., John Wiley, New York.
9. Ritson, C. 1977. Agricultural Economics - Principles and Policy, Crosby Lockwood and Staples, London.

# Department of Agricultural Statistics

**Course Layout**

| Sl. No. | Course Code and Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1 | AGST 309. Agricultural Statistics (Theory) | | 03 | 3 | I |
| 2 | AGST 310. Agricultural Statistics (Practical) | | 02 | 3 | I |
| 3 | AGST 385. Data Analysis using Statistical Packages (Theory -Elective) | | 02 | 3 | II |
| 4 | | Theory | 03 | | |
| | | Practical | 02 | | |
| | | Elective | 02 | | |
| | | **Total** | **07** | | |

| Course Code: AGST 309<br>Course Title: Agricultural Statistics (Theory) | Credit Hours: 3 | Level: 03 | Semester: I |
|---|---|---|---|

**Rationale:** The course is designed to develop students' knowledge about basic statistical methods. The course introduces descriptive statistics, correlation and regression analysis, probability theory, test of hypothesis and design of experiments.

**Course Objectives:**

- Acquire knowledge on the concepts of statistical methods and statistical inference to understand the importance of statistics.
- Understand the concepts involved in data presentation, analysis, interpretation and drawing inference.
- Gain knowledge about probability theory, tests of significance, parameter estimation, regression and correlation analytical techniques.
- Understand basic experimental designs; how to plan, conduct, analyze and interpret results of basic experiments.

| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Organize the data into a table or chart (frequency distribution).<br>• Interpret graphical methods for summarizing data (such as boxplots, histograms, frequency curve and ogive) | **Statistics**:<br>Definition, scope & limitations, variables and attributes, population and sample, frequency distributions, graphical representations of data. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation |
| • Calculate measures of central tendency for different types of variables.<br>• Interpret summary statistics for summarizing data sets of measures of central tendency. | **Measures of Location**:<br>Mean median and mode. Important properties of averages. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation |
| • Calculate measures of variability<br>• Interpret summary statistics for summarizing data sets of measures of dispersion. | **Measures of Variability**:<br>Absolute and relative measures of variability. Important properties of measures of dispersion. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation |

| | | | |
|---|---|---|---|
| • Explain lack of symmetry of distribution.<br>• Quantify the shape of the distribution. | **Shape Characteristics of Curves:** Skewness and kurtosis. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation |
| • Demonstrate an understanding of the basic concepts of probability<br>• Apply the laws of probability<br>• Recognize and interpret probability distributions and their properties. | **Probability**: Definition of probability, theorems of total and compound probability, marginal and conditional probability.<br>**Probability Distributions:** Binomial, Poisson and normal distributions. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving<br>Assignment | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation<br>Report |
| • Identify a possible relationship between two continuous variables from a scatter plot.<br>• Interpret correlation coefficient.<br>• Estimate linear regression line by OLS method and interpret. | **Relationship between variables**: Bivariate distribution, scatter diagram, correlation and regression analysis. Method of least squares. Properties of correlation and regression coefficients. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation |
| • Demonstrate an understanding of the basic concepts of hypothesis testing.<br>• Select a proper hypothesis test and how to interpret the data.<br>• Estimate and interpret p-values.<br>• Draw conclusions and derive meaningful information from the data. | **Test of significance**: Hypothesis, level of significance, degrees of freedom, Type-I and Type-II errors.<br>**Test Statistic(s):** t, F and $\chi^2$ and their applications. | Lecture<br>Visual presentation<br>Discussion<br>Problem solving<br>Assignment | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation<br>Report |
| • Apply and interpret the methods of analysis of variance (ANOVA) for basic designs.<br>• Apply strategy in planning and conducting experiments.<br>• Perform and interpret the F test in ANOVA. | **Design of Experiment**: Basic concept of analysis of variance, layout, linear models, basic principles of experimental design.<br>**Analysis of Variance:** Completely randomized design, randomized block design, Latin square design, split plot design. Multiple | Lecture<br>Visual presentation<br>Discussion<br>Problem solving<br>Assignment | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Calculation<br>Report |

| | | | |
|---|---|---|---|
| • Analyze data and interpret the experimental results in agriculture | comparison tests. | | |
| • Explain the latest research findings and information of Agricultural Statistics | Latest research findings and information regarding Agricultural Statistics | Assignment | Report |

**Reference Books:**


1. M.A. Ali 1969, 1973. Theory of Statistics Vol. 1 & 2, Dhaka Book Mart 38, Banglabazar, Dhaka.
2. G.H. Goulden 1952. Methods of Statistical Analysis, John Wiley, New York.
3. S.C. Gupta & V.K. Kapoor 1982. Fundamentals of Mathematical Statistics, S. Chand and Company Ltd, Ramnagar, New Delhi.
4. J.N. Kapur & H. Sexena 1976. Mathematical Statistics, S. Chand & Company Ltd., Ramnagar, New Delhi.
5. B L Agrawal. 1996. Basic statistics 3rd edition, New Age International Pvt. Ltd. New Delhi
6. R.N. Shil and S.C. Debnath 1992. An Introduction to the Theory of statistics, Minati Shil and Amita, Debnath, Mymensingh.
7. G.U. Yule & M. G. Kendall. 1965. An introduction to the Theory of Statistics, Charles Griffin, London.
8. R.G. D. Steel and J.H. Torrie. 1960. Principles and Procedures of Statistics. McGraw –Hill INc. New York.
9. S.C Gupta,.and V.K. Kapoor. 1988. Fundamentals of applied statistics, Chand and Com. New Delhi,
10. S M H Zaman *et al*. Simple Lessons From Biometry, Published by BRRI.
11. Singh S. and R P S. Verma. 1982. Agricultural statistics, Rama Publishers Meerut,

| ourse Code: AGST 310<br>Course Title : Agricultural Statistics (Practical) | Credit Hours: 02 | Level: 3 | Semester: I |
|---|---|---|---|
| **Rationale:** This course is designed to develop students' knowledge through hands on exercise about statistical methods used in different areas of agriculture. | | | |
| **Course Objectives:**<br>• Acquire skills in various statistical methods and their applications in different agricultural fields<br>• Offer knowledge on descriptive and inferential statistics | | | |
| **Intended Learning Outcomes (ILOs)**<br><br>The students will be able to- | **Course Content** | **Teaching –learning Strategies** | **Assessment Strategies** |
| • Construct frequency distribution.<br>• Interpret frequency distributions for summarizing data.<br>• Demonstrate graphical methods for summarizing. | Presentation of frequency distribution | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Calculate measures of locations.<br>• Interpret summary statistics for typical data. | Calculation of the different measures of locations | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Calculate measures of variability.<br>• Assess which methods for summarizing a data set are most appropriate.<br>• Recognize and interpret the shape characteristic of the distribution. | Calculation of the different measures of variability along with shape characteristics | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Draw and interpret scatter diagram for bivariate data. | Computation of correlation co-efficient. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Demonstration |

| | | | |
|---|---|---|---|
| • Calculate and illustrate the linear relationship of variables | | Demonstration<br>Problem solving | performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Estimate the linear regression line by OLS method.<br><br>• Select, apply and interpret the results of regression methods for the analysis of data. | Fitting of regression lines | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Compute probabilities for binomial and Poisson distributions.<br><br>• Explain the difference between the binomial and Poisson distributions. | Fitting of probability distributions (Binomial and Poisson) | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Identify and state null and alternative hypotheses.<br><br>• Compute different tests statistic by hand and using statistical software.<br>• Explain p-values | Computation and applications of t, $\chi^2$ and F statistic(s) | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Construct ANOVA for CRD RBD and LSD in the agricultural fields.<br>• Develop an experimental design that will be useful in testing the hypothesis and making conclusion. | Layout, linear models, analyses and interpretation of results relevant to basic designs | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Calculation<br>Viva-voce<br>Practical notebook |
| • Identify the best treatment among the treatments and interpret the results. | Multiple comparison tests (LSD and DMRT). | Lecture<br>Visual presentation<br>Discussion<br>Demonstration<br>Problem solving | Quiz/MCQ<br>Short answer<br>Demonstration<br>performance<br>Calculation<br>Viva-voce<br>Practical notebook |

**Reference Books:**


1. M.A. Ali 1969, 1973. Theory of Statistics Vol. 1 & 2, Dhaka Book Mart 38, Banglabazar, Dhaka.
2. G.H. Goulden 1952. Methods of Statistical Analysis, John Wiley, New York.
3. S.C. Gupta & V.K. Kapoor 1982. Fundamentals of Mathematical Statistics, S. Chand and Company Ltd, Ramnagar, New Delhi.
4. J.N. Kapur & H. Sexena 1976. Mathematical Statistics, S. Chand & Company Ltd., Ramnagar, New Delhi.
5. R.N. Shil and S.C. Debnath 1992. An Introduction to the Theory of statistics, Minati Shil and Amita, Debnath, Mymensingh.
6. S R S. Chandel. 1984. A hand book of agricultural statistics, Achal Prakashan Mandir,Kanpur,India.
7. G.U. Yule & M. G. Kendall. 1965. An introduction to the Theory of Statistics, Charles Griffin, London.
8. R.G. D. Steel and J.H. Torrie. 1960. Principles and Procedures of Statistics. McGraw -Hill INc. New York.
9. S M H Zaman *et al.* Simple Lessons From Biometry, Published by BRRI.

| **Course Code: AGST 385**<br>**Course Title: Data Analysis using Statistical Packages (Theory -Elective)** | **Credit Hours: 02** | **Level: 3** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to develop students' knowledge through hands on exercise about statistical methods using different statistical software in the field of agriculture. | | | |
| **Course Objectives:**<br>• Understand the fundamental concepts of computer<br>• Using computer for processing data<br>• Analyze and interpreting the outputs for inference. | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Explain the fundamental concepts of computer.<br>• Identify and discuss different functions of computer hardware and software.<br>.<br>• Explain major steps in the historical development of computers and information systems. | **Introduction to Computer:** Computer and its development. Types of computer according to size and function. Peripheral devices of computer system. Concept of software and hardware: BIOS, RAM, ROM, virus, compiler and interpreter. | Lecture<br>Visual presentation<br>Discussion | MCQ/Quiz<br>Short answer<br>Essay type answer |
| • Describe basic concepts of operating systems of Windows. | **Operating Systems:** Operating systems of computer: Windows. | Lecture<br>Visual presentation<br>Discussion | MCQ/Quiz<br>Short answer<br>Essay type answer |
| • Apply formatting to the document for creating table.<br>• Summarize data, create graphs and perform statistical calculations using Excel. | **Application Software: Microsoft Office**: Word, Excel, Access and PowerPoint. | Lecture<br>Visual presentation<br>Discussion<br>Hands on practice | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Demonstration performance |

| | | | |
|---|---|---|---|
| • Create data file in Access.<br>• Know the basic features of Power Point. | | | |
| • Explain the basic concepts of SPSS and STATA.<br><br>• Illuminate the operating system of SPSS and STATA. | **Statistical Software**: SPSS and STATA. Structure of SPSS and STATA. Operation commands, data properties, transformation, recoding and data management. | Lecture<br>Visual presentation<br>Discussion<br>Hands on practice | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Demonstration performance |
| • Perform statistical analysis of data using SPSS and STATA<br><br>• Analyze and interpret the outputs for drawing inference | **Applications in Agriculture:** Computation of descriptive statistics, correlation and regression analysis, analysis of categorical data, test of hypothesis, analysis of variance, comparing means and graphical representation of data. | Lecture<br>Visual presentation<br>Discussion<br>Hands on practice | MCQ/Quiz<br>Short answer<br>Essay type<br>Demonstration performance |
| • Perform an analysis of variance (ANOVA) using SPSS and STATA<br><br>• Interpret the ANOVA table for drawing inference | **Design of Experiment:** Analysis of variance in CRD, RBD, LSD, split plot design. Multiple comparison tests using SPSS and STATA. | Lecture<br>Visual presentation<br>Discussion<br>Hands on practice | MCQ/Quiz<br>Short answer<br>Essay type answer<br>Demonstration performance |

| | | | |
|---|---|---|---|
| • Describe the latest research findings and information of Statistical Packages for Agricultural Research | Latest research findings and information regarding Statistical Packages for Agricultural Research | Assignment | Report |

**Reference Books:**


1. N.C. Leandro. Fundamentals of Natural Computing. Basic Concepts, Algorithms, and Applications Edition, ISBN-13: 978-1584886433, ISBN 10: 1584886439
2. L.F. Torben. Microsoft Office Excel:Book Boon2010, eBook PDF , 135 pages ISBN-13 : 978-87-7681-67 9
3. C.A. Elliott & A.Wayne Woodward. Statistical Analysis Quick Reference Guidebook: With SPSS Examples, Paperback -2006 ISBN-10: 1412925606 ISBN-13: 978-1412925600
4. S. Rabe & H.B. Everitt. A Handbook of Statistical Analyses using STATA: Third Edition , A CRC Press Company Boca Raton London New York Washington, D.C.

   Kalicharan, N. 2001. An introduction to Computer Studies. Cambridge University Press.Taxali, R.K. 2001 Software Made Simple. Tata McGraw Hill Publishing Company Limited
5. S.Matt. Microsoft Office. 2010. Ultimate Tips and Tricks: MakeUseof.com(2010) online Book.
6. G. Argyrous. Statistics for Research. With a Guide to SPSS, London.
7. Statacorp Lp (Corporate Autor). STATA Programming Reference Manual, Release 12. ISBN-13: 9 1597180917, ISBN-10: 1597180912.

# Department of Animal Production & Management

## Course Layout

| Sl. No. | Course Code and Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1. | APMA 157: Livestock Production (Theory) | | 03 | 1 | II |
| | APMA 158: Livestock Production (Practical) | | 02 | 1 | II |
| | | Theory | 03 | | |
| | | Practical | 02 | | |
| | | **Total** | **05** | | |

| **Course Code: APMA 157**<br>**Course Title: Livestock Production (Theory)** | **Credit Hours: 03** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide fundamental concept of livestock and their practices involved in animal sciences | | | |
| **Course Objectives**<br>• Acquire knowledge about fundamental issues of farm animal<br>• Gain knowledge on animal management<br>• Understand livestock and poultry farming techniques<br>• Gather knowledge for uses of animal products and their by-products | | | |
| **Intended learning outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning strategies** | **Assessmet strategies** |
| • Discuss the importance and constraints of livestock and poultry<br>• Describe scope of livestock and poultry production in Bangladesh | **Concept of livestock-** History, importance, constraints and scopes of livestock and poultry | Lecture<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Explain livestock and poultry terms | **Livestock terms-** Definition of animal science, animal husbandry, livestock and poultry. Glossaries of cattle, buffalo, goat, sheep, horse, pig and poultry. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Explain ecological interaction with environment | **Ecology and environment-** Definition and branches of ecology, components of ecology, relationship of ecology with environment and other disciplines. Effect of climate on livestock production. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Describe the psychological, behavioral and physiological factors related to livestock production | **Psychology and behavior-** Psychology and behavior of domestic animals, Correlation of psychological, behavioral and physiological factors on livestock production | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Classify different breeds and breeding system of animals | **Livestock breeds and breeding-** Breeds of common farm animals (cattle, buffalo, sheep, goat) and poultry (chicken, duck, quail, pigeon, turkey) of Bangladesh and at the global level. Basic concept of breeding systems of livestock. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Describe the judging procedure of farm animals | **Selection and judging-** Selection and judging of dairy cows, beef cattle and draft animals | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Discuss housing of farm animals and poultry<br>• Describe management of livestock and poultry farms | **Housing and management-** Define housing, advantages and disadvantages, site selection and different types of housing of livestock and poultry. General livestock and poultry farm management. Function and tools of a livestock farm. Define manager, farm and management. Qualifications of a good manager. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Plan for setting a livestock and poultry farms | **Farm planning-** Planning and setting up livestock and poultry farms | Lecture<br>Visual presentation<br>Discussion<br>Assignment | MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Know about feedstuff, their classification and function of the nutrients | **Feeds and nutrients-** Definition of common terms of livestock feed stuffs. Classification of feeds. General purposes of feed stuffs. Essential feed nutrients and their functions. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Discuss the feeding and digestive system of ruminants and non-ruminants<br>• Describe the uses of urea, molasses, straw and their utilization in livestock | **Feeding and digestive system-** Different feeding system of animals. Digestive system of ruminants and non-ruminants. Uses of urea molasses straw, their utilization and toxicity. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |

| | | | |
|---|---|---|---|
| • Discuss livestock farming programs | **Livestock farming program-** Beef fattening program, dairy cattle, draft animal, buffalo, goat and sheep production | Lecture<br>Visual presentation<br>Discussion<br>Field visit | MCQ<br>Short answer<br>Essay type<br>Report |
| • Describe products and by-products of animals with their uses | **Animal products and by-products-** Introduction to livestock products (meat, milk, wool, mohair, fur, draft power and egg). Food value of meat, milk and egg. Slaughter house by-products and their uses. Farm yard manure, compost and biogas plant management. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Describe and classify livestock diseases with their prevention and control measures | **Concept of livestock health and diseases-** Definition of health and disease, categories of diseases, common livestock and poultry diseases in Bangladesh, signs of good and ill-health of animals, prevention and control of diseases, bio-security/bio-safety of a livestock and poultry farm. | Lecture<br>Visual presentation<br>Discussion | MCQ<br>Short answer<br>Essay type answer |
| • Describe the latest research findings and information of Livestock Production | Latest research findings and information regarding Livestock Production | Assignment | Report |

**Reference Books**


1. M.E. Ensminger. 1990. Animal Science. 9th edn., Pearson, New York.
2. G.C. Banerjee. 2011. A Text Book of Animal Husbandry. 8th edn., Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
3. D.N. Verma. 2005. A Text Book of Livestock Production Management in Tropic. Kalyani Publishers, New Delhi.
4. G.C. Banerjee. 1992. Poultry. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
5. M.C. Neshiem, R.E. Austic and I.E. Card. 1979. Poultry Production. 12th edn., Lea and Febiger, Philadelphia.
6. D.N. Verma. 1995. A Text Book of Animal Nutrition. 1st edn., Kalyani Publishers, New Delhi.
7. J. Prasad. 2010. Goat, Sheep and Pig Production and Management. Kalyani Publishers, New Delhi.
8. N.S.R. Sastry and C.K. Thomas. 2005. Livestock Production Management. 4th edn., Kalyani Publishers, New Delhi.
9. S.N. Mahindru. 2009. Milk and Milk Products. A.P.H. Publishing Corporation, New Delhi.
10. J. Prasad and J. Neera. 2010. Principles and Practices of Dairy Farm Management. 6th edn., Kalyani Publishers, New Delhi.
11. G.C. Banerjee. 1988. Feeds and Principles of Animal Nutrition, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
12. R A. Singh. 1990. Poultry Production. Kalyani Publishers, New Delhi.
13. P. Mc.Donald, R.A Edwards, J.F.D. Grennhalgh and C.A. Morgan. 2008. Animal Nutrition. 4th edn., Dorling Kindersley (India) Pvt. Ltd., Licensees by Pearson Education, India.
14. W.G. Pond, D.C. Church, K.R. Pond and P.A. Schokecht. 2006. Basic Animal Nutrition and Feeding. 5th edn., Wiley, India.
9. S.K. Ranjhan. 1993. Animal Nutrition and Practices. 4th Revised Edn., Vikash Pub. House Pvt. Ltd., New Delhi.
15. N.S.R. Sastry and C.K. Thomas. 2005. Livestock Production Management. 4th edn., Kalyani Publishers, New Delhi.
16. C. Devendra and M. Burns. 1983. Goat Production in the Tropics. Commonwealth Agricultural Bureau, Farnaham House, Slough, UK.

| **Course Code: APMA 158**<br>**Course Title**: **Livestock Production (Practical)** | **Credit Hours: 02** | **Level: 1** | **Semester: II** |
|---|---|---|---|
| **Rationale:** This course is designed to provide applied knowledge on elementary animal production and to apply the practical knowledge in different farm animal production. | | | |
| **Course Objectives:** The prime objectives of this course are to-<br>• Obtain practical knowledge on animal management<br>• Understand applied livestock and poultry farming techniques<br>• Acquire practical knowledge on the uses of animal products and by-products | | | |
| **Intended learning outcomes (ILOs)**<br>The students will be able to- | **Course content** | **Teaching-Learning strategies** | **Assessment strategies** |
| • Describe the approach and handle of animals | Approaching and handling of farm animals and birds | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Explain different points of animals and birds | Identification of external body parts of farm animal and fowl | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe different breeds of animals and birds | Identification of breeds of animals and birds | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |

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| • Describe the procedure of restraining and casting | Study restraining tools and casting of animals | Lecture<br>Discussion<br>Demonstration<br>Group work | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Determine age of animals | Dentition and ageing of animals | Lecture<br>Discussion<br>Demonstration<br>Group work | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Elucidate and apply different management practices of animals | Study on marking, dehorning, disbudding, castration, clipping, shearing, bedding, clothing, grooming and washing of animals | Lecture<br>Discussion<br>Demonstration<br>Group work | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Determine the live weight of animal | Determination of live weight of farm animals | Lecture<br>Discussion<br>Demonstration<br>Group work | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe the procedure of fattening program<br>• Practice beef fattening in the farm | Demonstration of beef fattening program at SAU farm | Lecture<br>Discussion<br>Demonstration<br>Group work | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |

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| • Illuminate and practice of record keeping in the livestock farm | Operational works and record keeping of livestock farm | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Practical notebook |
| • Determine the adulteration in milk | Determination of adulteration test of milk | Lecture<br>Discussion<br>Demonstration<br>Group work | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Identify and apply of farm equipments | Identification of farm equipments and their applications | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe animal feed stuffs<br>• Formulate rations for livestock and poultry | Identification of feeds and fodder. Ration formulation for animal and poultry. | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Describe the structure and composition of eggs<br>• Identify and select the hatching eggs for incubation | Study on structure and composition of eggs. Selection of hatching eggs and incubation practices. | Lecture<br>Discussion<br>Demonstration | MCQ<br>Short answer<br>Demonstration performance<br>Identification<br>Viva-voce<br>Practical notebook |
| • Demonstrate to gather practical knowledge for animal production in the farms | Visit to animal farms for practical experience | Lecture<br>Discussion<br>Demonstration<br>Field visit | MCQ<br>Short answer<br>Demonstration performance<br>Viva-voce<br>Report |

**Reference Books**


1. T.K. Ewer. 1985. Practical Animal Husbandry. Henry Ling Ltd. at the Dorset Press, Dorchester.
2. N.S.R. Sastry and C.K. Thomas. 1979. Farm Animal Management. Vikas, Publishing House Pvt. Ltd, New Delhi.
3. F.B. Morrison. 1984. Feeds and Feeding. Third 3rd edn., CBS Publishers & Distribution, Delhi.
4. G.C. Banerjee. 2012. Poultry. 10th edn. Vikas, Publishing House Pvt. Ltd., New Delhi.
5. C. Starr and R. Taggart. 1998. Ecology and Behavior. 8th edn., Wadsworth Publishing Company, Philadelphia.
6. K.T. Sarkar. 1991. Theory and Practice of Leather Manufacture, Madras.
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11. D. Ronal, M. Klgour and C. Dalton. 1984. Livestock Behaviour, London/ Toronto/ Sydney/ New York.
12. C. Elton. 1956. Animal Ecology. Sidgwick & Jackson Ltd., London.
13. C.A. Gopalakrishn and G.M.M. Lal. 1993. Livestock & Poultry Enterprise for Rural Development, Vikas Publishing house Private Ltd. New Delhi.
14. R A. Singh.1990. Poultry Production. Kalyani Publishers, New Delhi.
15. P.S. Verma. 2009. Animal physiology and ecology. S. Chand and Co. Ram Nagar, New Delhi.
16. T.P. Sethumadhavan. 2004. Sustainable Dairy Farming: An Overview. 1st edn., Jaypee Brothers Medical Publisher (P) Ltd., New Delhi.
17. J. Prasad and J. Neera. 2012. Principles and Practices of Animal Nutrition. 3rd edn., Kalyani Publisher, New Delhi.

# Department of Aquaculture & Biology and Genetics

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| **Course Code: FISH 181**<br>**Course Title: Integrated Aquaculture-Agriculture (Theory-Elective)** | **Credit Hours: 02** | **Level: I** | **Semester: II** |

## Course Layout

| Sl. No. | Course Code and Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1. | FISH 181: Integrated Aquaculture-Agriculture (Theory-Elective) | | 02 | 1 | II |
| | | Theory-Elective | 02 | | |
| | | Practical | - | | |
| | | **Total** | **02** | | |

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| **Rationale:** This course is designed to provide fundamental knowledge on scientific approaches of aquaculture and its integration with different agricultural sub-system. | | | |
| **Course Objectives:**<br>• Get introduced to fisheries and aquaculture resources of Bangladesh including different groups of economically important cultivable fishes and other aquatic organisms<br>• Understand fundamental aspects of scientific aquaculture<br>• Acquire knowledge on integrated aquaculture systems and their management practices | | | |
| **Intended Learning Outcomes (ILOs)**<br>The students will be able to- | **Course Content** | **Teaching-learning Strategies** | **Assessment Strategies** |
| • Explain various components of fisheries resources.<br>• Discuss current status of fisheries sector of Bangladesh. | **Introduction-** Fish and fisheries resources of Bangladesh, Different types of water bodies, current aquaculture and fisheries production in Bangladesh. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe aim, scope and importance constrains of aquaculture.<br>• Discuss concept and importance of integrated aquaculture. | **Scope and its importance-** Definition aims and importance of aquaculture, principle and importance of integrated aquaculture, different models of integrated aquaculture. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Classify commercially important fishes of Bangladesh.<br>• Explain different aquaculture systems. | **Classification of fish and aquaculture-** Categories of fishes, diversity in aquaculture, monoculture and polyculture, extensive, semi-intensive and Intensive aquaculture. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Classify aquaculture ponds with enumerating their characteristics.<br>• Describe various steps of pond construction and preparation for aquaculture. | **Pond types and preparation-** Definition and classification of pond, ecology of pond, characteristics of an ideal fish pond, steps of pond construction and preparation. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Explain how to monitor and maintain water quality of aquaculture ponds. | **Water quality management for aquaculture-** Physical, chemical and biological water quality parameters of aquaculture pond. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Identify harmful aquatic weeds, weed fish, pests and predators, and explain their control methods. | **Control of aquatic weeds and undesirable species-** Common aquatic weeds in aquaculture, methods of weed control, control of weed animals, pests and predators. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe various fertilizer and lime application methods and their benefits. | **Application of lime and fertilizer-** Importance, methods and dose of lime application, types of organic and inorganic fertilizer, dose, mode of application and benefits. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain fish transportation system and stocking. | **Transportation and stocking of live fish-** Source of fish seeds, causes of fish fry mortality during transportation, live fish transportation system, fish anesthetics, stocking of fish fry. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain different terminologies related to fish nutrition and fish feed technology.<br>• Identify different feed ingredients and assess the quality of a compound fish feed. | **Nutrition and feeding of fish-** Classification of fish food, fish feed ingredients, methods of feed preparation and application, methods of assessing nutritional quality of fish feed. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |
| • Describe rice field preparation for integrated rice-cum-fish farming system.<br>• Narrate fish stocking and post stocking management in integrated rice-cum-fish culture system. | **Rice-cum-fish/shrimp/prawn farming-** Advantages, selection of land, preparation of land, selection of rice variety, transplantation, land management, selection, stocking and management of fish and shrimp/prawn, harvesting of rice and fish. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |

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| • Illustrate horticultural crop production system on pond embankment. | **Integrated fish-horticultural crops farming-** Benefits, selection of crops for pond embankment, pond preparation, fry stocking and culture management, cultivation methods of suitable fruits and vegetable crops on pond embankments. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain rearing methods of poultry (chicken and duck) integrating with fish culture system. | **Fish-cum-poultry farming-** Pond preparation, selection and stocking of fish species, post stocking management of fish, construction of poultry shed, rearing methods of duck and chicken. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe cattle farming integrating with aquaculture system. | **Fish-cum-cattle farming-** Benefits, pond preparation, fish fry stocking, construction of cattle shed, cattle rearing method, stocking density of fish, health management of fish and cattle. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Illustrate preparation and operation of different aquaponics system. | **Aquaponics (integrated aquaculture-hydroponics):** Definition, basic principles, types, selection of crops and fish, construction, maintenance and management of the systems. Benefits. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Identify the symptoms of various pathogenic and nutritional diseases of fish and their control measure. | **Health management of fishes-** Etiology, symptoms, prevention and control of some common pathogenic, environmental and nutritional fish diseases. | Lecture<br>Visual presentation<br>Discussion<br>Assignment | Quiz/MCQ<br>Short answer<br>Essay type answer<br>Report |

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| • Explain harvesting and marketing of fish and other products produced from integrated farm. | **Harvesting and marketing of integrated aquaculture products-** Harvesting, preservation, processing and marketing of integrated farm products. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Describe practical experience on aquaculture systems. | **Field visit-** Field visit to an aquaculture farm. | Lecture<br>Visual presentation<br>Discussion | Quiz/MCQ<br>Short answer<br>Essay type answer |
| • Explain the latest research findings and information of Integrated Aquaculture | Latest research findings and information regarding Integrated Aquaculture | Assignment | Report |

**Reference Books:**


1. V. G. Jhingran. 1977. Fish and Fisheries in India. Hindustan Publishing, Delhi.
2. M. S. Rahman. 1992. Water Quality Management in Aquaculture.
3. M. A. Islam 2002. Aquaculture. Bangla Academy, Dhaka.
4. FAO. 2001. Integrated Agriculture-Aquaculture, A Primer. FAO Fisheries Technical Paper-407. Rome, Italy.
5. K. Ruddle and G. Zhong. 1988. Integrated Agriculture in South China. Cambridge University press, New York.
6. BFRI. 1987. Training Manual on Integrated Fish Farming to the Upazila Fisheries Officers DOF (19-27 September, 1987). Freshwater Aquaculture Research Station, Mymensingh, Bangladesh.

# Department of Development and Poverty Studies

**Course Layout**

| Sl. No. | Course Code and Course Title | | Credit Hours | Level | Semester |
|---|---|---|---|---|---|
| 1. | DEPS 153: Rural Sociology (Theory) | | 02 | 1 | II |
| | | Theory | 02 | | |
| | | **Total** | **02** | | |

| **Course Code: DEPS 153**<br>**Course Title: Rural Sociology** | **Credit Hours: 02** | **Level: 1** | **Semester: II** |
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**Rationale:** The rural sociology course is accommodating contemporary socio-cultural, economical and human relationships under diversified socio-cultural system. This course will enrich students' knowledge to overcome their prejudices, misconceptions, egoistic ambitions, class and religious hatreds as well as boost up the level of tolerance among multicultural communities.

**Course Objectives:**

- Develop knowledge on diversified cultures and focusing overall socio-economic and political issues of the society.
- Enhance the analytical thinking regarding human interaction, social organization, collective behavior, aspects of the total social system.
- Learn to address the human relationships and emerging contemporary social problems under changing society.

| **Intended Learning Outcomes (ILOs)**<br>The student will be able to- | **Course Content** | **Teaching-Learning Strategies** | **Assessment Strategies** |
|---|---|---|---|
| • Describe rural sociology its meaning origin and development<br>• Comprehend the role of rural sociologists and their relation with rural community. | **Rural Sociology:**<br>Origin, Meaning, Importance and nature of rural sociology.<br><br>Role of rural sociologists and rural community. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Discuss about Society, Community and Association.<br>• Develop Knowledge on Institution, Social Groups, Isolations, Group's networks. | **Primary Concepts:**<br>Basic concepts of society, Institution and Social groups. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Acquire knowledge on culture and its diversity.<br>• Boost up level of tolerance and maintain socio cultural harmony among multicultural environment. | **Culture**:<br>Culture and its elements; Norms, Values, Folkways, Mores, Cultural traits, Cultural unity and diversity. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Realize the concepts and meaning of social interaction and its role in society. | **Social Process;**<br>Human interaction as the base of a society and its development. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |

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| • Realize Family, kinship relationships and its importance under changing situation.<br>• Develop respect, sympathy and ethical values among the family members. | **Social Institutions:**<br>Family, types and its functions. Role of family and kinship bondage. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Describe social structure and class relations.<br>• Elicit transformation of social structure over time. | **Social Stratification:**<br>Definition, Types of social stratification. The caste and class system. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Explain population growth, its mechanism and consequence.<br>• Extract the ideas about migration and its consequences in society.<br>• Realize gender and its changing role in population growth. | **Population:**<br>Concept of demography, Fertility, Mortality, Migration. Theories of population.<br><br>Gender and sexuality. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Analyze contemporary social problems its nature, scope and causes.<br>• Find the path to way out of these problems. | **Social problems**:<br>Overpopulation, Slums, Women harassment, Corruption, and Social unrest. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Evaluate the structural change of the society.<br>• Explain the path of social change its mechanism and related eminent theories. | **Social Change:**<br>Definition, Causes and Factors of social change.<br><br>Theories of social change. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |
| • Explain rural and urban society and livelihood.<br>• Illustrate economic and cultural significance of agriculture.<br>• Describe social capital, trust and fatalism. | **Rural Society:** Rural community and livelihood. Rural and urban society. | Lecture<br>Visual presentation<br>Interactive discussion | Quiz /MCQ<br>Short answer<br>Essay type answer |

**Reference Books**


1. C.N.S. Rao. Sociology. 2012. S. Chand & Company ltd. New Delhi.
2. J.B. Chitamber. Introductory Rural Sociology. 2003. New Age International (P) Limited, New Delhi.
3. R. T. Schaefer. Sociology. 2010. McGraw Hill, New York.
4. T.B. Bottomore. Sociology: A Guide of Problem and Literature.1972. Allen and Unwin, London.
5. H.B.Frederick, O. F. Larson, G. W. Gillespie Jr. The Sociology of Agriculture. 1990. Greenwood Press. New York.
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# Faculty of Agriculture

# Sher-e-Bangla Agricultural University

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