#### Detail Curricula for B. Sc. Ag. (Honours) Degree

**B. Sc. Ag. (Hons.) Part – 1**

**THEORY COURSES**

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| **Course number** | **:** | **CST-101**  |
| **Course title** | **:** | **Agronomy - I (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

This course covers the understanding of the elementary principles and practices of field crop production and management of farm resources and inputs.

**Objectives**

* Introduce the concepts of agronomy and crop suitability in relation to agro-climate and agro-ecology
* Provide knowledge on field crop classification and cropping practices
* Make understand about the functions, sources and management of plant nutrients
* Impart knowledge on cultural and intercultural operations of field crops

**Learning outcomes**

* Explain the concepts of agronomy
* Justify crop suitability based on different agro-climatic and geographical condition
* Categorize crops and describe cropping practices
* State the functions, sources and management of plant nutrients
* Describe the cultural and intercultural operations of field crops

**Course content**

1. **Introduction to Agronomy:** Concept, importance, scope and basic principles. Evolution of agriculture.
2. **Agro meteorology** **of Bangladesh:** Concept of weather and climate. Cropping seasons and their characteristics. Rainfall and temperature pattern and their influence on crop distribution.
3. **Crops and Cropping:** Concept of crops, Agronomic classification of crops. Concept of cropping patterns, Crop rotation, and mono and multiple cropping.
4. **Crop Geography:** Land topography and its types and characteristics. Distribution of crops in relation to climate and soil in world’s perspective. Agro-ecological Zones of Bangladesh, their characteristics and crop suitability.
5. **Tillage:** Concept, objectives and types. Advantages and disadvantages of different types of tillage. Effect of tillage on soil characteristics and nutrient availability. Determinants of time, depth and number of ploughing. Characteristics of ideal tilth.
6. **Soil fertility and Plant Nutrition:** Soilfertility and productivity. Essential elements, criteria, forms & sources. Functions, deficiency symptoms and toxic effectsof important elements in crop plants.
7. **Manures and** **Fertilizers:** Definition, characteristics, classification and nutrient contents. Preparation and preservation of manures. Methods of application of manures and fertilizers; their advantages and disadvantages. Commonly used fertilizers in Bangladesh.
8. **Planting Practices:** Concept, types ofplanting materials. Planting methods, depth, density and their determinants. Field conditions for sowing.
9. **Intercultural Practices:** Concept, importance, various operation, mulching, weeding, thinning, gap filling, earthingup, their concepts and objectives.
10. Irrigation and Drainage: Concept, sources, methods, advantages and disadvantages.

**Teaching strategy**

* Lecture
* Question and answering
* Tutorial

**Assessment strategy**

* MCQ
* Quiz
* Short question
* Essay type question
* Assignment

**Books recommended**

Balasubramaniyan, P. and Palaniappan, S. P. 2009. Principles and Practices of Agronomy. Second Edition. Agrobios, India.

Bhuiya, M. S. U., Islam, M. M., Uddin, M. R., Salam, M. A. and Rahman, M. M. 2009. Introductory Agronomy. Oracle Publications, Dhaka, Bangladesh.

Das, P.C. 1997. Manures and Fertilizers, Kalyani Publishers. Ludhiana, New Delhi, Calcutta. 130p.

De, G.C. 1995. Fundamentals of Agronomy. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta. 429p.

Morachan, Y.B. 1993. Crop Production and Management. 2nd Edition (Reprint). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, Bombay, Calcutta. 294p.

Reddy, T. Y. and Reddi, G. H. S. 2008. Principles of Agronomy. Kalyani Publishers, Ludhiana, New Delhi, Hyderabad, Kolkata, India.

Singh, S.S. 1996. Principles and Practices of Agronomy. 3rd Edition (Reprint). Kalyani Publishers. New Delhi.

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| **Course number**  | **:** | **CST-102**  |
| **Course title**  | **:** | **Soil Science – I (Theory)**  |
| **Number of credits**  | **:** | **3** |
| **Total marks**  | **:** | **100** |

**Rationale**

This course is designed to cover fundamental aspects of soils in relation to crop production

**Objectives**

* Discuss soil composition and their functions
* Describe soil genesis and explain importance of different soil properties
* Identify and classify the soil air, water, temperature

**Learning outcomes**

* Explain soil and its components
* Describe rocks and minerals and their weathering processes, soil forming processes and factors
* Illustrate and evaluate soil genesis and soil formation
* Interpret soil physical properties and processes and their significance in crop production
* Classify soil pH and explain its significance in crop production

**Course content**

**Soil Genesis and Physics**

1. **Concept of soil:** Definition, scope and branches of soil science, Major mineral soil components, mineral and organic soil; Soil profile, pH and fertility.
2. **Soil forming rocks and minerals:** Classification, properties of important rocks; properties and composition of minerals.
3. **Soil formation:** Concept of Physical, Chemical and Biological weathering. Soil forming factors. Soil forming process-eluviation and Illuviation; Podzolization, Laterization, Humification and Calcificaiton process.
4. **Soil particles:** Soil separates and mechanical analysis, systems and particle size distribution; comparative characteristic of sand, silt and clay; Stoke’s law; Soil texture – definition, classes, methods of determination, importance. Soil structure- definition, genesis and factors, classification, importance. Particle-density and bulk density; porosity, factors affecting bulk density and porosity of soil, importance.
5. **Soil air, colour, temperature and consistence:** Soil air–composition, factors affecting the composition, importance. Soil colour, soil aeration– definition, composition and colour, factors affecting soil colour. Soil temperature - sources of soil heat, factors affecting soil temperature, control and role of temperature. Concept of soil consistence.
6. **Soil water:** Definition, gain and loss of soil water, importance, structure, hydrologic cycle; energy concepts, soil water potential: componenets of soil water potential, Hg and gauge tensiometer method. Classification of soil water and constant. Soil water infiltration- definition, equations, methods, and factors. Concept and characteristics of irrigation water qualities.
7. **Evapotranspiration:** Definition of Evapotranspiration (ET) & Potential Evapotranspiration (PET), factors affecting ET, Methods of ET determination -Lysimetric and Pan Evaporimetric method.

**Teaching strategy**

* Lecture
* Tutorial
* Self study/e-learning

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons Inc., New York.

Baver, L.D., Gardner, W. H. and Gardner, W.R. 1972. Soil Physics, 4thedition. John Wiley & Sons. Inc., New York.

Biswas, L.D., and Mukherjee, S.K. 1991. Text book of Soil Science. Tata McGraw-Hill Pub. Ltd., New Delhi.

Brady, N.C. and Weil, R.R. 2006. The Nature and Properties of Soils. Thirteen edition Pearson Education Pvt. Ltd. New Delhi, India.

Foth H.D. 1991 Fundamentals of Soil Science. 8th edition, Willey and Black, USA.

Miller, R.W. and Donahue, R.L. 1990. Soils- An Introduction to Soils and Plant Growth. Prentice Hall Inc. USA.

Subba Rao, N.S. 1987. Advances in Agricultural Microbiology. Oxford and IBH Pub. Co., New Delhi.

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| **Course number** | **: CST-103**  |
| **Course title** | **: Horticulture – I (Theory)** |
| **Number of credits** | **: 3** |
| **Total marks** | **: 100** |

**Rationale**

This course will focus on fundamental aspects of horticultural practices.

**Objectives**

* Provide knowledge on nursery management
* Explain the different methods of plant propagation
* Understand crop husbandry and postharvest management

**Learning outcomes**

* Describe the history, branches, importance and scope of horticulture
* Explain the principles and practices including planting methods, raising of seedlings and different intercultural operations
* Apply the skills of different nursery management and propagation practices
* Demonstrate training and pruning in horticulture
* Harvest and postharvest handling of different horticultural crops

**Course contents**

##### Fundamentals of Horticulture

1. **Introduction**: Origin, definition, history and branches of horticulture; different classification of horticultural crops, scope, importance and career opportunities of growing horticultural crops in Bangladesh.
2. Introduction to trees, shrubs and orchids.
3. **Preliminary crop propagations:** Definition, outline of plant propagation, methods of propagation and their advantages and disadvantages and buddage and cuttage.
4. **Principles and practices:** Preparation of soil, raising of seedling, planting methods, factors affecting of spacing, irrigation and fertilizer doses, application of manures and fertilizer, intercultural operations, irrigation and harvesting; rotation of crops and multiple cropping.
5. **Preliminary nursery management:** Horticultural nursery – definition and objectives; different classes and section of horticultural nursery and their advantages and disadvantages, preparation of nursery bed, raising of seedling in nursery beds; potting, depotting and reporting.
6. **Introduction to pruning and training:** Definition, objectives, principles, methods, types, and effect of pruning and training.
7. **Turf Management:** Development and maintenance of lawn, turf and hedges.

**Teaching strategy**

* Lecture
* Group discussion
* Video clip

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Pop quiz

**Books recommended**

Adams, C.R., K.M. Bamford and M.P. Early. 1993. Principles of Horticulture (2nd edn.). Linacre House, Jordan Hill, Oxford. (5th edition, 2011 available).

Bose, T.K., S.K. Mitra and M.K. Sadhu. 1986. Propagation of Tropical and Sub-tropical Horticultural Crops. Naya Prokosh, Calcutta. (1991 avaiable).

Davidson, H.R. Meckienburg, and C. Peterson, 1994. Nursery management: Administration and culture (3rd edition), Englewood cliffs, N.J. Prentice- Hall.

Hartmann, H.T., D.E. Kester and F.T. Davies Jr. 1990. Plant Propagation: Principle and Practices. Prentice-Hall, International editions. (7th edition, 2001 available).

Mondal, M.F.2000. Nursery and Plant Propagation (in Bangla). Mrs. Afia Mondal, BAU Campus, Mymensingh.

Prasad, S. and U. Kumar, U. 1999. Principles of Horticulture. Agro Botanica, New Delhi.

Thompson, A. K. 2003. Fruits and Vegetables: Harvesting, Handing and Storage (Second edition). Blackwell Publishing Ltd. Oxford, UK.

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| **Course number** | **:** | **CST-104**  |
| **Course title** | **:** | **Agricultural Botany – I (Theory)**  |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

This course has been designed to offer knowledge on morphology of crop plants in relation to classification, production, tolerance and improvement

**Objectives**

* Describe detail morphological, anatomical and embryological features of crops in relation to plant taxonomy
* Explain ethno-botanicalresources and their utilities.

**Learning outcomes**

Upon completion of the course, students should be able to:

* Understand descriptors of different crop plants for identification, compare and contrast.
* Achieve knowledge about taxonomy of plants and economic importance of different crops.
* Describe embryogenesis and its relation to embryo, endosperm, seed and fruit development.

**Course content**

Plant Morphology, Taxonomy, Economic Botany and Embryology

1. **Introduction to Plant Family:** a) Compositae, b) Cruciferae, c) Cucurbitaceae, d) Gramineae, e) Leguminosae, f) Palmae, g) Rutaceae and h) Solanaceae.
2. **External morphology of the following vital crops:** Brinjal, Groundnut, Jute, Lentil, Mustard, Rice, Sweet gourd, Wheat.
3. **Taxonomy:** Introduction, concept of taxon and botanical nomenclature, principles and systems of plant classification.
4. **Cell:** Concept, structures and ultra-structures of protoplasmic components of cell, functions of important organelles.
5. **Cell wall:** Components and composition of cell wall, patterns of thickening, cell wall organization, plasmodesmata, pit- structures of simple and bordered pits and their functions, primary pit field.
6. **Tissue and tissue system:** Concept, classification and morphology of meristematic, simple, vascular and secretory tissues, structures and their functions, tracheary elements and sieve elements, vascular bundles and major types, tissue system- epidermal, procambiam and vascular; epidermal appendages.
7. **Primary structure:** Concept of primary growth, structures of root and stem of monocot and dicot plants, structures of isobilateral and dorsiventral leaves.
8. **Secondary structure:** Concept of normal and anomalous secondary growth, activities of typical vascular cambium, formation of periderm and its functions.
9. **Anatomy of following crops:** Rice, Wheat, maize, Jute and Cucurbit.
10. **Economic important plants:** Fibre, oil, timber, medicinal and rubber yielding plants and their products with economic importance.
11. **Embryology:** Concept of sporogenesis and gametogenesis in cryptogamas, microsporogenesis & microgametogenesis, megasporogenesis and megagametogenesis, pollination, fertilization, development of embryo, endosperm, seed, fruit, parthenogenesis and polyembryone.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Class attendance
* Assignment
* Essay type question

**Books recommended**

Arrur. J. Eamas, Laurence H. Macdniels. 1993. An Introduction to Plan Anatomy. Tata Megraw Hill Publlishing Co. Ltd. New Delhi.

Ashok Bendre, Ashok Kumar. 1999. A Text Book of Practical Botany Vol. I & II. Rastogi Publications, Shaviji Road, Meerot, India.

Carlquist, S. 1961. Comparative plant anatomy. Holt. Rinehart and Winston, New York.

Cobley, L.S. 1956. Introduction to botany of tropical crops. Longmans, London.

Cutter, E.G. 1971. Plant anatomy: experiment and interpretation. Edward Arnold, London.

Cutter, E.G. 1978. Plant anatomy. Vol. 1&2. Edward Arnold, London.

Dutta, A.C. 1975. Botany for degree students. 4th Ed. Oxford Univ. Press, Calcutta.

Eames, A.J. and MacDaniels, L.H. 1949. An introduction to plant anatomy. McGraw-Hill, New York.

Gupta, R.K. 1961. Text book of systematic botany. 5th ed., Atea Ram Pub., Delhi.

Hill, A.F. 1952. Economic botany. 2nd ed., McGraw-Hill, New York.

Maheshwari, P. 1950. An introduction to the embryology of angiosperms. McGraw-Hill, New York.

Pandey, B.P. 1997. Modern Practical Botany, Vol. I & II. S. Chand & Com. Ltd. Ram Nagar, New Delhi-110055.

Pandey, B.P. 2000. Economic botany. 6th ed., S. Chand & Co., New Delhi.

Pandey, B.P. 2001. Plant Anatomy. S. Chand & Co., New Delhi.

Pophm, R.A. 1966. Laboratory manual for plant anatomy. C.V. Mosby, Saint Louis.

Purseglove, J.W. 1963. Tropical crops. Vol. 1&2. Longmans, London.

Rendle, A.B. 1967. The classification of flowering plants. Vol. 1&2. Cambridge Univ. Press, Cambridge.

Simpon, M.G. 2010. Plant Systematics. 2nd ed., Elsevier Acad. Press, New York.

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| **Course Number** | **:** | **CST-105** |
| **Course Title** | **:** | **Farm Mechanics (Theory)**  |
| **Number of Credits** | **:** | **3** |
| **Total marks** | **:** | **100** |
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| **Rationale** |
|  | This course covers basic knowledge on farm mechanization for sustainable agricultural production  |
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| **Objectives*** Provide knowledge on heat engine, agricultural machineries, and pumps
* Explain and analyze the field and economic performances of engine, agricultural machineries, and pumps
* Describe estimation of small construction cost in the field of agriculture.
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| **Learning outcomes**  |
|  | * Identify status, benefits and constraints of agricultural mechanization in Bangladesh.
* Explain different types of engine, their systems and troubleshooting.
* Illustrate different tillage implements, crop establishment, harvesting, threshing & drying machineries.
* Evaluate field and economic performance of different types of agricultural machineries.
* Describe irrigation methods, irrigation efficiency, pump selection and cost analysis.
* Estimate material and cost of a simple agricultural construction
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| **Course content** |
| 1. **Farm mechanization:** Definition of mechanization; benefits of mechanization; present status and constraints of agricultural mechanization in Bangladesh.
2. **Introduction to engine:** Definition of engine; classification of engine; working principle of different systems of engines; engine terminology and computing different parameters of engine.
3. **Farm machinery:** Introduction to different tillage implements, crop establishments, harvesting, threshing & drying machineries.
4. **Field & Economic performance of agricultural machinery:** Definition of field & economic performance; computing drawbar power, field efficiency and annual cost of agricultural machineries.
5. **Irrigation:** Definition of irrigation; methods of irrigation; centrifugal pump; irrigation efficiency; and cost calculation for irrigation.
6. **Drying of agricultural crops:** Definition of drying, importance of drying, methods of drying and cost calculation for drying.
7. **Building materials and cost estimation:** Different building materials (brick, sand, cement and wood) and estimation of material and cost for simple farm structure.
8. **Seasoning**: Concept, benefits, seasoning of timber and bamboos.
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**Teaching Strategy**

* Lectures
* Discussion
* Demonstration by video
* Question & answer
* Self Study
* Case Studies
* Practice & Group Studies

**Assessment Strategy**

* Question & answer
* Assignment
* Quiz
* Observation

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| **Books recommended**  |
| Donnel Hunt (1983). Farm Power and Machinery Management. Iowa State University Press, Iowa.M. A. Aziz (1967). A Text Book of Estimating and Costing. Zohri Pub,. Dhaka.M. Michael and T. P. Ojha (1978). Principles of Agricultural Engineering (Vol. I & II). Jain Brothers (New Delhi).S. C. Jain and C. R. RAI. (1980). Tractor Engine Maintenance and Repair. Tata McGraw Hill Publishing Company limited, New Delhi.V. E. Hansen, O.W. Israelsen and G. E. Stringham (1993). Irrigation Principles and Practice. John Wiley & Sons. |

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| **Course number** | **:** | **CST-106** |
| **Course title** | **:** | **Chemistry (Theory)**  |
| **Number of credits** | **:** | **3** |
| **Total marks:**  | **:** | **100** |

**Rationale**

This course deals with the physical, analytical chemistry and electro-chemistry.

**Objectives**

* Provide knowledge of chemical equilibrium and law of mass.
* Explain the oxidation and reduction, temperature and presume on equilibrium.
* Discuss the chemical analyses, types of analyses titration and spectro photometric analyses.

**Learning outcomes**

* Explain chemical equilibrium law of massaction.
* Mathematical formulation of mass law.
* Explain oxidation and reduction redox reaction.
* Describe the electro chemistry buffer solution, pH, pOH ionrsation.
* Discuss different types of analyses, titrention cobrimetroy and spectrophtometericaralyse.
* Explain colbids crystalloids, coagulation and electropherosis.

**Course content**

**Physical and Analytical Chemistry:**

1. Chemical Equilibrium: Reversible reaction, Chemical equilibrium. Law of mass action, mathematical formulation and its applications. Effect of temperature and pressure on chemical equilibrium.

2. Oxidation and Reduction: Definition of oxidation and reduction, redox reaction; oxidation number.

3. Electro Chemistry: Ionic equilibrium (Oswald low of dilution) buffer solution, buffer activity, buffer capacity, pH & pOH of solution, ionization, constant of water.

4. Analytical chemistry: Chemical analysis, types of analysis, principals of volumetric analysis, and base titration, oxidation-reduction titration, precipitation titration, and complexometric titration, colarimetry and spectrophotometric analysis. Beer and Lamberts law and its application.

5. Colloids and crystalloids: Classification of colloids general methods of preparation of colloidal solution. Properties of colloids, coagulation Peptitization, electropherosis.

Organic Chemistry:

**6. Introduction:** Definition and scope. Aliphatic, Aromatic, Saturated and unsaturated hydrocarbon. Structure of molecules O, N, C orbital and hybridization of orbitals.

**7. Chemical bonding:** Covalent bonding, σ, π bond hydrogen bonding, cleavage of covalent bond (Carbonium ion, Carbonion, free radical)

**8. Chemical reactions:** Different types of chemical reactions, classification of reagents.

**9. Carbonyl compounds**: Aldehydes and ketone.

**10. Carboxylic acids:** Defferent types of carboxylic acid, Mono, di, tri.

**11. Heterocyclic compounds:** Definition and numbering of some compounds.

**Teaching Strategy**

* Lectures
* Discussion
* Demonstration by video
* Question & answer
* Self Study
* Case Studies
* Practice & Group Studies

**Assessment Strategy**

* Question & answer
* Assignment
* Quiz
* Observation

Recommended Books

Basic Inorganic Chemistry by F.A.Cotton & G.Wilkinsons.

Modern Concepts in Biochemistry by R.C. Bohinski.0

Modern Inorganic Chemistry by R.D.Madan.

Modern Inorganic Chemistry by S.Z.Haider, 1974.

Organic Chemistry Vol. I & 2 by I.L.Finar, 1985.

Physical Chemistry with applications to life sciences by D. Fisanberg and D. Chrothers.

Physical Chemistry, Principles and applications to life sciences by Tinoco.Jr, K.Sauer & J.C.Wang.

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| **Course number** | **:** | **CST-107** |
| **Course title** | **:** | **Agricultural Economics (Theory)**  |
| **Number of credits** | **:** | 3 |
| **Total marks** | **:** | **100** |

**Rationale**

This course aims at studying basic and introductory economic concepts on diverse set of issues of individual’s and firms’ decision making.

**Objectives**

* Understand the basic concepts of economics and agricultural economics
* Explain the fundamentals of consumer’s and producer’s behavior
* Discuss techniques to solve basic economic theory and their application

**Learning outcomes**

* Explain the nature and scope of agricultural economics
* Determine consumer’s choices, preferences and behavior
* Describe the factors and theories of production
* Discuss theory of farms and markets
* Evaluate different cost and revenue concepts
* Find out different cost and returns of agricultural crops

**Course content**

1. **Introduction:** Definition of economics; Micro economics and Macro economics; Basic concepts in economics; Definition of agricultural economics; Special Characteristics of Agricultural Economics; Distinguishing feature of agricultural products in relation to industrial products; Farmer’s role as a decision maker.
2. **Consumer Behaviour and Demand:** Demand and supply analysis; Marshallian utility analysis; Indifference curve analysis; Consumer’s surplus and producer’s surplus.
3. **Elasticity of demand:** Definition and types of elasticity of demand; Degrees of elasticity of demand; Methods of measuring price elasticity of demand; Factors affecting elasticity of demand.
4. **Factors of production:** Meaning of production; Factors of production-land, Labour, Capital and Organization; Efficiency of labour; Factors affecting efficiency of labour; Methods of improving efficiency of farm labour; Division of labour; Advantages and disadvantages of division of labour.
5. **Production Function:** The concept of production function; Law of diminishing returns and the three stages of production; Law of increasing, constant and decreasing returns, Marginal rate of substitution; Cost of production- Fixed cost and variable cost, Short run and Long run, Opportunity cost; Profit maximization and cost minimization for an agricutlural enterprise.
6. **Banking, Money & Agricultural credit:** The concept of a bank and money; Types of bank, Functions of central, commercial and specialized banks; Hypothetical balance sheet of a commercial bank; Agricultural credit and its sources.
7. **Land tenure, Land reform & Size of Farm:** Types of farm size, Factor influencing the size of farm, measures of farm size; Land tenure and productivity in Bangladesh; Land reform in Bangladesh.
8. Hypothetical economic analysis of costs and returns of different agricultural crops.

**Teaching strategy**

* Lecture
* Group discussion
* e -learning

**Assessment strategy**

* MCQ
* Short question
* Assignment

**Books recommended**

Ahuja, H. L. (1977). Advanced Economic Theory, S. Chand & Company Ltd., Ram Nagar, New Delhi-110055.

Bishop, C. E. and Toussiant W. D. 1958: An Introduction to Agricultural Economic Analysis. John Wiley and Sons, New York.

Dewett, K. K. (2005). Modern Economic Theory, S. Chand & Company Ltd., Ram Nagar, New Delhi-110055.

Ferguson, C. E., and Gould, J. P. (1975). Microeconomic Theory, Fourth Edition, Richard D. Irwin Inc. Illinois.

Mankiw, N. G. (2004). Principles of economics (3rd ed., Mason OH: Thomson / South-Western,). ISBN: 0-324-20309-8.

Ritson, C. 1977: Agricultural Economics: Principles and Policy, Granada Pub, London.

Samuelson. P. A. and Nordhaus, W. D. (1989). Economics, 13th Edition, McGraw Hill International Edition, Singapore.

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| **Course number** | **:** | **CST-108** |
| **Course title** | **:** | **Rural Sociology (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks:**  | **:** | **100** |

**Rationale**

The course provides knowledge on sociological way of thinking about agrarian society, rural community and rural development.

**Objectives**

* Provide knowledge on various features of the society, culture, and social institutions in agrarian settings
* Describe the implications of rural social stratification, social inequality and rural power structure
* Discuss the patterns, causes and consequences of social change, social problem and rural development
* Explain gender roles in agriculture and rural development
* Familiarize students with social research process

**Learning outcomes**

* Explain basic features of rural society and rural sociology
* Analyze the implications of rural sociology in agriculture and rural development
* Identify and explain different elements of culture
* Analyze social differentiation, stratification, social class and social inequality
* Explain rural social change, agrarian transformation and rural development
* Comprehend the conduction of social research

**Course content**

1. **Introduction:** Definition of Sociology and Rural Sociology, Origin and Development of Rural Sociology, Scope and Importance of Rural Sociology, Implication of Rural Sociology in Agricultural Society, Role of Rural Sociologists and Agriculturists in Agricultural and Rural Development.
2. **Culture and Society:** Meaning of Culture, Rural Culture and Agrarian Culture, Characteristic and Function of Culture, Elements of Culture, Culture Variability and Diversity, Value Degradation, Cultural Adaptability in terms of Globalization, Drivers of Cultural Change, Rural Social Institutions, Ethics and Education.
3. **Family:** Concept, types and functions of a family. Family and agriculture in Bangladesh.
4. **Social Differentiation and Stratification:** Social Differentiation and Stratification, Social Inequality, Principles of Social Stratification, Characteristic of Social Stratification, Form of Social Stratification, Rural Social Stratification in Bangladesh with Reference to Agrarian Stratification, Gender Stratification.
5. **Social Change and Agrarian Transformation**: Definition, Characteristics, and Causes of Social Change, Rural Social Change, Contemporary Social Problems.
6. **Rural Development:** Concepts and Definition, Pro-poor Development, Role of Agriculture in Rural Development, GO and NGO Initiatives for Rural Development Sustainable Livelihood Framework, Sustainable Development Goals.
7. **Feminization of Agriculture:** Concepts on Sex and Gender, Sex and Gender Roles, Women Empowerment and Development Agencies, Gender Role in Agriculture, Women Entrepreneurship, Gender Analytical Framework.
8. **Leadership:** Definition, types, characteristics of leaders, qualities of a good leaders, duties and responsibilities of professional and local leader, criteria for selection of local leader, different methods for identification of local leader, importance and recognition of local leader .

**Teaching strategy**

* Lecture
* Group Discussion
* Field Visit
* Video clip

**Assessment strategy**

* Written Test
* Assignment
* Presentation

**Books recommended**

Chambers, R. (1983). Rural Development*:* Putting the Last First.Prentice Hall:Harlow.

Chittambar, J.B. (2015). Introductory Rural Sociology. New Age Int: New Delhi.

Green, G. P. (Ed.). (2013). Handbook of Rural Development. Edward Elgar Publishing.

Hillyard, S. (2011). The Sociology of Rural Life. Berg Publishers: Oxford.

IFAD (2009). Gender in agriculture Sourcebook. The World Bank.

Rogers, E.M. et al.(1988).Social Change in Rural Societies: An Introduction to Rural Sociology.Prentice-Hall:NJ.

Shaefer, Richard T. 2011. Sociology (9thedition).

**B. Sc. Ag. (Hons.) Part – 1**

**PRACTICAL COURSES**

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| **Course number** | **:** | **CST-109** |
| **Course title** | **:** | **Agronomy – I (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course is designed to familiarize the students with different inputs and farm machineries, and practicing cultural operations of crop production.

**Objectives**

* Introduce the students with different field crops and their growth phases
* Demonstrate the fertilizer and manure applications and composting methods
* Identify different manures and fertilizers, soil and meteorological instruments
* Show different agricultural implements and demonstrate their operations for calculating efficiencies
* Identify deficiency symptoms of plant nutrients and calculate manure & fertilizer requirements for crops

 **Learning outcomes**

* Identify different field crops, soil, manures and fertilizers, farm implements and meteorological instruments
* Familiarize with fertilizer and manure applications and composting methods
* Operate common farm implements and calculate their efficiencies
* Recognize deficiency symptoms of plant nutrients
* Calculate manure and fertilizer requirements for crops
* Identify different growth phases and performed intercultural operations of a crop raised by themselves

**Course content**

1. Introduction to farm implements‑ (a) Identification, (b) Practicing of different operations and (c) Determination of their efficiency.
2. Identification of soil textural classes by the finger feels method.
3. Identification of manures, fertilizers and noting their physical characteristics.
4. Computation of manures and fertilizers for different crops.
5. Preparation of compost.
6. Preservation of farm yard manure.
7. Practicing weeding, thinning, gap filling, mulching and earthing up in crop filed.
8. Study of meteorological tools and instruments and climatic pattern of Bangladesh.

**Teaching strategy**

* Lecture
* Demonstration
* Lab work
* Field work
* Problem solving
* Assignment

**Assessment strategy**

* Sample identification
* Illustration
* Oral examination
* Exercise

**Books recommended**

Bhattacharya, B. 2008. Advanced Principles and Practices of Agronomy. Kalyani Publishers, New Delhi.

Mavi, H.S. 1974. Introduction to Agro-meteorology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Simpson, K. 1986. Fertilizers and Manures. Longman Groups Limited. Hong Kong.

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| **Course number**  | **:** | **CST-110** |
| **Course title**  | **:** | **Soil Science ­– I ( Practical)**  |
| **Number of credits**  | **:** | **2** |
| **Total marks**  | **:** | **50** |

**Rationale**

This course is designed to cover practical aspects of biophysical properties of soil.

**Objectives**

* Provide knowledge about hands- on practice of soil properties
* Impart practical skill of collecting soil samples and measuring soil quality attributes
* Identify fertilizers, rocks and minerals that are involved in soil genesis

**Learning outcomes**

* Describe safety measures to conduct laboratory analysis
* Collect and process soil samples for quantifying soil density and porosity
* Identify rocks, minerals and fertilizers
* Demonstrate agents of sterilization
* Demonstrate soil different properties

**Course content**

**Soil Science Lab and Field Jobs**

1. Precautions to be taken while working in a laboratory.
2. Collection and preservation of the soil samples.
3. Identification of important rock and mineral specimens.
4. Determination of soil pH using the colorimetric method.
5. Determination of soil colour using Munsell colour charts.
6. Particle size analyses of soil using the hydrometer method and detection of the soil textural classes.
7. Determination of the pore size distribution of soil.
8. Determination of the bulk density of soil using the core sampler method.
9. Determination of the particle density of soil using the volumetric flask method.
10. Determination of the soil water infiltration using the ring infiltrometer method.
11. Determination of the saturated hydraulic conductivity of soil using the constant head method.

**Teaching strategy**

* Lecture
* Tutorial
* Self study/e-learning

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Alexander, M. 1977. Introduction to Soil Microbiology. John Wiley & Sons Inc., New York.

Baver, L.D., Gardner, W. H. and Gardner, W.R. 1972. Soil Physics, 4thedition. John Wiley & Sons. Inc., New York.

Biswas, L.D., and Mukherjee, S.K. 1991. Text book of Soil Science. Tata McGraw-Hill Pub. Ltd., New Delhi.

Brady, N.C. and Weil, R.R. 2006. The Nature and Properties of Soils. Thirteen edition Pearson Education Pvt. Ltd. New Delhi, India.

Foth H.D. 1991 Fundamentals of Soil Science. 8th edition, Willey and Black, USA.

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| **Course number** | : **CST-111** |
| **Course title** | : **Horticulture – I (Practical)**  |
| **Number of credits** | : **2** |
| **Total marks** | : **50** |

**Rationale**

This course will focus on practical aspects of nursery management, plant propagation, seedbed preparation, training, pruning and harvesting of horticultural crops.

**Objectives**

* Describe the skills on modern nursery management
* Demonstrate the techniques of plant propagation
* Demonstrate seedbed preparation
* Hands-on practice of different planting and harvesting methods

**Learning outcomes**

* Prepare layout of a nursery
* Identify and use of nursery equipments
* Practice planting methods and intercultural operations
* Prepare seedbed and nursery bed
* Practice potting, de-potting and repotting
* Conduct propagation practices of different horticultural crops
* Operate harvesting of different horticultural crops using various methods

**Course content**

1. Identification of important ornamental plants in different areas of Bangladesh and preparation of album.
2. Propagation practices of important ornamental plants and flowers by cutting.
3. Introduction to modern nursery highlighting its components.
4. Identification of different nursery tools and their uses.
5. Preparation of a seed bed and raising of seedlings.
6. Annual nurseries activities and year round plan and work schedule of nursery.
7. Pruning and training practices of horticultural plants.
8. Different planting methods of horticultural crops sowing, dibbling, transplanting and planting.
9. Potting, depotting and repotting practices.
10. Methods of digging (Single and double digging) of horticultural plants.
11. Practicing different application methods of manure and fertilizer in vegetables and fruits.
12. Survey of a horticultural farm, identification of its problems and suggestion for their improvements.

**Teaching strategy**

* Lecture
* Demonstration and individual practice
* Group discussion
* Video clip
* Questioning and answering
* White and black board

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Pop quiz

**Books recommended**

Acquaah, G. 2008. Horticulture: Principles and Practices. Prentice Hall; 4 edition.

Bakhshai, J.C., D.U. UPPAL and H.N. Khajuria. 1997. (2nd edn.). The Prunning of Fruit Trees and Vines. Kalyani Publishers. India.

Bose, T.K., S.K. Mitra and M.K. Sadhu. 1986. Propagation of Tropical and Sub-tropical Horticultural Crops. Naya Prokosh, Calcutta. (1991 avaiable).

Edward, R. and C. S. 2010. Introductory Horticulture. Delmar Cengage Learning; 8th Revised edition. 5 Maxwell Drive, Clifton Park, NY 12065-2919.

Hartmann, H.T., D.E. Kester and F.T. Davies Jr. 1990. Plant Propagation: Principle and Practices. Prentice-Hall, International editions. (7th edition, 2001 available).

Mondal, M.F.2000. Nursery and Plant Propagation (in Bangla). Mrs. Afia Mondal, BAU Campus, Mymensingh.

Sharma, S. K. 2010. Postharvest Management & Processing of Fruits & Vegetables. New India Publishing Agency.

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| **Course number** | **:** | **CST-112**  |
| **Course title** | **:** | **Agricultural Botany – I (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course has been designed to offer hands-on practices on structure & function of crop plants.

**Objectives**

* Equip the students with practical knowledge and understanding of crop morphology.
* Demonstrate ethno-botany and economically important crops.

**Learning outcomes**

Upon completion of the course, students should be able to:

* Identify plant families to compare and contrast the external morphology of different crops.
* Prepare herbarium sheets.

**Course content**

**1. External morphology of the following crops and their relatives:** Brinjal, Groundnut, Jute, Lentil, Mustard, Rice, Sweet gourd and Wheat.

**2.** Visit to the field laboratory/botanical garden.

**3**. Visit to different forests of Bangladesh and preparation of herbarium of forest plants.

**4. Slide preparation:** Sectioning, staining and mounting, temporary and semi-permanent slides, demonstration of microtome and maceration techniques.

**5. Demonstration of the following:**

1. Nucleus, nucleolus, plastids, primary wall, secondary wall, thickening of cell wall;
2. Parenchyma, collenchyma, sclereid, fibre and secretory cells both in transverse and longitudinal sections/macerated materials;
3. Structure of anther, pollen, pollen germination, hand pollination technique, ovary, ovule and placenta.
4. Internal structures of isobilateral and centric dorsiventral leaves.

**6.** **Anatomy of different crops:** Stem and root of Rice, Wheat, Maize, Jute and Cucurbit.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Class attendance
* Assignment
* Practical Job

**Books recommended**

1.Ashok Bendre, Ashok Kumar. 1999. A Text Book of Practical Botany Vol. I & II. Rastogi Publications, Shaviji Road, Meerot, India.

2. Pandey, B.P. 1997. Modern Practical Botany, Vol. I & II. S. Chand & Com. Ltd. Ram Nagar, New Delhi-110055.

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| **Course Number** | **:** | **CST-113** |
| **Course Title** | **:** | **Farm Mechanics (Practical)**  |
| **Number of Credits** | **:** | **2** |
| **Total marks** | **:** | **50** |
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| **Rationale** |
|  | This course covers basic knowledge on farm mechanization for sustainable agricultural production  |
|  |  |
| **Objectives*** Provide knowledge on heat engine, agricultural machineries, and pumps
* Explain and analyze the field and economic performances of engine, agricultural machineries, and pumps
* Describe estimation of small construction cost in the field of agriculture.
 |
| **Learning outcomes**  |
|  | * Identify status, benefits and constraints of agricultural mechanization in Bangladesh.
* Explain different types of engine, their systems and troubleshooting.
* Illustrate different tillage implements, crop establishment, harvesting, threshing & drying machineries.
* Evaluate field and economic performance of different types of agricultural machineries.
* Describe irrigation methods, irrigation efficiency, pump selection and cost analysis.
* Estimate material and cost of a simple agricultural construction
 |
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| **Course content** |
| 1. Introduction to some basic parts of an IC engine.
2. Introduction to engine cooling systems.
3. Introduction to a petrol engine fuel system.
4. Introduction to lubricating system of an engine.
5. Repair and maintenance, trouble shooting and power transmission system of C.I and S.I engines.
6. Introduction to a centrifugal pump.
7. Operation of power tiller and tillage implements.
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**Teaching Strategy**

* Lectures
* Discussion
* Demonstration by video
* Practice & Group Studies

**Assessment Strategy**

* Question & answer
* Assignment
* Quiz
* Observation

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| **Books recommended**  |
| Donnel Hunt (1983). Farm Power and Machinery Management. Iowa State University Press, Iowa.M. A. Aziz (1967). A Text Book of Estimating and Costing. Zohri Pub,. Dhaka.M. Michael and T. P. Ojha (1978). Principles of Agricultural Engineering (Vol. I & II). Jain Brothers (New Delhi).S. C. Jain and C. R. RAI. (1980). Tractor Engine Maintenance and Repair. Tata McGraw Hill Publishing Company limited, New Delhi.V. E. Hansen, O.W. Israelsen and G. E. Stringham (1993). Irrigation Principles and Practice. John Wiley & Sons. |
| **Course number** | **:** | **CST-114** |
| **Course title** | **:** | **Chemistry (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks:**  | **:** | **50** |

**Rationale**

This course deals with the physical, analytical chemistry and electro-chemistry.

**Objectives**

* Provide knowledge of chemical equilibrium and law of mass.
* Explain the oxidation and reduction, temperature and presume on equilibrium.
* Discuss the chemical analyses, types of analyses titration and spectro photometric analyses.

**Learning outcomes**

* Explain chemical equilibrium law of massaction.
* Mathematical formulation of mass law.
* Explain oxidation and reduction redox reaction.
* Describe the electro chemistry buffer solution, pH, pOH ionrsation.
* Discuss different types of analyses, titrention cobrimetroy and spectrophtometericaralyse.
* Explain colbids crystalloids, coagulation and electropherosis.

**Course content**

**Section- A**

1. Preparation of primary standard solution of Na2CO3 and Oxalic acid.
2. Preparation and standardization of NaOH, HCl & H2SO4 solution.
3. Estimation of iron from ferrous sulphate.
4. Iodometric determination of copper by Iodometrically.

**Section- B**

1. Determination of plant constituents-alkaloids, flavonoids.
2. Organic qualitative analysis:Detection of elements and identification of functional groups present in organic compounds containing not more than two functional groups.

**Teaching Strategy**

* Lectures
* Discussion
* Demonstration by video
* Question & answer

**Assessment Strategy**

* Question & answer
* Assignment
* Quiz
* Observation

Recommended Books

Basic Inorganic Chemistry by F.A.Cotton & G.Wilkinsons.

Modern Concepts in Biochemistry by R.C. Bohinski.0

Modern Inorganic Chemistry by R.D.Madan.

Modern Inorganic Chemistry by S.Z.Haider, 1974.

Organic Chemistry Vol. I & 2 by I.L.Finar, 1985.

Physical Chemistry with applications to life sciences by D. Fisanberg and D. Chrothers.

Physical Chemistry, Principles and applications to life sciences by Tinoco.Jr, K.Sauer & J.C.Wang.

**B. Sc. Ag. (Hons.) Part – 2**

**THEORY COURSES**

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| **Course number**  | **:** | **CST-201**  |
| **Course title**  | **:** | **Agronomy – II (Theory)**  |
| **Number of credits**  | **:** | **3** |
| **Total marks**  | **:** | **100** |

**Rationale**

This course is designed to provide basic knowledge on seed, weed and their development, quality improvement, production and storage is vital for an agriculture graduate.

**Objectives**

* Give the students a basic idea about seed and weed features
* Illustrate quality seed production techniques
* Provide knowledge about seed rate, storage and treatment
* Make the student understand the concept of seed germination, vigour, dormancy and weed science
* Impart knowledge about seed certification and marketing systems in Bangladesh

**Learning outcomes**

* Gain the basic concept of seeds and seed quality attributes
* Interpret the seed and weed in crop production techniques
* Explain seed rate, storage conditions and treatment techniques
* Describe seed germination, vigour and dormancy
* Familiarize with seed certification and marketing systems in Bangladesh
* Provide knowledge about crop-weed competition and herbicides

**Course content**

**Seed Technology & Weed Science**

1. **Introduction to Seed:** Definition, importance, classification and structure, formation and development of seed.
2. **Seed Quality:** Determination of seed quality. Attributes of quality seed. Importance of quality seed in crop production. Factors affecting seed quality during production and processing.
3. **Seed Germination and Vigour:** Definition and process of germination. Conditions necessary for germination. Concept of seed viability and vigour. Significance of seed vigour in crop production.
4. **Seed Dormancy:** Definition, kinds and causes. Importance of dormancy in crop production. Means of breaking seed dormancy.
5. **Seed Rate:** Concept, planting value of seed. Factors affecting seed rate.
6. **Seed Crop Cultivation:** Basic principles, methods of cultivation and harvesting of seed crop. Processing and grading of seed.
7. **Principles of Seed Storage:** Environmental factors affecting seed in storage. Types of storage facilities for seed. Safe conditions for seed storage. Factors affecting seed longevity deterioration. The processes involved in seed deterioration.
8. **Seed Treatment:** Objectives and procedures. Seed treating chemicals.
9. **Seed Testing:** Definition and objectives. Seed sampling. Testing of seeds for moisture, purity, germination, viability and vigour.
10. **Quality Control of Seed:** Definition and objectives. Seed certification procedure. Role of National Seed Board, Seed Certification Agency in the quality control of seed. Present status of production and supply of seed in Bangladesh.
11. **Introduction to Weed:** Definition, characteristics and classification. Agricultural and non‑agricultural losses caused by weeds. Positive value of weed, brief account of the common weeds of Bangladesh with emphasis on the biology of major weeds.
12. **Crop‑Weed Competition:** Survival mechanism of weeds. Distribution of weeds. Concept, critical period of weed competition and factors affecting crop‑weed completion, competitive ability of weeds and the factors affecting it.
13. **Weed Management:** Concept and principle of integrated weed management. Prevention and eradication of weed. Cultural, mechanical, biological and herbicidal methods of weed control‑ their advantages and disadvantages. Classification, formulation and mode of action of herbicides. Methods of herbicide application.

**Teaching strategy**

* Lecture
* Question and answering
* Tutorial

**Assessment strategy**

* MCQ
* Quiz
* Short question
* Essay type question
* Assignment

**Books recommended**

Agrawal, R. L. 2009. Seed Technology. Second Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.

Basra, A.S. (ed). 2006. Handbook of Seed Technology. Haworth Press New York, USA.

Basra, A.S. (ed.). 1995. Seed Quality: Basic Mechanisms and Agricultural Implications. Food Product Press, New York.

Bewley, J.D. and Black, M. 1994. Seed Physiology of Development and Germination. 2nd Edition, Springer-Verlag. London.

Copeland L.O. and McDonald, M.F. 2001. Principles of Seed Science and Technology – 4th Ed. Burgess Pub. Co., USA

Copeland, L. O. and McDonald, M. B. 1995. Seed Science and Technology. 3rd Edition, Chapman & Hall, New York.

Joshi, A. K. and Singh, B. D. 2005. Seed Science and Technology. Kalyani Publishers, New Delhi, India.

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| **Course number**  | **:** | **CST-202**  |
| **Course title**  | **:** | **Soil Science – II (Theory)**  |
| **Number of credits**  | **:** | **3** |
| **Total marks**  | **:** | **100** |

**Rationale**

Students need to obtain knowledge and skill on soil chemistry ion exchange, mineralogy and problem soils.

**Objectives**

* Provide knowledge on soil chemistry and Problems soil.
* Impart basic ideas of problems soils.
* Explain soil reaction, ion exchange and clay mineralogy.
* Describe problem soils of Bangladesh and their reclamation strategies.

**Learning outcomes**

* Explain soil chemistry and liming.
* Interpret ion exchange soil colloids and clay mineralogy.
* Analyze the soil colloid.
* Formulate and find out the reclamation of problem soils of Bangladesh.

**Course content**

**Soil Survey, Classification and Bangladesh Soils**

1. **Soil Survey:** Definition, objectives, kinds and methods of soil survey, concept of mapping and report preparation. Soil survey activities of SRDI in Bangladesh.
2. **Soil Classification:** Definition, objectives, principles, introduction and brief history of soil classification, soil Taxonomy–concept, categories, major features and derivation of diagnostic horizons, characteristics of soil orders and equivalent general soil types of Bangladesh.
3. **Soil Erosion and Conservation:** Soil erosion–definition, kinds, types of water erosion, factors affecting soil erosion, universal soil loss equation (USLE). Soil conservation-objectives and techniques of soil conservation.
4. **Geology and Geography of Bangladesh:** Brief account of geological time scale; and tertiary hill sediments, Madhupur clay and recent alluviuam. Geography of hill, terraces and floodplains.
5. **Soils of Bangladesh:** Agro-ecological zones (AEZ)–Concept and criteria for AEZ classification, Short description of AEZs-location, extents, physiography, land types, ecological hazards and present lend use. Soil series identification: profile description and chemical characteristics of selected soil series in Bangladesh. Name and concept of general soil types of Bangladesh.
6. **Problem Soils of Bangladesh:** List of problem soils and their location and extent. Formation, characteristics and uses of peat soils. Concept of acid sulphate and saline soils.
7. **Soil Degradation:** Concept, types: Physical degradation-clay migration, plough pan formation, burial of fertile land by sand deposition. Chemical degradation, soil fertility depletion, acidification, salinization, alkalization, biological degradation.
8. **Land Capability Classification:** Criteria for land evaluation concept of land capability and crop suitability, land capability classification of Bangladesh.

**Teaching strategy**

* Lecture
* Tutorial
* Self study/e-learning

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Amin, M. S. and Bhuiya, Z. H. 1982. Mrittika Biggan, Maghan, Mohanganj, Mymemsingh.

Biswas, T. D. and Mukherjee, S. K. 1989. Text Book of Soil Science. Tata McGraw Hill Pub. Co. New Delhi.

Brady, N. C. 1989. The Nature and Propertice of Soils. McMillan Pub. Co. New York.

FAO. 1988. Agroecological Regions of Bangladesh. Report No. 2. UNDA / FAO. Rome.

Foth, D. H. and Turk, L. M. 1973. Fundamentals of Soil Science. John Wiley and Sons. New York.

Green land, D.J. and Lal, R. 1977. Soil Conservation and Management in the Humid Tropics. John Willy and Sons. New York.

Idris, M. 1987. Erosion Hazard areas in Bangladesh. Report on Soil Conservation. SRDI, Dhaka.

Rahman,M. R. 2005. Soils of Bangladesh. Darpon Pub., 38/2kha, Tajmohal Market, Banglabazar.Dhaka-1100.

Soil Survey Staff. 1978. Soil Txonomy. A basic classification. Agricultural Handbook No. 456. Soil Conservation Service. USDA.

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| **Course number** | **: CST-203**  |
| **Course title** | **: Horticulture – II (Theory)**  |
| **Number of credits** | **: 3** |
| **Total marks** | **: 100** |

**Rationale**

This course will focus on the floriculture horticulture and its production and management practices, design landscape horticulture. .

**Objectives**

* Outline the scope, classification, production and management practices of ornamental plants and plantation crops
* Describe the theory and principles of landscape gardening

**Learning outcomes**

* Explain scope and importance and classify ornamental plants and plantation crops
* Perform production and management of flowers and ornamental plants
* Design and layout of landscape gardening
* Establish and decorate different formal and informal gardens
* Manage and develop the cut and dry flower business
* Produce, manage and process different plantation crops

**Course content**

**Floriculture and Landscape Horticulture**

1. **Introduction:** Definition, origin and history of ornamental plants, classification of ornamental plants, scope, importance and careers of growing ornamental plants in Bangladesh.
2. **Production and management of bedding flowers**: Zinnia, cosmos, calendula, globe amaranth, phlox, antirrhinum, dianthus, corn flower, gerbera and poppy.
3. **Production and management of commercial and cut flowers**: Rose, dahlia, chrysanthemum, carnation, tuberose, gladiolus, marigold, aster, jasmine, lilies and lotus.
4. **Production and management of ornamental plants**: Palms, ferns and cacti.
5. **Special technique in ornamental horticulture:** Development and maintenance of bonsai, topiary and shrubbery.
6. **Garden architecture and decoration:** Establishment and maintenance of home and institutional gardens, water-gardens, rock gardens and parks.
7. **Floral arrangement:** Principles and style of floral arrangement, floristry, floral crafts, and dehydrated flowers and foliages.
8. **Landscape horticulture and its design:** Concept and definition, objectives and classification and principles of landscape horticulture.

**Teaching strategy**

* Lecture
* Group discussion
* Video clip

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Pop quiz

**Books recommended**

Arora, J. S. 1998. Introductory Ornamental Horticulture.3rd ed. Kalyani Publisher, Calcutta, India.

Gorley. R.H.B., Hardon, J.J and W Wood, B.J. 1976. Oil Palm Research, Elsevier, Sci, Pub. Amsterdam.

Grindal, E.W. 1960. Everyday Gardening in India. D.B. Taraporenvalsa Sons, Bombay.

Havlerl, A.W. 1962. The Garden in the Plains. Oxford Univ. Press. London.

J. B. Edmiond *et al.* Fundamentals of Horticulture. Tata McGraw-hill Publishing co. ltd. New Delhi.Bose, T.K. and Yadav, L.P. 1989. Commercial Flowers Naya Praksh, Calcutta.

Jules Janick, 1982. Horticultural Science. Surjeet Publications, 7k, Koihapur, Kamla Nagor, Delhi.

Kuck. L.E and Tongg, R.C. 1960. The Modern Tropical Gardens, Tongg. Pun, Honolulu.

Macmillan, H.F. 1962. Tropical Planting and Gardenning Macmillan, London.

Roychowdhury, N & H.P. Mispra. 2001, Text Book on Floriculture and Landscaping. Shyamal Ghosh publishers.

S. Prasad and U. Kumar.1999. Principles of Horticulture. Agrobotanica. 4E 176 Jn. Vyas Nagar, Bikaner, India.

Swarup, V. 1979. Garden Flowers, National Book Trust, New Delhi.

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| **Course number** | **:** | **CST-204**  |
| **Course title** | **:** | **Agricultural Botany – II (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

The course has been designed to cover fundamental aspects of plant physiology and ecology relevant for growth, development, adaptation and distribution of plants.

**Objectives**

* Describe detail anatomical features of crops in relation to plant taxonomy.
* Students will be able to know how about tissue and tissue system.
* Students will learn primary and secondary structure of plant.
* Students will understand about anatomical structure of root and stem and leaf of different crops.

**Learning outcomes**

Upon completion of the course, students should be able to:

* Illustrate the structure, function of cells and tissues of roots, shoots and leaves.
* Compare and contrast internal structures of field crops for varietal identity.
* Know the anatomical structure of root, stem and leaf.

**Course content**

**Ecology, Ecosystem and Plant Adaptation**

1. Ecology: Definition, branches of ecology, biosphere, environment, habitat, ecological niche.
2. Ecological factors: Climatic, edaphic, topographic and biotic factors on plant growth and development.

3. Ecosystems: Concept, classification, functional and structural components, laws of thermodynamics, energy flow in ecosystem, food chain, food web and ecological pyramid.

4. Plant succession: Causes, formation of vegetation, process and types of hydrosere, xerosere and lithosere.

5. Plant adaptation based on water requirement: Hydrophytic, mesophytic, xerophytic, halophytic and mangroves adaptation.

6. Micro and macro environment: Concept, components, microclimate manipulation and improvement of crop production.

7. Agro-climatological parameters:

Light: Classification and distribution; factors affecting the quality and quantity of light penetration and absorption. Modification and regulation of light environment for the improvement of crop production.

Temperature: Plants response to the variation of temperature and methods to modify soil and air temperatures for the improvement of crop production.

Water: Significance of water to plants, hydrological cycling, forms of water and precipitation, Causes, effects and control of droughts.

Wind: Effects of winds upon vegetation, development of wind profiles over crop surfaces and their impact.

8. Environmental pollution

**Soil Pollution:** Concept of soil pollution, soil degradation, nature of degradation. Concept of soil pollution by heavy mattels: As, Pb, Cu, Cr, Cd, Hg etc., its causes and adverse effects. Pesticide pollution in soil and their residual effects.

**Water Pollution:** Water pollution and its causes adverse effects of water pollution, pollution from industrial, agricultural and domestic and others sources. Ponds, cannels, rivers and sea water pollution.

**Air Pollution:** Sources, causes, effects and its control.

**9. Biodiversity:** Definition, types, importance. Hotspots of biodiversity, threats of biodiversity, conservation to biodiversity: In situ and ex situ conservation.

10. Biogeochemical cycles in the ecosystem: Water cycle, carbon cycle, oxygen cycle, nitrogen cycle, sulpher cycle and phosphorus cycle.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment
* Class attendance

**Books recommended**

Agarwal, A.K. and P.P. Deo. 2006. Plant Ecology Agrobios, India.

Ambasht, R.S. and K.N. Ambasht. 2000. A text book of plant ecology. CBS Publisher and distributor, Daryagong, New Delhi.

Andrews, W.A. 1972. A Guide to the Study of Envormental Pollution.

Arora, S. 1995. Fundamentals of Environmental Biology.

Cheema, S.S., B.K. Dhaliwal and T.S. Sahta. 1991. Theory and Digest Agronomy. Kalyani Publishers. New Delhi.

Farnkel, O.H., A.H.D. Brown and J.J. Burdon. 1995. The Conservation of Plant Biodiversity.

Hawksworth, D.L., P.M. Krik and S.D. Clarke. 1997. Biodiversity Information: Needs and Options.

Kumar, H.D. 2006. Agriculture Ecology. A.P.H. Publishing Corporation, New Delhi.

Mehra, V.B. and S.K. Khanna. 1982. Plant Ecology.

Misra, K.C. 1998. Manual of Plant Ecology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Odum, E.P. 1996. Fundamentals of ecology. Saunders, Philadel.

Purekar, P.N., R.B. Sing and R.D. Deshmuka. 1992. Plant Physiology and Ecology. S. Cand & Co. Ltd., Ram Naar, New Delhi-10055.

Shukla, R.S. and Chandel, P.S. 1998. Plant ecology. S. Chand and Co. Ltd. RamNagar, New Delhi.

Sinha, R.K. 1996. Biodiversity: Global Concerns.

Subrahmanyam, N.S. and A.V.S.S. Sambamurty. 2006. Ecology. Narosa Publishing House, New Delhi.

Wilson, E.O. and F.M. Peter. 1988. Biodiversity. National Academy Press, Washington, D.C.

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| **Course number** | **: CST-205** |
| **Course title** | **: Entomology-I (Theory)** |
| **Number of credits** | **: 3** |
| **Total marks** | **: 100** |

**Rationale**

This course is designed to provide the students with the detail knowledge on elementary aspects of insects and arachnids enabling them to identify and classify insects, mites and spiders.

**Objectives**

* Provide taxonomic knowledge for classification of insects and arachnids
* Acquaint students with insects’ morphological structures and their functions
* Develop skills to categorize insects, mites and spiders in different orders and families
* Impart knowledge on physiology, reproduction and neurobiology of insects

**Learning outcomes**

* Identify insects and arachnids.
* Explain insects morphological structures and features.
* Describe systematics of insects and arachnids with their agricultural importance.
* Outline physiological and anatomical process of insects.
* Illustrate insect nervous system.

**Course content**

**Introductory Entomology**

1. **Arthropoda:** General characters and classification. Class: Crustacea, Arachnida, Trilobita; chilopoda, diplopoda, pauropoda, symphyla, insecta. Orders of insects, spiders, mites and their agricultural importance.
2. **Insect morphology:** An introduction to insect structures; external anatomy of grasshopper. Structures and functions of the insect integument. Various types of antennae, mouth parts and legs in insects. Modification of wings.
3. **Moulting and metamorphosis:** Definition and importance; types of metamorphosis; mechanism of moulting; types of larvae and pupae of insects.
4. **Internal anatomy and physiology:** Digestive system; excretory organs and excretion, Circulatory system; haemolymph and its functions; circulatory organs and mechanism of circulation.
5. **Respiratory** **system:** Respiration in terrestrial insects; respiration in aquatic and endo parasitic insects.
6. **Nervous system:** central, peripheral and sympathetic nervous systems.

**Teaching strategy**

* Lecture
* Videos
* Presentation
* Self-study/E-learning
* Tutorial

**Assessment strategy**

* Written test (Short, descriptive type question)
* Quiz test
* Assignment

**Books recommended**

Borror, D.J., Delong, D.M. and Triplehorn, C.A. 1976. An introduction to the study of insects. Holt Rinchart and Winston, New York.

Gillot, C. 1995. Entomology. Plenum Publ. Corp., New York.

Imms, A.D. A General Text Book of Entomology. Springer Publ.

Mani, M.S. 1990.General Entomology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Nayar, K. K., Ananthakrishnan, T. N. and David, B. V. 1985. General and applied Entomology. Tata McGraw- Hill Publ. Co. Ltd., India.

Ross, H. H. 1965. A text book of Entomology. John Wiley, New York.

Saxena, S. C. 1996. Biology of insects. Oxford & IBH Publishing Company.

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| **Course number** | **: CST-206**  |
| **Course title** | **: Plant Pathology – I (Theory)** |
| **Number of credits** | **: 3** |
| **Total marks** | **: 100** |

**Rationale**

This course deals with a basic knowledge and understanding of the plant diseases and their causes.

**Objectives**

* Interpret the significance of plant diseases.
* Explain and illustrate the basic concept of different plant pathogens.

**Learning Outcomes**

* Explain the concept of Plant Pathology
* Describe and distinguish different plant pathogens.

**Course content**

1. **Introduction to Plant Pathology:** Concept, history, causes and significance of plant diseases with special reference to Bangladesh. Different types of disease symptoms and sign.
2. **Fungi:** Concept,general characteristics of fungi including morphology, reproduction and nutrition, nomenclature and classification of fungi. Study of the following genera including their families and orders: *Synchytrium, Pythium, Phytophthora, Albugo, Rhizopus, Penicillium, Aspergillus, Erysiphe, Puccinia, Ustilago and Agaricus.*
3. Detailed study of the orders, families and genera of Deuteromycotina.
4. **Bacteria:** Concept, general morphology, reproduction and nutrition, infection process, classification of plant pathogenic bacteria.
5. **Plant Viruses and Mycoplasmas:** Concept, nature of viruses, physical and chemical structures, infection process and replication, transmission, identification and classification of viruses; viroids and mycoplasmas.
6. **Plant Parasitic Nematodes:** Concept, morphology, anatomy, physiology with special emphasis to feeding and reproduction; classification of plant parasitic nematodes.
7. **Plant diseases caused by parasitic phanerogams:** *Cuscuta, Loranthus and Orobanche.*

**Teaching strategy**

* Lecture
* Demonstration
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Presentation of assignment

**Books recommended**

Alexopoulos, C.J. 1962. Introductory Mycology. John Wiley & Sons. Inc. N.Y.

Bawden, F.C. 1964. Plant Viruses and Virus diseases. The Ronald Press.

Christensen, Cm. 1961. The Molds and Man: An Introduction to Fungi. University of Mennesota Press,

Corbett, J. K. and H. D. Sister (Ed) 1964. Plant Virology. University of Florida Press. Gainsville.

Goto, M. 1996. Fundamental of Bacterial Plant Pathology. Academic Press Inc. Tokyo.

Mathews, R.E.F. 1991. Plant Virology. Third Edition. Academic Press. INC. 1250 Sixth Avenue, San Diego, California, USA.

Mehrotra. Brahm Swarlep. 1967. The Fungi. 2nd ed. Oxford & IBH Publishing Co., New Delhi.

Pelezar. M. J. I. Jr. and R. D. Reid. 1950. Microbiology. McGraw‑ Hill Book, Company, New York.

Singh, R. S. 1973. Plant Diseases. 3rd ed. Oxford & IBH.

Stakman. E. C. and J. C. Harrar, 1957. Principles of Plant Pathology. The Ronald Press Company, New York.

Stavenson, G. 1967. The Biology of Fungi. Bacteria and Viruses.

Thiman, K. V. 1966. The life ofBacteria.The MacMillan Co.

Thome, G. 1961. Principles of Nernatology. MacGraw‑Hill Book Co., N. Y.

Webster, J. 1990. Introduction to Fungi. Third Edition. Cambridge University Press, Cambridge.

Weidel, W. 1959, Virus. The University of Michigan Press.

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| **Course number**  | **:**  | **CST-207** |
| **Course title**  | **:**  | **Genetics and Plant Breeding – I (Theory)**  |
| **Number of credits**  | **:**  | **3** |
| **Total marks**  | **:**  | **100** |

 **Rationale**

The course will provide fundamental knowledge on cell structure, genetically important cellular components and cellular events for advanced cytogenetical studies.

**Objectives**

* Describe different cellular organelles with genetic importance
* Explain cell division processes
* Distinguish among different types of chromosomes
* Describe the effect of different agents on chromosomes
* Interpret the karyotype and evolution in speciation

**Learning outcomes**

* Describe cell organelles of genetic importance
* Explain different events of cell division processes
* Illustrate the structure of different types of chromosome and their function
* Describe the effect and application of different agents on chromosomes
* Interpret the causes of karyotypic variation

**Course content**

**Genetics and Plant Breeding**

1. **Cell division:** Principal event**s** significance of mitosis and meiosis, mitosis vs meiosis.
2. **Chromosome:** Concept and types of chromosomes, prokaryotic vs eukaryotic chromosome, euchromatin vs heterochroniatin, chemical composition and special types of chromosomes. Mechanism of Breakage-Fusion-Bridge cycle in chromosomal instability.
3. **Karyotype:** Concept, characteristics, variation and its role on specification.
4. **Structural and numerical changes of chromosomes:** Concept, classification, meiotic behaviour and cytogenetic consequences.
5. **Hybrid-Weinberg law:** Gene in populations, frequency of gene and genotype, algebraic proof of the maintenance of genetic equilibrum factors changing gene frequencies.
6. **Haploid and double haploid:** Concept, classification, why we need double haploid. Application of haploid and double haploid in plant breeding.
7. **Mendel's laws of inheritance:** Mendel and his experiments; law of segregation and independent assortment..
8. **Modifications of Mendel's monohybrid and dihybrid F2 phenotypic ratios:** Modifications due to allelic and nonallelic gene interactions
9. **Linkage and crossing over:** Concept; mechanism and theories of crossing over, factors affecting crossing over, Mendel's second law is limited to linkage, absence of crossing over in male drosophila, significance of linkage and crossing over; genetic map using three-point test cross progeny.
10. **Gene:** Classical and modern concepts; evidences of DNA as the genetic material; chemical compositions of DNA and RNA, differences between DNA and RNA, Watson and Crick’s model of DNA.
11. **Plant transformation:** Transgenic plants; plant transformation, *Agrobacterium*-mediated transformation, DNA-mediated transformation.
12. **Transforming principles:** Griffith’s experiments and Hershey-Chase experiment for evidence of DNA as genetic material.
13. **Male sterility:** Types, causes and inheritance of male sterility, transfer of male sterility to a new strain.
14. **Self-incompatibility:** Concept and types of Self-incompatibility.
15. **Apomixis:** Concept, types and application in crop improvement

**Teaching strategy**

* Lecture
* Small group discussion
* Tutorial

**Assessment strategy**

* Written exam
* Quiz
* Drawing
* Assig

**Books recommended**

Burns, G.W. 1980. The Science of Genetics 4th ed. Macmillan publishing co. Inc. New York.

Cytologia - International Journal of Cytogenetics and Cell Biology. 1998.

Gupta, P.K. 1995. Cytogenetics. 1st. ed. Rastogi, India.

Perry, J. and Appels, R. 1998. Chromosome structure and Function. Plenum press, New York and London.

Sarma, A. 1991. Chromosomes. Oxford & IBH Pub. Co. New Delhi

Sharma A.K. and Sharma, A. 1980. Chromosomes Technique-theory and practice 3rd ed. Butterworthes. London.

Singh. B.D. 2001. Fundamentals of Genetics. 3rd . Ed. Kalyain Publisher, New Delhi‑I 10002, India.

Swanson, C.P.; Merz, J. and Young, W. J. 1988. Cytogenetics. The chromosome in Division, inheritance and evolution. Prentice Hall of India private Ltd.

Swanson, C.P.; Merz. Y. And Young. W.J. 1987. Cytogenetics. Prentice Hall press. London.

Verma, P.S. and Agarwal, V. K. 1998. Cytology. S. Chand & Co. Ltd. Ram Nagar, New Delhi.

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| **Course No** | **:** | **CST-208**  |
| **Course Title** | **:** | **Agricultural Extension – I (Theory)**  |
| **Number of Credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

This course is intended to let the students learn about fundamental issues of extension education, leadership and human behaviour.

**Objectives**

* Deliver the information about the concepts of extension, extension education extension teaching methods and aids
* Acquaint the students with learning process
* Provide ideas on different extension teaching methods and their use
* Offer fundamental ideas of leadership and human behaviour in extension work.

**Learning outcomes**

* Explain fundamental issues of extension education and extension work
* Describe the learning theories and laws of learning along with their implications in extension work
* Identify and explain extension teaching methods and aids along with their utilizations in extension work
* Justify the use of leadership skill in extension work
* Explain the issues related to motivation in extension work
* Apply need theories in extension work

**Course content**

1. **Concept and meaning of agricultural extension:** Basic concept of extension and agricultural extension; objectives, phases, scope, functions, philosophy, principle, evolutionof agricultural extension. Interrelationship of agricultural education, research and extension.
2. **Agricultural education:** Definition, objectives, types and principles of education. Adult education-definition, objectives and principles.
3. **Motivation and learning:** Concept of need, motivation, learning. Characteristics of need and importance of motivation extension work. Theories of need-Maslow, Hertzberg and McGregor. Elements in the learning process, theories of learning and laws of learning and their implication in extension work. Criteria for effective learning, special features of adult learning and principles of adult learning as applicable to agricultural extension.
4. **Leadership:** Definition, types, characteristics of leaders, qualities of a good leader, duties and responsibilities of professional and local leader, criteria for selection of local leader, different methods for identification of local leader, importance and recognition of local leader .
5. **Extension service in Bangladesh:** Department of Agricultural Extension (DAE) and its development in Bangladesh. New Agricultural Extension Policy (NAEP) in Bangladesh-aims and components of NAEP.
6. **Basis of human behaviour:** Personality, behaviour, fatalism, frustration and its adjustment, attitude.
7. **Group and group dynamics:** Definition, Characteristics, stages, formation.

**Teaching strategy**

● Lecture and discussion

● Self study

● Assignment

**Assessment strategy**

* Written examination
* Assignment
* Short question

# Recommended Books

Chambers, R. 1983. Rural Development - Putting the Last First,. Longmans, London.

Chitambar, J. B. 1973. Introductory Rural Sociology. Willy Sastern, Delhi.

DAE. 1996. Agricultural Extension Manual. Department of Agricultural Extension. Ministry of Agriculture. Govt. of the Peoples. Republic of Bangladesh.

Dahama, O. P. 1978. Extension and Rural Welfare. Ramprasad and Sons. Agra.

Singh, K. 1985. Rural Society. Proakashan Kendra, Luknow.

Sunderson, D. 1948. Rural Sociology and Rural Social Organization. Joh Willy and Sons, New York.

Swaminathan, M.S. 1982. Science and Integrated Rural Development, Concept Pub. Co. New Delhi.

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| **Course number** | **:** | **CST-209** |
| **Course title** | **:** | **Biochemistry – (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

The students need to have a proper knowledge on the physical and chemical aspects of biomolecules for understanding of physiological phenomena of plants and animals and their improvement.

**Objectives**

* Provide knowledge on sources and classification of biomolecules
* Explain properties and biochemical functions of biomolecules
* Construct structure of biomolecules

**Learning outcomes**

* List the sources of different biomolecules
* Classify different biomolecules
* List the biological functions of different biomolecules
* Describe the physical and chemical properties of biomolecules
* Compare and contrast among various biomolecules
* Determine the structure of unknown biomolecules
* Contrast Oligomeric/polymeric forms of various biomolecules

**Course content**

1. Introduction to nutritional biochemistry.
2. Biochemistry of food nutrients:
	1. **Carbohydrates:** Definition, occurrence, source, classification, biological importance and nutritive values. Physical and chemical properties, stereo isomerism, chemistry of monosaccharides, disaccharides and polysaccharides with special reference to starch, cellulose and cell wall polysaccharides. Color reactions of carbohydrates.
	2. **Proteins:** Definition, occurrence, source, classification, biological importance and nutritive values. Physical and chemical properties. Amino acid composition of protein and peptides. Reactions of amino acids. Amino acid as ampholytes, isoelectric point. Protein structure.
	3. **Lipids:** Definition, occurrence, source, classification, biological importance and nutritive values. Physical and chemical properties. Fatty acid composition of fats. Characterization of fats, oils and waxes. Phospholipids with special reference to lecithin and cephalin.
	4. **Vitamins:** Structure, co-enzyme activity, classification, dietary sources, recommended daily allowance and deficiency symptoms.
	5. **Minerals:** Sources, role in metabolism, deficiency symptoms, daily requirements. Interrelationship between vitamins and micronutrients.
3. Nutrient contents of food crops like cereals, legumes, oil seeds, nuts, fruits, vegetables and their availability. Anti-nutritional factors. Dietary fiber.
4. Comparative nutritive value of plant foods and animal foods.
5. Digestion and absorption of carbohydrates, proteins and lipids in human.
6. **Balanced diet:** Balanced diet, BMR, SDA. Diet chart for different act growing. Energy requirements according to Age, Sex and Size.
7. Effect of post-harvest handling and processing on the nutrient contents of food substances.
8. **Nutritional problem:** Nutritional problems in Bangladesh and to combat the malnutrition in Bangladesh.Diseases due to specific nutritional deficiency.
9. **Plant hormones**: **:** Classification and biochemical functions
10. **Enzyme:** Definition, classification and chemical nature of enzyme. Concept of coenzymes and prosthetic groups. Mode of action of enzymes and factors affecting their reactions.
11. **Nucleic acid:** Occurrence, composition classification, structure, chemical and physical properties. Functions of nucleic acids.
12. **Carbohydrate metabolism:**
	1. Glycolysis. Aerobic and anaerobic fate, metabolism of disaccharides. Physical importance of aerobic and anaerobic glycolysis. ATP synthesis.
	2. Tricarboxylic acid cycle. Amphibolic nature and anapleurotic reactions of TCA cycle.
	3. Pentose phosphate pathway and glyoxylate pathway.
	4. Glycogen metabolism: Glycogenolysis, glycogenesis.
13. **Lipid metabolism:** Degradation of triglyceride and phospholipids, oxidation of saturated and unsaturated fatty acids. Propionate metabolism.
14. **Protein metabolism:** Outline of amino acid metabolism, decarboxylation, oxidative deamination, trasamination, metabolic fates of amino groups, urea cycle, toxicity of ammonia.

**Teaching strategy**

* Lecture
* Group discussion
* Exercise
* Assignment
* Video clip

**Assessment strategy**

* Gap filling
* Multiple choice
* Short question
* Essay type question
* Assignment

**Books recommended**

Conn, E.E. Stumpf, P.K. 1987. Outlines of Biochemistry. 5th edition. John Wiley and Sons, New York.

Devlin, T.M. 2002. Textbook of Biochemistry. 5th edition. John Wiley and Sons, Inc. USA.

Lodish, H., Berk, A., Kaiser, C.A., Keieger, M., Bretscher, A., Ploegh, H. and Martin, K.C., 2016. Molecular Cell Biology. 8th edition. W. H. Freeman and company, New York.

Murray, R.K. 2002. Harper’s Biochemistry. 25th edition. MeGraw Hill. Printed in Singapore.

Nelson, D.L. and Michal, M.M. 2017. Lehninger Principles of Biochemistry. 7th edition. W. H. freeman and company. New York.

Stryer, L. 1995. Biochemistry. 4th edition. W. H. freeman and company. New York.

Voet, D and Voet, J.G. 1995. Biochemistry. 2nd edition. John Wiley and Sons, New York.

**B. Sc. Ag. (Hons.) Part – 2**

**PRACTICAL COURSES**

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| **Course number** | **:** | **CST-210** |
| **Course title** | **:** | **Agronomy – II (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course covers the practical aspects of seeds, their quality control, treatment and production.

**Objectives**

* Enable the students to identify and classify seeds of different field crops
* Demonstrate different seed structures
* Exhibit different seed sampling techniques
* Enable the student to perform the different seed and weed
* Teach the students calculating seed rate of different crops
* Identify of weed and preparation of weed herbarium

**Learning outcomes**

* Identify and classify seeds of different field crops
* Familiarize with different seed structures
* Perform different seed sampling techniques
* Test seeds for different quality attributes
* Calculate seed rate of different crops
* Raise seed crops
* Identification of weeds propagules and prepare weed herbarium

**Course content**

1. Identification of seed of field crops and preparation of a seed album.
2. Study of structures of monocotyledonous and dicotyledonous seeds and their appendages.
3. Techniques of seed sampling.
4. Moisture test of seed.
5. Purity test of seed.
6. Viability test of seed.
7. Germination test of seed.
8. Vigour tes**t** of seed.
9. Calculation of seed rate of crops.
10. Practicing seed treatment.
11. Growing seed crop in students' individual plots.
12. Identificationof weeds and weed seeds/propagules and preparation of weed herbarium.
13. Study of life cycle and morphology of major weeds‑ (a) grass (b) sedge (c) broadleaf weeds and (d) pot culture.
14. Identification of herbicides and their physical characteristics.
15. Calibration of a sprayer.
16. Herbicide calculation.
17. Spraying of non‑selective, pre‑emergence and post‑emergence herbicides in crop field to study their effect on crop and weed.

**Teaching strategy**

* Lecture
* Demonstration
* Lab work
* Field visit

**Assessment strategy**

* Sample identification
* Illustration
* Exercise
* Oral examination

**Books recommended**

Hampton, J.G. and Tekrony, D.M. (eds.). 1995. Handbook of Vigour Test Methods. 3rd Edition. International Seed Testing Association, Zurich, Switzerland.

ISTA. 1999. International Rules for Seed Testing. 1999. Supplement to Seed Science and Technology. Vol. 27. pp. 27-32.

Nema, N. P. 1989. Principles of Seed Certification and Testing. Allied Publishers Limited. Ahmedabad, Bangalore, Bombay, Calcutta, Hyderabad, Lucknow, Madras, New Delhi, India.

Sen, S. and Ghosh, N. 2008. Seed Science and Technology. Kalyani Publishers, Ludhiana, New Delhi, Hyderabad, Kolkata, India.

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| **Course number**  | **:** | **CST-211** |
| **Course title**  | **:** | **Soil Science – II ( Practical)**  |
| **Number of credits**  | **:** | **2** |
| **Total marks**  | **:** | **50** |

**Rationale**

The course offers in-field knowledge about all aspects of soil chemistry, classification, ionization and problem soil.

**Objectives**

* Demonstrate various soil properties in the laboratory.
* Hands-on soil ionization.
* Prepare methods of reclamation of problem soils.

**Learning outcomes**

* Determine soil texture, colour and reaction (pH)
* Measure soil organic and inorganic carbon
* Interpret the salinity level
* Explain soil genesis and horizon differentiation

**Course content**

* 1. Determination of soil pH by glass electrode pH meter method.
	2. Principle and uses of compound microscope.
	3. Techniques of sterilization.
	4. Motality test of Bacteria.
	5. Preparation of Bacterial media.
	6. Gram staining of Bacteria.
	7. Soil profile identification by field visit.
	8. Soil series identification by SRDI method.
	9. Field visit to important AEZ soils of Bangladesh (Barind Soils, Acid Sulphate Soils, Saline Soils, Peat Soils, Hill Soils etc).
	10. Techniques of soil survey (SRDI).
	11. Concept of SRDI soil Maps.
	12. Use of Fertilizer Recommendation Guide (BARC).
	13. Use of Thana Nirdeshika (SRDI).

**Teaching strategy**

* Lecture
* Tutorial
* Self study/e-learning

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Amin, M. S. and Bhuiya, Z. H. 1982. Mrittika Biggan, Maghan, Mohanganj, Mymemsingh.

Biswas, T. D. and Mukherjee, S. K. 1989. Text Book of Soil Science. Tata McGraw Hill Pub. Co. New Delhi.

Brady, N. C. 1989. The Nature and Propertice of Soils. McMillan Pub. Co. New York.

FAO. 1988. Agroecological Regions of Bangladesh. Report No. 2. UNDA / FAO. Rome.

Foth, D. H. and Turk, L. M. 1973. Fundamentals of Soil Science. John Wiley and Sons. New York.

Green land, D.J. and Lal, R. 1977. Soil Conservation and Management in the Humid Tropics. John Willy and Sons. New York.

Idris, M. 1987. Erosion Hazard areas in Bangladesh. Report on Soil Conservation. SRDI, Dhaka.

Rahman,M. R. 2005. Soils of Bangladesh. Darpon Pub., 38/2kha, Tajmohal Market, Banglabazar.Dhaka-1100.

Soil Survey Staff. 1978. Soil Txonomy. A basic classification. Agricultural Handbook No. 456. Soil Conservation Service. USDA.

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| **Course number** | : **CST-212** |
| **Course title** | : **Horticulture – II (Practical)**  |
| **Number of credits** | : **2** |
| **Total marks** | : **50** |

**Rationale**

This course will cover practical aspects of ornamental and landscape horticulture.

**Objectives**

* Demonstrate identification of important flowers and ornamental plants
* Prepare and pack cut flowers and bouquets
* Design landscape gardens and manage garden activities
* Demonstrate different techniques of bonsai preparation
* Describe the cost- benefit analysis of ornamental plants

**Learning outcomes**

* Identify the ornamental plants and their propagating materials
* Prepare seed album and herbarium of ornamental plants
* Generate strategies for preparation and packaging of cut flowers for marketing
* Construct bouquet and design of different flower arrangements
* Make bonsai and topiary, grow orchids and cacti and raise saplings of plantation crops
* Develop graphic design of different ornamental gardens and park
* Estimate the production cost and predict benefit cost analysis of ornamental plants

**Course content**

1. Field visit for identification of horticultural crops (flowers, ornamental plants, cacti, fern, orchid and their seeds) in different areas of Bangladesh and preparation of album.
2. Propagation practices of important ornamental plants and flowers.
3. Study on planning and design of an ideal home garden.
4. Graphics design and modelling of park, rock garden, water garden, road side plantation.
5. Cultivation practices of ornamental plants in individual plot.
6. Cost benefits analysis of important commercial flowers.

**Teaching strategy**

* Lecture
* Group discussion
* Video clip

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Pop quiz

**Books recommended**

Arora, J. S. 1998. Introductory Ornamental Horticulture.3rd ed. Kalyani Publisher, Calcutta, India.

Gorley. R.H.B., Hardon, J.J and W Wood, B.J. 1976. Oil Palm Research, Elsevier, Sci, Pub. Amsterdam.

Grindal, E.W. 1960. Everyday Gardening in India. D.B. Taraporenvalsa Sons, Bombay.

Havlerl, A.W. 1962. The Garden in the Plains. Oxford Univ. Press. London.

J. B. Edmiond *et al.* Fundamentals of Horticulture. Tata McGraw-hill Publishing co. ltd. New Delhi.Bose, T.K. and Yadav, L.P. 1989. Commercial Flowers Naya Praksh, Calcutta.

Jules Janick, 1982. Horticultural Science. Surjeet Publications, 7k, Koihapur, Kamla Nagor, Delhi.

Kuck. L.E and Tongg, R.C. 1960. The Modern Tropical Gardens, Tongg. Pun, Honolulu.

Macmillan, H.F. 1962. Tropical Planting and Gardenning Macmillan, London.

Roychowdhury, N & H.P. Mispra. 2001, Text Book on Floriculture and Landscaping. Shyamal Ghosh publishers.

S. Prasad and U. Kumar.1999. Principles of Horticulture. Agrobotanica. 4E 176 Jn. Vyas Nagar, Bikaner, India.

Swarup, V. 1979. Garden Flowers, National Book Trust, New Delhi.

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| **Course number** | **:** | **CST-213**  |
| **Course title** | **:** | **Agricultural Botany – II (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course has been designed to offer practical knowledge on basic cellular functions and structural modifications in plants for adaptation in different habitats.

**Objectives**

* + Equip the students with practical knowledge and understanding of crop anatomy
	+ Demonstrate the adaptive features of important plants.

**Learning outcomes**

Upon completion of the course, students should be able to:

* + Prepare temporary and permanent slides for microscopy
	+ Identify cells, cell organelles, plant tissues, pollen, placenta and leaves
	+ Illustrate anatomical features of roots, stems and leaves of crops
	+ Know about adaptive features of different ecological plant types.

**Course content**

1. Introduction to adaptive features of different ecological plant types e.g. mesophytes, xerophytes, hydrophytes, halophytes, heliophytes and sciophytes.
2. Study on biotic related plants-commensals, ammensals, parasites, symbionts etc.
3. Methods of ecological survey of plant communities and field study of plant habitats.
4. Experiments on flow of energy in agroecosystem on light, heat transfer and radiant energy.

**Teaching strategy**

* + Lecture
	+ Demonstration and practice
	+ Group discussion

Assessment strategy

* MCQ
* Short question
* Practical job
* Assignment
* Class attendance

Books recommended

Agarwal, A.K. and P.P. Deo. 2006. Plant Ecology Agrobios, India.

Ambasht, R.S. and K.N. Ambasht. 2000. A text book of plant ecology. CBS Publisher and distributor, Daryagong, New Delhi.

Shukla, R.S. and Chandel, P.S. 1998. Plant ecology. S. Chand and Co. Ltd. RamNagar, New Delhi.

Sinha, R.K. 1996. Biodiversity: Global Concerns.

Subrahmanyam, N.S. and A.V.S.S. Sambamurty. 2006. Ecology. Narosa Publishing House, New Delhi

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| **Course number** | **: CST-214** |
| **Course title** | **: Entomology- I ( Practical)**  |
| **Number of credits** | **: 2** |
| **Total marks** | **: 50** |

**Rationale**

This course is designed to provide the students with the practical knowledge on elementary aspects of insects and arachnids.

**Objectives**

* illustrate insects, mites and spiders, and their appendages
* demonstrate the preparation of temporary and permanent slides of insect appendages
* Explain collection and preservation of insect specimen
* demonstrate dissection and display of anatomical organs of insect

**Learning outcomes**

* Explain external and internal anatomical features of insect
* Illustrate different appendages of insects with modifications
* Prepare slide for insect studies
* Identify economically important insects, mites, and spiders relevant to agriculture

**Course content**

1. Techniques of preparation of temporary and permanent slides of antennae, mouthparts, legs, wings and scales of insects.
2. External morphology of grasshopper, various types of antennae, legs, mouthparts and wings of insects.
3. Study of morphology and various systems of grasshopper, cotton bug and lepidopterous insect.

**Teaching strategy**

* Lecture
* Video clip
* Self-study/E-learning
* Demonstration

**Assessment strategy**

* Written test (MCQ, Short type question)
* Quiz test
* Assignment
* Interview

**Books recommended**

Borror, D.J., Delong, D.M. and Triplehorn, C.A. 1976. An introduction to the study of insects. Holt Rinchart and Winston, New York.

Gillot, C. 1995. Entomology. Plenum Publ. Corp., New York.

Imms, A.D. A General Text Book of Entomology. Springer Publ.

Mani, M.S. 1990.General Entomology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Nayar, K. K., Ananthakrishnan, T. N. and David, B. V. 1985. General and applied Entomology. Tata McGraw- Hill Publ. Co. Ltd., India.

Ross, H. H. 1965. A text book of Entomology. John Wiley, New York.

Saxena, S. C. 1996. Biology of insects. Oxford & IBH Publishing Company.

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| **Course number** | : **CST-215** |
| **Course title** | : **Plant Pathology - I (Practical)** |
| **Number of credits** | : **2** |
| **Total marks** | : **50** |

**Rationale**

Providing practical knowledge on field crop diseases.

**Objectives**

* Describe different field crop diseases through symptoms study and field visit.
* Demonstration of identification of causal organisms A of field crop diseases in the laboratory.

**Learning outcomes**

* Identify plant diseases with their causal organisms of different field crops.
* Relate host-pathogen interactions in disease development.

**Course content**

1. Calibration of microscope and measurements of plant pathogens.
2. Techniques involved in preparation of slides for ­microscopic study.
3. Preparation of culture media.
4. Sterilization: Methods and techniques.
5. Isolation and detection of fungi, bacteria and nematodes from diseased plant materials and soil.
6. Isolation, detection and inculation of viruses from diseased plant materials
7. Study of the following genera of fungi:
8. *Synchytrium,* *Pythium, Mucor, Rhizopus, Aspergillus, Penicillium, Agaricus, Alternaria,, Curvularia, Pyricularia, Fusarium, Rhizoctonia* and *Sclerotium*,
9. Demonstration of different types of symptoms of plant diseases.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Practical job
* Assignment

**Books recommended**

Alexopoulos, C.J. 1962. Introductory Mycology. John Wiley & Sons. Inc. N.Y.

Bawden, F.C. 1964. Plant Viruses and Virus diseases. The Ronald Press.

Christensen, Cm. 1961. The Molds and Man: An Introduction to Fungi. University of Mennesota Press,

Corbett, J. K. and H. D. Sister (Ed) 1964. Plant Virology. University of Florida Press. Gainsville.

Mehrotra. Brahm Swarlep. 1967. The Fungi. 2nd ed. Oxford & IBH Publishing Co., New Delhi.

Pelezar. M. J. I. Jr. and R. D. Reid. 1950. Microbiology. McGraw‑ Hill Book, Company, New York.

Singh, R. S. 1973. Plant Diseases. 3rd ed. Oxford & IBH.

Stakman. E. C. and J. C. Harrar, 1957. Principles of Plant Pathology. The Ronald Press Company, New York.

Stavenson, G. 1967. The Biology of Fungi. Bacteria and Viruses.

Thiman, K. V. 1966. The life ofBacteria.The MacMillan Co.

Thome, G. 1961. Principles of Nernatology. MacGraw‑Hill Book Co., N. Y.

Weidel, W. 1959, Virus. The University of Michigan Press.

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| **Course number**  | **:**  | **CST-216** |
| **Course title**  | **:**  | **Genetics and Plant Breeding – I (Practical)** |
| **Number of credits**  | **:**  | **2** |
| **Total marks**  | **:**  | **50** |

**Rationale**

The course will provide practical knowledge on important events of cell division

**Objectives**

* Introduce basic laboratory rules on microscopy for cytological studies
* Demonstrate and identify stages of mitosis and meiosis
* Explain the effects of physical and chemical agents on chromosomal aberrations

**Learning outcomes**

* Prepare slides from plant samples to describe and identify different stages of mitosis and meiosis
* Examine the effect of colchicine and gamma-ray on somatic cell division

**Course content**

1. Demonstration of mitosis in onion root tip cells.
2. Demonstration of meiosis in the pollen mother cells of onion/maize.
3. Effect of colchicine treatment on onion/garlic root tip chromosomes.
4. Introduction to practical genetics: Demonstration and maintenance of parents, F1 and F2 generation plants experimental farm.
5. Problems on monohybrid crosses: Complete dominance, partial dominance and co‑dominance.
6. Problems on dihybrid crosses: Complete dominance, partial dominance and co‑dominance.
7. Problems on trihybrid cross: Complete dominance.
8. Problems on gene interaction: Non‑epistatic and epistatic gene interaction.
9. Problems on linkage and crossing over: Using two and three‑point test cross.

**Teaching strategy**

* Lectures
* Demonstration of different stages of cell division
* Demonstration of normal versus aberrations in dividing cells
* Tutorial

**Assessment strategy**

* Quiz
* Identificaton of diffrent phases of cell divisions
* Experiment
* Assignment

**Books recommended**

Burns, G.W. 1980. The Science of Genetics 4th ed. Macmillan publishing co. Inc. New York.

Cytologia - International Journal of Cytogenetics and Cell Biology. 1998.

Gupta, P.K. 1995. Cytogenetics. 1st. ed. Rastogi, India.

Perry, J. and Appels, R. 1998. Chromosome structure and Function. Plenum press, New York and London.

Sarma, A. 1991. Chromosomes. Oxford & IBH Pub. Co. New Delhi

Sharma A.K. and Sharma, A. 1980. Chromosomes Technique-theory and practice 3rd ed. Butterworthes. London.

Singh. B.D. 2001. Fundamentals of Genetics. 3rd . Ed. Kalyain Publisher, New Delhi‑I 10002, India.

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| **Course number** | **: CST-217** |
| **Course title** | **: Agricultural Extension – I (Practical)** |
| **Number of credits** | **: 2** |
| **Total marks** | **: 50** |

**Rationale**

The course is designed to make teaching effective through utilization of different extension teaching methods and aids

**Objectives**

* To provide information on various aspects on different extension teaching methods and aids
* To deliver instructions to prepare, present and practice the commonly used extension teaching methods and aids
* To guide the students to use group techniques in extension work

**Learning outcomes**

* Understand the basic concepts and procedure of demonstrations.
* Prepare various teaching aids and apply them during extension teaching.
* Prepare a presentation in projector.
* Understand group techniques and their application in extension work.
* Prepare a lecture script and present it as part of practice.

**Course content**

1. Presentation of basic facts about Bangladesh agriculture.
2. Acquaintance with the works of extension organizations related to agricultural development.
3. Farm and home visits.
4. Delivering talk (Lecturing): Practice of delivering talk on assigned topic.
5. Methods of collecting data.
6. Preparation of questionnaire.
7. Procedure of interviewing.
8. Small group discussion techniques: Brainstorming, Role playing and Phillips 66 procedure and practice.
9. Visit to selected farm/Agricultural Research Institute/ Non Government Organization of agricultural importance.

**Teaching strategy**

* Lecture
* Individual presentation
* Group discussion/ Group work
* Group presentation
* Video presentation practice

**Assessment strategy**

* Test and Assignment

# Recommended Books

Chambers, R. 1983. Rural Development - Putting the Last First,. Longmans, London.

Chitambar, J. B. 1973. Introductory Rural Sociology. Willy Sastern, Delhi.

DAE. 1996. Agricultural Extension Manual. Department of Agricultural Extension. Ministry of Agriculture. Govt. of the Peoples. Republic of Bangladesh.

Dahama, O. P. 1978. Extension and Rural Welfare. Ramprasad and Sons. Agra.

Singh, K. 1985. Rural Society. Proakashan Kendra, Luknow.

Sunderson, D. 1948. Rural Sociology and Rural Social Organization. Joh Willy and Sons, New York.

Swaminathan, M.S. 1982. Science and Integrated Rural Development, Concept Pub. Co. New Delhi.

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| **Course number** | **:** | **CST-218** |
| **Course title** | **:** | **Biochemistry – (Practical)** |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

The students need to have a proper knowledge on the physical and chemical aspects of biomolecules for understanding of physiological phenomena of plants and animals and their improvement.

**Objectives**

* Provide knowledge on sources and classification of biomolecules
* Explain properties and biochemical functions of biomolecules
* Construct structure of biomolecules

**Learning outcomes**

* List the sources of different biomolecules
* Classify different biomolecules
* List the biological functions of different biomolecules
* Describe the physical and chemical properties of biomolecules
* Compare and contrast among various biomolecules
* Determine the structure of unknown biomolecules
* Contrast Oligomeric/polymeric forms of various biomolecules

**Course content**

1. Use of an analytical balance.
2. Preparation of various standard solutions.
3. Calibration of volumetric apparatus.
4. Acid base titration:
	1. Titration of a mixture of a strong acid and a weak acid.
	2. Titration of a strong acid with a strong base.
	3. Titration of a weak acid with a strong base.
5. Qualitative test of carbohydrates and proteins and vitamins.
6. Paper chromatographic separation of amino acids and sugars.
7. Quantitative estimation of thiamin and ascorbic acid in plant sample.

**Teaching strategy**

* Lecture
* Group discussion
* Exercise

**Assessment strategy**

* Gap filling
* Multiple choice
* Short question
* Essay type question
* Assignment

**Books recommended**

Conn, E.E. Stumpf, P.K. 1987. Outlines of Biochemistry. 5th edition. John Wiley and Sons, New York.

Devlin, T.M. 2002. Textbook of Biochemistry. 5th edition. John Wiley and Sons, Inc. USA.

Lodish, H., Berk, A., Kaiser, C.A., Keieger, M., Bretscher, A., Ploegh, H. and Martin, K.C., 2016. Molecular Cell Biology. 8th edition. W. H. Freeman and company, New York.

Murray, R.K. 2002. Harper’s Biochemistry. 25th edition. MeGraw Hill. Printed in Singapore.

Nelson, D.L. and Michal, M.M. 2017. Lehninger Principles of Biochemistry. 7th edition. W. H. freeman and company. New York.

Stryer, L. 1995. Biochemistry. 4th edition. W. H. freeman and company. New York.

Voet, D and Voet, J.G. 1995. Biochemistry. 2nd edition. John Wiley and Sons, New York.

**B. Sc. Ag. (Hons.) Part – 3**

**THEORY COURSES**

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| **Course number** | **:** | **CST-301**  |
| **Course title** | **:** | **Agronomy – III (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

## Rationale

This course is designed to provide basic knowledge on crops, cropping, crop evaluation and production technology of selected crops.

**Objectives**

* Provide knowledge about concept of cropping system and crop evaluation
* Explain crop diversification and pattern
* Describe production technology of important crops
* Elucidate different weed management practices

## Learning outcomes

* Explain the concept of crops, cropping system
* Interpret multiple cropping and crop diversification
* Describe different dimensions of crop-intensification
* Explain different crops production technology

## Course content

1. **Introduction to farm management:** Meaning, scope, objectives, farm management decisions, functions and limitations of farm management.
2. **Farm and farming:** Definition, types of farming with advantages and disadvantages, factors to be considered for the establishment of a farm.
3. **Economic principles of farm management:** Economic principles applied to farm management, principles of selection of farm enterprises.
4. **Farm planning and budgeting:** Definition, necessity of farm planning, factors to be considered during farm planning, characteristics of good farm plan, limitations of farm planning, types of farm budgeting.
5. **Farm record:** Concept, objectives, farm record maintenance, limitations and types of farm record.
6. **Agricultural labour:** Definition, classification, factors governing supply of labour, problem of labour and improvement of labour efficiency.
7. **Land use and crop statistics in Bangladesh:** Categories of land use system, area, production, and yield of crops of Bangladesh.
8. **Agro-ecosystem:** Concept, system properties, determinants, types, resources, characteristics of farming system of Bangladesh.
9. **Cropping calendar:** Objectives, utility and procedure of preparation.
10. **Cropping scheme:** Utility and principles of preparation.
11. **Cropping system:** Concept and determinants.
12. **Multiple cropping:** Objectives, types, advantages and disadvantages. Factors affecting the selection of species combination-Principle and practices.
13. **Crop rotation:** Planning of crop rotation.
14. **Crop diversification:** Concept, importance, present status and future strategy in Bangladesh.
15. **Crop intensification:** Concepts, importance, and limitations
16. **Cropping pattern:** Cropping patterns of Bangladesh and possibilities of their improvement.
17. **Crop evaluation:** Crop yield estimation, crop cutting experiment, crop reporting, and crop forecasting.
18. **Production technology of crops:** Origin, climate and soil requirements, characteristics of species, sub species and cultivars, cultivation practices, post-harvest operation and cost of production of the following crops:
19. **Cereal crops:** Rice, wheat and maize.
20. **Narcotic crops:** Tobacco.
21. **Pulse crops:** Lentil and mungbean.

# Teaching strategy

* Lecture
* Discussion
* Tutorial

## Assessment strategy

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Beneke, R.R. 1966. Managing the Farm Business. John Wiley and Sons, Inc. New York, London, Sydney.

Chatterjee, B.N.; Maiti, S. and Mandal, B.K. 1989. Cropping System (Theory and Practice) Second ED. Oxford and IBH Publishing Co. Pvt. New Delhi, Bombay, Calcutta. 345p.

Efferson, J.M. 1953. Principles of Farm Management. McGraw‑ Hill Book Co., New York.

Hedge, T.R. 1969. Farm Management Decision. Prentice Hall, Inc. Englewood Cliffs. London.

Hoques, M.Z. 1984. Cropping Systems in Asia. On‑Farm Research and Management. IRRI, Philippines.

Kipps, M.S. 1978. Production of Field Crops. 6th Edition. Tata McGraw‑Hill Pub. Company Ltd. New Delhi, India, 790p.

Kundu. D.; Basak, K.C. and Sarker, P.D. 1959. Jute in India. Indian Central Jute Committee, Calcutta, India.

Martin, J.H., Leonard, W,H. and Stamp, D.L. 1967. Principles of Field Crop Production. 3rd Edn., McMillan New York. 1118p.

Quddus, M.A. 1985. Bangladesher Khadya Shasya O Arthakari Phasaal. Bangla Academy, Dhaka. 403p.

Thakur, C. 1979. Scientific Crop Production. Vol. I and II.3rd Edn. Metropolitan Book Co., New Dehli‑1 10002, India.

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| **Course number**  | **:** | **CST-302** |
| **Course title**  | **:** | **Soil Science – III (Theory)** |
| **Number of credits**  | **:** | **3** |
| **Total marks**  | **:** | **100** |

**Rationale**

This course offers infield knowledge about all aspects of soil survey, classification, mapping and conservation.

**Objectives**

* Demonstrate various soil properties both in the field and laboratory.
* Hands on soil survey in the field.
* Prepare soil map and report preparation.

**Learning outcomes**

* Determine soil texture, colour and reaction (pH).
* Depict mechanical processes in soils.
* Describe soil erosion and conservation.
* Explain soil pollution and degradation.
* Interpret land capability classification.

**Course content**

#### Soil Chemistry and Microbiology

1. **Soil reaction:** Soil pH, forms of H+ ion in soil, grading of soil according to pH values, sources or causes of soil acidity, role of pH on nutrient availability, problems of soil acidity. Acid sulphate soil–formation, location and extents in Bangladesh, classification, characteristics and management.
2. **Liming:** Principles of liming reactions, factors affecting liming reactions, kinds of liming materials, efficiency of liming materials, neutralizing index, chemical reactions between liming materials and acid soils, lime requirement and liming factors, methods of appling, lime balance sheet, effect of overliming, role of lime on soil properties. Some problems about estimating lime requiments.
3. **Soil colloids and clay mineralogy:** Nature and important properties of soil colloids, types of soil colloids; concept of silicate clays, structure of layer silicate clays–structural units; 1:1 type, 2:1 types and 2:2 types of mineral, comparative properties of important silicates clays. Concept of buffering capacity of soil.
4. **Ion exchange:** Definition, caption and anion exchange, origin of ion exchange, causes of negative charge on soil colloids, CEC, BSP and milliequivalent, factors affecting CEC and importance of CEC. Factors affecting and importance of anion exchange. Concept of contact exchange and root CEC.
5. **Submerged soils:** Definition, kinds, difference between aerated and sub-merged soils, characteristics of submerged soil, Redox potential and factors affecting redox potential, sequentional reduction reactions, transformation of N, P, K, S, Fe and Zn; CH4 formation and impact on environment.
6. **Saline and alkaline soils:** Saline soil–definition, characteristics, formation, classification, location and extents, management of saline soils; saline tolerance crops. Alkaline soils–definition, properties of alkaline soils, concept of calcareous soils, and management of alkaline soils.
7. **Soil organisms:** Classification; concept of Protista, Procarotes and Eucariotes; classification of Bacteria and Algae; occurrence and functions of Bacteria, Fungi, Algae, Protozoa and Earthworms. Concept on Mycrrhizal Symbiosis.
8. **Biological Nitrogen Fixation (BNF):** Definition, agents, symbiotic and non symbiotic N-fixation. Legume-rhizobium symbiosis, cross inoculation group and legume crops. Azolla-anabaena symbiosis, importance and limitations in Bangladesh. Blue-green algae (BGA)-ecology, Physiology, importance and methods of production. Factors affecting Azolla and BGA growth.

**Teaching strategy**

* Lecture
* Tutorial
* Self-study/e-learning

**Assessment strategy**

* MCQ
* Short questions
* Essay type questions
* Assignment

**Books recommended**

Alexauder, M. 1977. Introduction to Soil Microbiology. John Wiley and Sons. New York.

Allen, D. N. 1949. Experiments in Soil Bacteriology. Burgers Pub. Co. Minneapolis.

Allen, E. N. and Allen, O. N. 1981. The leguminosae. A Source Book of Characteristics, Uses and Nodulation. The University of Wisconsin Press, Madison.

Black, C. A. 1973. Soil Plant Relationship. Wiley Eastern Private Ltd. New Delhi.

Burris, R. H. 1974. Methodology. In The Biology of Nitrogen Fixation. Ed. A. Quispel North Holland Pub. Co. Amsterdam.

Burton, J. C. 1967. *Rhizobium* Culture and Use. In Microbial Technology. Ed. H. J. Peppler, Reinhdd Pub. Corp. New York.

Chhabra, R. 1996. Soil Salinity and Water Quantity. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi, Calcutta.

De, G. C. 1998. Fundamentals of Agronomy. Oxford and IBH Pub. Co. Pvt. Ltd. Calcutta.

Harley, J. L. and Smith, S. E. 1983. *Mycorrhizal* Symbiosis, Academic Press, New York.

Marks, C. G. and Koslowski, T.T (eds.) 1973. *Ectomycorrhizae* - Their Ecology and Physiology. Academic Press, New York.

Mudaliar, V. T. S, 1984. Principles of Agronomy. Bapp. Co. Bangalore.

Subba Rao, N. S. 1977. Soil Microorganisms and Plant Growth. Oxford and IBH Pub. Co. New Delhi.

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| **Course number** | **: CST-303** |
| **Course title** | **: Horticulture – III (Theory)** |
| **Number of credits** | **:** **3** |
| **Total marks** | **:** **100** |

**Rationale**

This course focuses on different aspects of vegetable and spices including production and processing technologies, seed production and vegetable forming.

**Objectives**

* Provide knowledge on modern aspects of vegetable and spice production.
* Explain the technologies of processing for vegetable and spice.

**Learning outcomes**

* Explain background, status of production and export of vegetable and spice crops.
* Classify vegetable and spice crops and summarize their morphology.
* Illustrate present situation of production, import and supply and develop quality seed production strategies of vegetable seeds.

**Course content**

###### Production Technology of Vegetables and Spices

1. **Introduction to olericulture:** Definition and concept; discipline and its areas, classification and importance of vegetables and spices.
2. **Common vegetables in Bangladesh:** Nomenclature, morphology and growth habit.
3. **Vegetable production in Bangladesh**: Background, present situation and associated problems, scope of development.
4. **Environmental factors affecting vegetable production:** Role of temperature, light, air, rainfall, humidity and soil on the growth and development of vegetable.
5. **Vegetable seeds and other propagating materials:** Present situation of vegetable seed production in Bangladesh: Production methods of important vegetable seeds, seed quality,seed vigor and factor affecting viability of vegetable seeds, storage of vegetable seeds, methods of vegetative propagation of some important vegetable crops in Bangladesh.
6. **Soil less production of horticultural plants**: Water culture (Hydroponics) and sand culture.
7. **Production practices of vegetable crops**: Tomato, Brinjal, Cabbage, Cucumber, Cauliflower, Radish, Lady’s finger, Potato, Spinach, Watermelon, Pointed gourd, Lettuce, Sweet potato and Leafy vegetables.
8. **Production and processing of spices and condiments:** Onion, Garlic, Ginger, Turmeric, Chili, Cumin, Black pepper, Bay leaf, Cinnamon and Coriander.
9. **Vegetable farming:** Kitchen garden and commercial farming, organic farming, poly-tunnel production, inter, multiple and relay cropping, crop rotation of vegetables and spices: principles, advantages and schedulling of crop rotation

**Teaching strategy**

* Lecture
* Group discussion
* Video clip

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Pop quiz

**Books recommended**

J. B. Edmiond et al. Fundamentals of Horticulture. Tata McGraw-hill Publishing Co. ltd. New Delhi.

Jules Janick.1982.Horticultural Science.Surjeet Publications, 7k, Koihapur, Kamla Nagor, New Delhi.

Katyal, S.L. 1977. Vegetable Growing in India, Oxford & IBH Pub. Co., New Delhi, India.

P. Hazra and M. G. Som.1999. Technology for Vegetable Production and Improvement. Naya Prokash, 206 Bidhan Sarani, Culcutta, India.

Prasad, S. and U. Kumar.1999. Principles of Horticulture. Agrobotanica. 4E 176 Jn. Vyas Nagar, Bikaner, India.

Thompson, H. C. and W.C. Kelly. 1957. Vegetable Crops. McGraw Hill Book Cp. Inc. New York.

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| **Course number** | **:** | **CST-304**  |
| **Course title** | **:** | **Agricultural Botany– III (Theory)**  |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

The course has been designed to offer knowledge on plant physiology and plant regulators.

**Objectives**

* Provide knowledge on physiological processes of plants.
* Students will be able to know how to food materials produced and metabolic activity occurs in plant body.
* Students will learn about different plant growth regulators and their impact on crop production.
* Students will understand about photoperiodism and vernalization.
* Students will gain an understanding about stress physiology of plants.

**Learning outcomes**

Upon completion of the course, students should be able to:

* Describe the physiological aspects of osmoregulation, evapotranspiration, water use efficiency (WUE) and dry matter (DM) production.
* Evaluate photosynthetic pathways, carbon use efficiency, metabolic limitations to dry matter yield, chloroplastic antioxidant defense system.
* Explain energy expenditure during respiration and growth and evaluate modified atmospheric conditions for handling and storability of plant products.
* Know about plant growth regulators, impact of day length and cold on flowering and stress physiology.

**Course content**

**Plant physiology**

1. Plant water relationship: Concept and measurement of water potential, absorption mechanisms, path of absorption and water movement, factors affecting absorption, theories of ascent of sap, water loss phenomena in leaf and other plant parts.
2. Transpiration: Concept, mechanism of opening and closing of stomata, stomatal movement, factors affecting stomatal movement and transpiration.
3. Photosynthesis: Photosynthetic apparatus, light and dark reactions, photosynthetic pathway and their significance, factors essential for photosynthesis.
4. Respiration: Concept, types, mechanisms, importance, relationship of carbohydrate metabolism to other compounds, factors affecting respiration, controlling measures for photorespiration, relationship among respiration, growth and storage of plant products.
5. Growth regulators: Concept, classification, effects of phytohormones (auxin, gibberellins, cytokinins and others) on growth and development with special reference to agricultural crops.

6. Seed physiology: Structure and chemical composition, sources of assimilate and maturation, stored seed reserves and its control: dormancy- causes and mechanism.

7. Growth and development: Concept, factors affecting growth, determinate and indeterminate growth, growth correlation and growth dynamics, vegetative and reproductive growth, plant growth and yield analysis techniques.

8. Photoperiodism and vernalization: Concept, process, mechanism and application to agriculture.

9. Stress physiology: Types, nature of injury, causes, mechanisms and survival measures to overcome.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment
* Class attendance

**Books recommended**

Bewley, J.D. and Black, M. 1994. Seeds: Physiology of development and germination. 2nd ed. Plenum Press, New york.

Cheema, S.S., B.K. Dhaliwal and T.S. Sahta. 1991. Theory and Digest Agronomy. Kalyani Publishers. New Delhi.

Copeland, L.O. 1988. Principles of Seed Science & Technology. S.S. Chabrafor Surjeet Publicatios, 7-Kolhapur Road, Kamal Nagar, Delhi-110007.

Datta, S.C. 1994. Plant physiology. Wiley Eastern Ltd., Calcutta, India.

Devlin, R.M. and Witham, F.H. 1977. Plant physiology. 4th ed. CBS Pub. & Distributors. New Delhi.

Fosket, D.E. 1994. Plant growth and development. Academic Press Inc. California.

Gardner, F.P., Pearce, R.B. and Mitchell, R.L. 1985. Physiology of crop plants. Lowa State Uni. Press, USA.

Hall, D.O., Scurlock, J.M.O., Bolhar-Nordenkampf, H.R., Leegood, R.C. and Long, S.P. 1993. Photosynthesis and production in a changing environment: A field and laboratory manual. Chapman and Hall, U.K.

Hans, M. 1984. Class experiments in plant physiology. George Allen & Unwin Pub. Ltd., London.

Hunt, R. 1982. Plant growth curves: The functional approach to plant growth analysis. Edward Arnold, London.

Levit, J. 1980. Response of plants to environmental stresses. Academic Press, New York.

McDonald, M.B. and Copeland, L.O. 1989. Seed science and technology: Laboratory manual. Iowa State Univ. Press, USA.

Mohr, H. and Schopfer, P. 1994. Plant physiology. Springer, Berlin.

Nilsen, E.T. and Orcutt, D.M. 1996. The physiology of plants under stress. John Wiley and Sons, Increased., New york.

Pandey, S.N. and Sinha, B.K. 1972. Plant physiology. Vikas Publishing House Pvt. Ltd., New Delhi.

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| **Course number** | **:** | **CST-305** |
| **Course title** | **:** | **Entomology – II (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks:**  | **:** | **100** |

**Rationale**

This course will provide detail knowledge on pest management for environmentally sound and sustainable crop protection.

**Objectives**

* Provide knowledge on the pest agro-ecosystem.
* Explain of insect polymorphism.
* Describe the methods of pest management.
* Design approaches of Integrated Pest Management.

**Learning outcomes**

* Describe the basics of pest management and insect polymorphism
* Analyze pest status and methods of insect population and crop loss estimation
* Describe the basic concepts of insect pest management
* Explain and use different methods of insect pest management
* Develop and apply IPM in crop production

**Course contents**

Systematic Entomology, Insect Embryology and Pest Management

1. **Systematic entomology:** Diagnostic characteristics of the important families of the orders: Thysanura, Odonata, Orthoptera, Dictyoptera, Thysanoptera, Isoptera, Hemiptera, Homoptera, Lepidoptera, Coleoptera, Diptera and Hymenoptera.
2. **Insect physiology:** Endocrine system, neuro secretary cells, carpora cardiaca, corpora allata and thoracic glands, types of hormones and their functions, Instar, sub-imago and imago. Hormonal control of metamorphosis.
3. **Insect Nutrition:** Nutritional requirements of carbohydrates, fats and proteins and their metabolism of insects.
4. **Insect reproduction and embryology:** Reproductive systems, spermatogenesis and ogenesis, types of reproduction. Development and formation of the embryo, segments and appendages.
5. **Pest and pest management:** Concept of pest and pest management. Agro-ecosystem, economic threshold, economic injury level and equilibrium position, outline of pest management. Biology, nature of damage and control measures of major insect pests of vegetables, fruits and stored products.

**Teaching strategy**

* Lecture
* Assignment
* Video clip
* Self-study/E-learning
* Tutorial

**Assessment strategy**

* Written test
* Quiz test
* Assignment

**Books Recommended**

Atwal, A.S. 1976. Agricultural pest of India and Southeast Asia. Kalyani Publishers, New Delhi.

Dent, D. Insect Pest Management. CAB International. Inite Kingdom.

Evans, J.W.1987. Insects Pests and Their Control. Sony Reprints Agency. New Delhi.

Flint M.L. and Van deu-Boseh.R. 1981. Intorduction to integrated pest management. Plenum Publ. Crop. New York.

Metcalf, R.L. and W.H. Luckman. 1994. Introduction to Insect Pest Management. Intercept Ltd. Hampshire.

Price, P.W. 1984. Insect Ecology (Second ed.) John wiley and sons, New York.

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| **Course number** | : **CST-306** |
| **Course title** | : **Plant Pathology – II (Theory)** |
| **Number of credits** | : **3** |
| **Total marks** | : **100** |

**Rationale**

Providing knowledge on principles of plant pathology, diseases of field crops and their management.

**Objectives**

* Explain host-pathogen interaction to disease development.
* Describe field crop diseases, etiology and effect of factors for disease development.
* Impart the knowledge on management of field crop diseases.

**Learning Outcomes**

* Describe the pathogenesis of different plant diseases. .
* Explain the mechanism of dispersal of plant pathogens.
* Illustrate the interactions of different components of disease development.
* Describe the different methods of plant disease control.
* Explain the detail information on diseases of different field crops.

**Course Content**

**Diseases of field crops**

1. **Pathogenesis:** Parasitism and pathogenicity, chain of events in disease development. Enzymes and toxins in disease development, pathogenic effects on physiological functions of plants.
2. **Dissemination of plant pathogens:** Importance, factors and mechanism, disease development, predisposition.
3. **Epidemiology:** Concept of epidemiology and epiphytotic, types of epidemic, components of epiphytotic: Host, pathogen, time, human and their role in disease development in the epidemic form, decline of epidemic of plant diseases.
4. **Plant disease forecasting:** Concept, basic of plant disease forecasting, basic consideration of plant disease forecasting, critical weather and preparation of critical model for major plant disease forecasting: Late blight of potato, BLB of rice, Leaf blight of wheat, Grey blight of mustard etc.
5. **Methods of plant disease control:** Cultural, Legislative, Chemicals, Host resistance, Biological, Integrated approach concepts, components and economics.
6. **Diseases of the following crops and their management practices:**
	1. **Cereals:** Rice, wheat, maize, barley and millets.
	2. **Fibres:** Jute and cotton.
	3. **Pulses:** Pea, gram, lentil, blackgram, mungbean, grasspea and pigeonpea.
	4. **Oilseeds:** Mustard, groundnut, sesame, soybean and sunflower.
	5. **Sugar Crop:** Sugarcane.

**Teaching Strategy**

* Lecture
* Demonstration
* group discussion

**Assessment Strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Agrios, G. N. 1969. Plant Pathology. Academic Press, New York,

Alexopoulos, C. J. and E. S. Beneke. 1962. Laboratory Manual for Introductory Mycology, Bargees Publishing Co.

Ashrafuzzaman, M. H. 1976. 1st ed. Laboratory Manual of Plant Pathology. Department of Plant Pathology, BAU,

Ashrafuzzaman, M. H. 1976. A Lecture Guide to Crop Diseases. 1st ed. Department of Plant Pathology. BAU.

Barnett, R. 1. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Co.

Carter, W. 1962. Insects in Relation to Plant Diseases. McGraw Hill Book Company.

Frobisher, M. 1953. Fundamentals of Microbiology. Fifth edition, London, Saunders.

Funder, S. 1968. Practical Mycology. Hafner Publishing Co.

Leech, J. G 1940. InsectsTransmission of Plant Diseases. McGraw I Hill Book. Co.

Mehrotra, R. S. 1980. Plant Pathology. Tata McGraw Hill Publishing Co.

Rangaswami, G. 1962. Bacterial Plant Diseases in India. Bombay. Asia Publishing House.

Rangaswami, G. 1972. Diseases of Crop Plants in India. Prentice Hall of India Private Ltd.

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| **Course number**  | **:**  | **CST-307** |
| **Course title**  | **:**  | **Genetics and Plant Breeding – II (Theory)**  |
| **Number of credits**  | **:**  | **3** |
| **Total marks**  | **:**  | **100** |

**Rationale**

The course covers the basic principles of genetics & cytogenetics

**Objectives**

* Understand the basic concepts of Mendelian inheritance
* Explain the genetic mechanisms involved in multiple allelism, sex determination  and extra nuclear inheritance
* Provide knowledge on linkage and crossing over, mutation, mutagenes and their effects
* Describe the meiotic behaviors and cytogenetic consequences of genetic variations
* Deliver a comprehensive idea on mating system

**Learning outcomes**

* Describe the Mendelian pattern of inheritance
* Outline the concept and significance of linkage & crossing over, multiple allelism, quantitative inheritance, extra-nuclear inheritance and sex determination
* Explain Gene, its structure and function
* Describe the concept of mutation and their possible implications in crops improvement
* Describe the mating system

**Course content**

1. **Multiple alleles:** Concept and characteristics of multiple alleles, test of allelism; inheritance of multiple alleles.
2. **Quantitative inheritance:** Multiple factor hypothesis; comparison of multiple factor inheritance with Mendelian inheritance.
3. **Mutation:** Concept, classification and characteristics of mutation; types of mutagenes and their effect, spontaneous vs induced mutation, procedure of mutation breeding.
4. **Mode of pollination:** Characteristics of self and cross-pollinated crops, mechanism promoting self and cross pollination, determination of the mode of pollination.
5. **Heterosis and inbreeding:** Concept, types and measurement of heterosis, hypothesis of heterosis, inbreeding, effect of inbreeding and degree of inbreeding depression, heterosis vs inbreeding depression.
6. **Hybridization:** Concept, types and steps of hybridization.
7. **Distant hybridization:** Definition, objectives, barriers and application in crop improvement.
8. **Mating system:** Random mating, genetic assertive mating, phenotypic assorting mating, genetic disassortive mating and phenotypic disassortive mating.
9. **Heritability:** Definition, types, main features, grading of heritability, factors influencing heritability.
10. **Micropropagation:** Definition, stages, functions, causes and application.
11. **Tissue culture:** Concepts and basic techniques in tissue culture, totipotency, prerequisites for cell and tissue culture, factors of plant regeneration, media preparation and sterilization techniques, achievement.
12. **Anther culture:** Procedure, factors influencing anthers, utilization in plant breeding.
13. **Embryo culture:** Types, techniques, factors affecting the success of embryo culture and application in plant breeding
14. **Somaclonal variation:** Concept, causes of somaclonal variation, application in crop improvement and selection of somaclonal variation.

**Teaching strategy**

* Lecture
* Assignment
* Video clip
* Small group discussion

**Assessment strategy**

* MCQ
* Short question
* Essay type question

**Books recommended**

Application of Plant in *vitro* technology. 1993. Malaysian Biochemical society.

Brown, T. A. 2002. Gene cloning and DNA analysis: An introduction 4th edition. Blackwell science.

Dixon, R. A. 1987. Plant cell culture: a practical approach IRL Press. Oxford, Washington DC.

Gamborg, 0. L. and Phillips. G. C. 1995. Plant cell. tissue and organ culture, Fundamental methods. Narosa Pub. House. New Delhi, Bombay. Loud. Madras, Calcutta.

Ignacimuthee. S.S.J. 1998. Plant Biotechnology IBH. Pub. Co. Pvt. Oxford.

Jane, K.; Setlow and Alexander. H. 1982. Genetics engineering. Principles and methods. Plenum Press, New York.

Michael. W. F., Graham. S. W. And young. M. M. 1992. Plant Biotechnology Perogamon Press, Tokyo, Seoul, Newyork, Oxford.

Moss. J. P. 1992. Biotechnology and crop improvement in Asia. Andraprodesh ICRISAT, India.

Old, R. W. and Primrose. S. B. 1994. Principles of Gene Manipulation‑ An introduction to Genetic Engineering. Blackwell Scientific Publications. London. 5 h edition,

Primrose, S. B. 1987. Modern Biotechnology. Blackwell Scientific Publications, London.

Proceeding of the International Symposium, 1993. Applications of plant in *vitro* technology. Malaysia, 16‑18 Nov. 1993.

Raymond, L.; Rodriguoz and Robert, C. Tait. 1983. Recombinant DNA techniques ‑ An introduction. The Benjamin/cummings Publishing Co. London.

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| **Course number** | : **CST-308** |
| **Course title** | : **Agricultural Extension – II (Theory)** |
| **Number of credits** | : **3** |
| **Total marks** | : **100** |

**Rationale**

This course is intended to give basic understanding of extension communication and dissemination of technologies along with application of knowledge of teaching in extension work.

**Objectives**

* Provide information on communication process and its implication in extension work.
* Acquaint students with fundamental issues of communication.
* Introduce extension teaching and teaching aids.
* Equip students with different communication network and levels.

**Learning outcomes**

* Describe communication process, its models and their implications in extension work.
* Explain communication network and levels.
* Apply different extension teaching methods.

**Course content**

**A. Agricultural communication**

1. **Meaning and concept of communication:** Origin, concept, nature and purpose of communication; types of communication; and importance of communication in extension work.
2. **Communication process:** Steps in communication process, elements of communication process, Models of communication- Laswell Model; Bradock Model; Shannon and Weaver Model; Defleur Model; Berlo Model; Oakley and Garforth Model. Noise and feedback in communication, Barriers of communication, ways of overcoming the barriers to communication, concept of communication fidelity.
3. **Communication Network and Levels:** Communication: Chain or Y, Wheel, Circle, Star, and Com-con. Pattern or form of communication.

**B. Extension teaching methods**

1. **Extension teaching:** Definition of teaching method and extension teaching methods, principles of teaching, criteria for effective extension teaching, steps of extension teaching methods, teaching plan, qualities of an effective extansion teacher, guideline for a sound teacher, different types of teaching methods. Factors influencing the choice of methods.
2. **Teaching method:** Purpose and classification of teaching aids, selection of appropriate teaching aids.
3. **Extension teaching methods with special reference to result and method demonstration:** Demonstration and its objectives, result demonstration and method demonstration, essential elements, advantages and limitation of result and method demonstration, comparison between result and method demonstration.
4. **Group discussion technologies:** Conference, seminar, symposium, workshop.

**C. Diffusion of innovation**

1. **Diffusion process:** Concept of innovation, adoption, diffusion and diffusion process, elements of diffusion process, characteristics of innovation, consequences of innovation.
2. **Innovation-decision process:** Stages of innovation-decision process, types of innovation-decision, barriers of diffusion innovation, factors affecting the diffusion among the farmers.
3. **Adopter categories of farmers:** Adopter categories of the farmers and characteristics of adopter categories.

**Teaching strategy**

* Lecture and discussion
* Self-study
* Video clip
* Assignment

**Assessment strategy**

* Written examination
* MCQ
* Assignment

**Books recommended**

Beal, G. M., Bholem, J.M. and Raudabaugh, J. N. 1962. Leadershipo and Dynamic Group Action. Iowa State University Press.

Berlo, D.K. 1960. The Process of Communication. New York: Holt, Rinehart and Winston Inc.

Bernard, H. W. 1975. Psychology of Learning and Teaching. McMillan Hill Books Co. N.Y.

Kreitlow, B. W., Aiton, E. W. and Lorrenes A. I. 1966. Leadership of Action in Rural Communities. Dauville, Illinois. The Interstate Printers and Pub. Inc.

McQuail, D. and Windahl, S 1981. Communication Models for the Study of Mass Communication. London: Longman.

Morgan, B.G., E. Holmes and C. L. Bundy. 1963. Methods in Adult Education. Ulinois. The Interstate Printers and Pub. Inc.

Sandhu, A.S. 1993. Textbook on Agricultural Communication: Process and Methods.Kolkata: Oxford & IBH Publishing Co. Pvt. Ltd.

Singh, R, 1987. A Text of Extension Education. Sahityakala Prakashan, Ludhiana, India.

Supe, S. V. 1983. An Introduction to Extension Education. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi.

Supe, S.V. 1983. An Introduction to Extension Education. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi.

Swanson, B.E. R.P. Bentz and A.J. Sofranko (1997). Improving Agricultural Extension: A Reference Manual. Rome: FAO of the United Nations.

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| **Course number** | **:** | **CST-309** |
| **Course title** | **:** | **Agricultural Chemistry (Theory)**  |
| **Number of credits** | **:** | **3** |
| **Total marks:**  | **:** | **100** |

**Rationale**

This course deals with the chemistry and technology of pesticides and agro-industrial crops, and the efficient management of biomass resources, bioremediation and utilization for sustainable crop production.

**Objectives**

* Provide knowledge on chemistry and formulation of pesticides and their mode of action.
* Acquaint the students with the theoretical and applied knowledge on manufacturing, processing, quality control, storage and use of different agro-industrial crops.
* Provide knowledge on scope and importance of renewable energy and bioremediation.

**Learning outcomes**

* Identify and refer pesticide formulations and explain their chemistry and mode of action for efficient use
* Explain the quality control and regulations of pesticides
* Explain manufacturing, processing, quality control, storage and use of different industrial crops.
* State and compare different sources of renewable energy.
* Describe bioremediation technologies and their applications**.**

**Course content**

**1. Fertilizer concepts:** Feed stocks and classification of fertilizers. Physical and chemical properties of fertilizers. Mixed, compound and liquid fertilizers, Advantages and disadvantages of mixed and liquid fertilizers,

**Manufacturing of fertilizers:**

**2. Nitrogenous fertilizers:** Raw materials, Synthesis of ammonia and carbondioxide, production of urea.

**3. Phosphatic fertilizers:** Phosphatic rocks, sulphuric acid manufacture, phosphoric acid manufacture, production of OSP, TSP and DAP.

**4. Potassic fertilizer:** Types and composition of potash ores, manufacture of potassimm chloride.

**5. Pesticide formulations:** Concept on pest, pesticide and pesticide formulations; Chemistry and utilization of auxiliary materials for insecticide, fungicide and herbicide formulations; Dust, wettable powder, granule, emulsifiable concentrates, fumigant, aerosol and microencapsulation.

**6. Pesticide chemistry:** Preparation, properties, mode of action and uses of commonly used pesticides: Natural organic compounds, organochlorinated hydrocarbons, organophosphorus, organocarbamate and synthetic pyrethroid insecticides, synthetic fungicides, herbicides and acaricides; Compatibility of pesticides with agrochemicals.

**7. Chemistry and technology of agroindustrial products:**

**Rubber:** Tapping system; composition and processing of natural rubber; classification, preparation/synthesis and properties of synthetic rubber.

**Sugar:** Condition and quality of sugarcane, manufacture of plantation white sugar, industrial utilization of sugar mill by products.

**Tea:** Manufacturing processes and change of chemical composition in tea leaves, aroma, tea infusion and liquoring quality of tea.

**8. Renewable resources of energy:** Concept, scope and importance; comparative feasibility of renewable energy against bioenergy.

**9. Bioremediation technology:** Scope and importance of bioremediation; bioremediation treatment technologies; bioremediation organisms, bioavailability of compounds and biological process requirements.

**10. Environmental Chemistry:** Effect of pesticides and fertilizers on soil, plant, water, fish and their influence on the environment. Compatibility of pesticides with agrochemicals, pesticides and health hazards.

**Teaching strategy**

* Lecture
* Discussion
* Video clips
* Field trip

**Assessment strategy**

* Essay/Short type question
* MCQ
* Assignment

**Books recommended**

Alexander, M. 1999. Biodegradation and Bioremediation. 2nd ed., Academic Press, California, USA.

Deublein, D. and Steinhauser, A. 2008. Biogas from Waste and Renewable Resources: An Introduction. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

Dhingra, K.C. 1984. Hand Book on Rubber and Rubber Goods Industries. Small Industry Research Institute, New Delhi.

Hou, C.T. and Shaw, J.F. 2008. Biocatalysis and Bioenergy. John Wiley and Sons, Inc., Hoboken, New Jersey.

Jain, N.K. (ed.). 1999. Global Advances in Tea Science. Aravali Books International Pvt. Ltd., New Delhi, India.

Manahan, S.E. 2010. Environmental Chemistry. 9th ed., CRC Press LLC, Boca Raton, Florida, USA.

Mathur, R.B.L. 1987. Hand Book of Cane Sugar Technology. Oxford and IBH Publishing Co. Calcutta, India.

Mital, K.M. 1997. Biogas System - Policies, Progress and Prospects. Taylor & Francis, New York, USA.

Olguin, E.J., Sanchez, G. and Hernandez, E. (eds.) 2000. Environmental Biotechnology and Cleaner Bioprocesses. Taylor & Francis Inc., London.

Ramulu, U. S. S. 1995. Chemistry of Insecticides and Fungicides. Oxford and IBH Pub. New Delhi India.

Stevens, C.V. and Verhe, R. 2004. Renewable Bioresources: Scope and Modification for Non-food Applications. John Wiley and Sons, UK.

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| **Course number** | **:** | **CST-310** |
| **Course title** | **:** | **Agricultural Statistics (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks:**  | **:** | **100** |

**Rationale**

This course will provide knowledge on regression, methodology, sample survey, test of significance and experimental design.

**Objectives**

* Provide knowledge on research methodology.
* Explain the sample survey and random sampling.
* Describe the regression and experimental design.

**Learning outcomes**

* Explain the regression co-efficient and different tests.
* Analyze the methodology of survey.
* Describe different test of significance and experimental design.

**Course content**

1. Definition and scope of statistics, Origin and historical development of statistics, Variable, Different types of variables. Frequency distribution; construction and graphical representation of data with numerical example.
2. Central tendency, Measures of central tendency with numerical example.
3. Random experiment, outcome, sample space, events, union and intersection of events with venn diagram, mutually exclusive, equally likely, independent and dependent events. Definition of probability, conditional probability. Additive and multiplicative laws of probability.
4. Random variable, probability distribution. Derivation, properties and uses of binomial distribution, poisson and normal distribution.
5. Simple correlation and regression, scatter diagram, the Pearson’s correlation coefficient with its properties, least squares method for fitting regression line. Properties of regression coefficient.

**6.** Meaning of methodology, methods of data collection and sampling, estimation of sample sizes, methods of construction of indices, study of methodologies of different notation and local survey.

**7.** Ideas of field survey, sample survey and complete enumeration, steps in a sample survey, preparation of questionnaire, schedules, instruction etc, survey enumeration, pilot survey, requirement of good sample design. Sampling and non-sampling errors, accuracy and precision.

**8.** Hypothesis, null hypothesis, alternative hypothesis, type-I error, type-II error, level of significance. Preliminary concept of t-test, F-test, chi-square, test and their applications: testing of hypothesis regarding population mean, equality of two means, population variance, goodness of fit and independence of two attributes in a contingency table, test of significance of correlation coefficient and regression coefficients.

**9.** Experimental design: Basic concepts and principles. Completely randomized, randomized blocked and Latin square design.

**Teaching strategy**

* Lecture
* Discussion
* Video clips
* Field trip

**Assessment strategy**

* Essay/Short type question
* MCQ
* Assignment

Recommended Books

Ahmed A. Rashid, M. A. A. Bhuiya and M. Z. Hossain: Experimental Designs Theory and Application.

Barnett, V. 1979. Sample surveys: Principles and Methods, Edward Arnold, London.

Blackburn, D.J.(ed) 1994. Extension Handbook: Processes and Practice. Toronto Thomprson. Educational Pub. Inc.

Chudhuri, A. and H. Stenger 1992. Survey sampling Methods and Thorey.

Cochran & Cox. 2000. Experimental Design, 2nd Ed, Wiley, New York.

Cochran, W.G. 2002. Sampling Technique, 4th ed, Wiley, N.Y.

Das, M.N. and N.C. Giri 1986. Design and Analysis of Experiments, 2nd Ed, Wiley Eastern Ltd., India.

Kothari, O.R. 1990. Research Methodology; Methods and techniques. Wiley Eastern Lid. New Delhi.

Montgomery, D. C. 2003. Design and Analysis of Experiments. 5nd Ed, Wiley, New York (Principal Text).

**B. Sc. Ag. (Hons.) Part – 3**

**PRACTICAL COURSES**

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| **Course number** | **:** | **CST-311** |
| **Course title** | **:** | **Agronomy – III ( Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

## Rationale

This course covers practical aspects of crops, cropping and their management.

# Objectives

* Identify major crop and cropping system.
* Explain the life cycle of major crop and production technology.
* Prepare nursery beds.
* Describe production cost of crops.

**Learning outcomes**

* Identify and classify cropping pattern.
* Explain the life cycle of major crops.
* Prepare crop calendar.
* Calculate the production cost of crops.

## Course content

1. Study of farm records and their maintenance.
2. Study of land utilization and crop statistics of Bangladesh.
3. Preparation of complete yearly budget of a farm.
4. Preparation of a cropping scheme
5. Laying out an agricultural farm.
6. Preparation of a crop report.
7. Preparation of crop calendar.
8. Preparation of crop rotation schedules for field crops.
9. Study of major cropping pattern of Bangladesh in relation to climatic parameters.
10. Preparation of nursery beds (wet and dry) for raising seedlings of rice and tobacco.
11. Conduction of a crop cutting experiment.
12. Computation of production cost of rice, wheat, maize and Tobacco.

# Teaching strategy

* Lecture
* Experiment
* Field visit
* Group discussion

**Assessment strategy**

* Sample identification
* Illustration
* Exercise
* Assignment

**Books recommended**

Beneke, R.R. 1966. Managing the Farm Business. John Wiley and Sons, Inc. New York, London, Sydney.

Chatterjee, B.N.; Maiti, S. and Mandal, B.K. 1989. Cropping System (Theory and Practice) Second ED. Oxford and IBH Publishing Co. Pvt. New Delhi, Bombay, Calcutta. 345p.

Efferson, J.M. 1953. Principles of Farm Management. McGraw‑ Hill Book Co., New York.

Hedge, T.R. 1969. Farm Management Decision. Prentice Hall, Inc. Englewood Cliffs. London.

Hoques, M.Z. 1984. Cropping Systems in Asia. On‑Farm Research and Management. IRRI, Philippines.

Kipps, M.S. 1978. Production of Field Crops. 6th Edition. Tata McGraw‑Hill Pub. Company Ltd. New Delhi, India, 790p.

Kundu. D.; Basak, K.C. and Sarker, P.D. 1959. Jute in India. Indian Central Jute Committee, Calcutta, India.

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| **Course number**  | **:** | **CST-312** |
| **Course title**  | **:** | **Soil Science – III ( Practical)**  |
| **Number of credits**  | **:** | **2** |
| **Total marks**  | **:** | **50** |

**Rationale**

The course is designed todevelop generic skills on the measurement of soil physical and microbial properties

**Objectives**

* Determine soil pH using electrode pH meter.
* Measure soil pH and cation exchange capacity
* Prepare bacterial media.

**Learning outcomes**

* Sterilize technique and prepare bacterial media.
* Determine soil pH
* Categorize soils into different AEZ

**Course content**

1. Determination of organic carbon in soil by wet oxidation method and estimation of organic matter.
2. Determination of lime requirement of soil.
3. Determination of free carbonates of soil by HCL titration method.
4. Determination of CEC by Ammonium acetate extraction method.
5. Determination of Electrical Conductivity of soil by EC meter.
6. Study on the nodulation in different legumes, pulses, ground nut, sunhemp and dhaincha etc.
7. Isolation and authentication of *Rhizobium* from legume root nodule.
8. Preparation, production and application of *Rhzobium* bio-fertilizer.
9. Preparation, production and application of Azolla.
10. Preparation, production and application of BGA.
11. Preparation, production and application of normal Compost and Vermicompost.
12. Total count of bacteria and Blue-Green Algal inoculants.

**Teaching strategy**

* Lecture
* Tutorial
* Self-study/e-learning

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Alexauder, M. 1977. Introduction to Soil Microbiology. John Wiley and Sons. New York.

Allen, D. N. 1949. Experiments in Soil Bacteriology. Burgers Pub. Co. Minneapolis.

Allen, E. N. and Allen, O. N. 1981. The leguminosae. A Source Book of Characteristics, Uses and Nodulation. The University of Wisconsin Press, Madison.

Black, C. A. 1973. Soil Plant Relationship. Wiley Eastern Private Ltd. New Delhi.

Burris, R. H. 1974. Methodology. In The Biology of Nitrogen Fixation. Ed. A. Quispel North Holland Pub. Co. Amsterdam.

Burton, J. C. 1967. *Rhizobium* Culture and Use. In Microbial Technology. Ed. H. J. Peppler, Reinhdd Pub. Corp. New York.

Chhabra, R. 1996. Soil Salinity and Water Quantity. Oxford and IBH Pub. Co. Pvt. Ltd. New Delhi, Calcutta.

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| **Course number** | **:** | **CST-313** |
| **Course title** | **:** | **Horticulture – III (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

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**Rationale**

This course will provide practical knowledge identifying horticultural crops, intercultural operations, fertilizer management, seed, seedlings and estimation of cost.

**Objectives**

* Illustrate different group of vegetables crop.
* Describe methods of vegetables cultivation.
* Explain measures of fertilizer use.
* Discuss seeds and seedlings of vegetables.
* Assess cost of cultivation of vegetables crops and spices.

**Learning outcomes**

* Identify common vegetables crops.
* Discuss practicing intercultural operations of different vegetables crop.
* Apply methods of fertilizer rate and application.
* Assess production of vegetables.

**Course content**

1. Field visit for identification of horticultural crops (vegetables and spices) in different areas of Bangladesh and preparation of album.
2. Practicing of intercultural operation in different vegetable crops.
3. Different planting methods of vegetables with sowing dibbling and transplanting.
4. Estimation of seed rate and fertilizer doses for different vegetable crops.
5. Methods of manuring and fertilizers of vegetable crops.
6. Field layout for planting vegetable crops.
7. Identification of seeds and seedlings of vegetables and spices.
8. Study of important morphological features related to production of some important vegetable crops, spices and condiments.
9. Estimation of cost of cultivation of tomato, potato, cabbage and brinjal.
10. Seed extraction technique and processing of tomato, brinjal and white gourd.
11. Each student shall spend 3 months (one crop season) in the 3rd year and shall be attached to a particular farm from any one of the following areas:

Zhum cultivation: Sylhet/Rangamati.

Offshore areas of Khulna, Barisal, Patuakhali, Bhola and Noakhali.

Barind Tract: North of Naogaon, Part of Dinajpur, Nawabgonj and Rajshahi.

**Teaching strategy**

* Lecture
* Role play
* Video clip
* Lab and field demonstration

**Assessment strategy**

* Written test
* Quiz test
* Assignment
* Oral test
* Presentation

**Books recommended**

Jules Janick.1982.Horticultural Science.Surjeet Publications, 7k, Koihapur, Kamla Nagor, New Delhi.

Katyal, S.L. 1977. Vegetable Growing in India, Oxford & IBH Pub. Co., New Delhi, India.

P. Hazra and M. G. Som.1999. Technology for Vegetable Production and Improvement. Naya Prokash, 206 Bidhan Sarani, Culcutta, India.

Prasad, S. and U. Kumar.1999. Principles of Horticulture. Agrobotanica. 4E 176 Jn. Vyas Nagar, Bikaner, India.

Thompson, H. C. and W.C. Kelly. 1957. Vegetable Crops. McGraw Hill Book Cp. Inc. New York.

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| **Course number** | **:** | **CST-314**  |
| **Course title** | **:** | **Agricultural Botany – III (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

The course has been designed to offer practical knowledge on physiological and ecological processes and functions of plants in field condition.

**Objectives**

* Enrich knowledge on fundamental physiological processes of plants.
* Provide practical knowledge on measurement methods or tools for growth and development in plants.

**Learning outcomes**

 Upon completion of the course, students should be able to:

* Demonstrate important physiological processes in plants.
* Determine water potential in plant tissues.
* Demonstrate the distribution and abundance of stomata in dorsiventral and isobilateral leaves.
* Evaluate variation in C3, C4 and CAMplants.
* Demonstrate basic phenomena on photosynthesis and respiration.
* Separate photosynthetic pigments.

**Course content**

1. Experiments to demonstrate- osmosis, plasmolysis, transpiration and ascent of sap.
2. Measurement of water status and water potential in plant tissues.
3. Study of distribution and abundance of stomata in different types of leaves.
4. Study of anatomical structure of leaves in C3, C4 and CAM plants.
5. Experiments to demonstrate photosynthesis and respiration.
6. Experiments on plant pigments: separation, quantification and chlorophyll stability index.
7. Study of monocotyledon
8. Monocotyledonous and dicotyledonous seed structure.
9. Techniques of crop growth and yield analysis.
10. Demonstration of the effects of different PGRs (Plant Growth Hormones) on growth and yield in crops.
11. Field visit and Report Presentation.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Practical job
* Assignment
* Class attendance

Recommended Books

Datta, S.C. 1994. Plant physiology. Wiley Eastern Ltd., Calcutta, India.

Devlin, R.M. and Witham, F.H. 1977. Plant physiology. 4th ed. CBS Pub. & Distributors. New Delhi.

Gardner, F.P., Pearce, R.B. and Mitchell, R.L. 1985. Physiology of crop plants. Lowa State Uni. Press, USA.

Hall, D.O., Scurlock, J.M.O., Bolhar-Nordenkampf, H.R., Leegood, R.C. and Long, S.P. 1993. Photosynthesis and production in a changing environment: A field and laboratory manual. Chapman and Hall, U.K.

Hans, M. 1984. Class experiments in plant physiology. George Allen & Unwin Pub. Ltd., London.

Mohr, H. and Schopfer, P. 1994. Plant physiology. Springer, Berlin.

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| **Course number** | **:** | **CST-315** |
| **Course title** | **:** | **Entomology – II (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

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**Rationale**

This course will provide practical knowledge on insect ecology and methods collecting, preparing and preserving insects.

**Objectives**

* Illustrate methods of collection insects
* Explain preservation of process of mature and immature insects
* Discuss different plant protection equipment, baits and traps
* Assess pest population and crop loss

**Learning outcomes**

* Identify common insects in Bangladesh
* Apply precautionary measures during pesticide application
* Use different plant protection equipment, traps and baits
* Assess crop yield loss related problems

**Course contents**

#### Systematic Entomology

1. Method of collecting, preparing and preserving insects (immature and adult stages) and mites.
2. Collection and identification of insects (upto 75 families) of economic importance in Bangladesh and setting in insect Boxes.

#### Plant protection Equipment’s

1. Pest controls appliances (ground and aerial), their operation and maintenance.

**Teaching strategy**

* Lecture
* Role play
* Video clip
* Lab and field demonstration

**Assessment strategy**

* Written test
* Quiz test
* Assignment
* Oral test
* Presentation

**Books Recommended**

Atwal, A.S. 1976. Agricultural pest of India and Southeast Asia. Kalyani Publishers, New Delhi.

Dent, D. Insect Pest Management. CAB International. Inite Kingdom.

Evans, J.W.1987. Insects Pests and Their Control. Sony Reprints Agency. New Delhi.

Flint M.L. and Van deu-Boseh.R. 1981. Intorduction to integrated pest management. Plenum Publ. Crop. New York.

Metcalf, R.L. and W.H. Luckman. 1994. Introduction to Insect Pest Management. Intercept Ltd. Hampshire.

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| **Course number** | **:** | **CST-316** |
| **Course title** | **:** | **Plant Pathology – II (Practical)** |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course deals with the diagnosis of the disease problem in the lab and field for planning and designing proper control measures.

**Objectives**

* Demonstrate different methods of diagnosis of diseases of fruits, vegetables, cash crops and agroforest trees through symptoms study and field visits.
* Demonstrate hands-on practice for identification of the disease causing agents of fruits, vegetables, cash crops and agroforest trees.
* Explain detail procedure of different seed health testing methods.

**Learning Outcomes**

* Prepare plant disease herbarium.
* Diagnose diseases of fruits, vegetables, cash crops and agroforest trees.
* Detect health status of seeds.
* Write prescription following ethical principles of pesticide use..

**Course content**

**Field & Laboratory studies of plant diseases.**

**1.** Detailed study (symptoms, preparation of slides and identification of pathogens) of the followings:

* 1. Brown spot, Blast & BLB of Rice.
	2. Stem rot, Black band & Anthracnose of Jute.
	3. Leaf blight, leaf rust, foot rot & loose smut of wheat and covered smut of barley.
	4. Tikka, leaf rust & collar rot of groundnut.
	5. Root‑knot diseases.
	6. Cercospora leaf spot of blackgram & mungbean.
	7. Alternaria blight of crucifers.

**2.** Brief study (symptoms aided by permanent slides of the pathogen) of the followings:

1. BLB,BLS, Stem rot, Bakanae, False smut, NBS, Sheath blight, Sheath rot, Leaf scald, Ufra, Grassy stunt, yellow dwarf and Tungro of rice.
2. Leaf spot, Soft rot & Mosaic of Jute
3. Angular leaf spot & Ball rot of cotton
4. Foot and root rot, mosaic, rust, wilts & blights of pulses and oilseed crops.
5. Smut, Wilt, White leaf, Pineapple disease and Red rot of Sugarcane.

**3.** Demonstration of Koch's postulates by using fungi, bacteria, nematodes and viruses.

**4.** Studies on the diseases in seedbed.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Experiment
* Assignment

**Books recommended**

Agrios, G. N. 1969. Plant Pathology. Academic Press, New York,

Alexopoulos, C. J. and E. S. Beneke. 1962. Laboratory Manual for Introductory Mycology, Bargees Publishing Co.

Ashrafuzzaman, M. H. 1976. 1st ed. Laboratory Manual of Plant Pathology. Department of Plant Pathology, BAU,

Ashrafuzzaman, M. H. 1976. A Lecture Guide to Crop Diseases. 1st ed. Department of Plant Pathology. BAU.

Barnett, R. 1. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Co.

Carter, W. 1962. Insects in Relation to Plant Diseases. McGraw Hill Book Company.

Frobisher, M. 1953. Fundamentals of Microbiology. Fifth edition, London, Saunders.

Funder, S. 1968. Practical Mycology. Hafner Publishing Co.

Leech, J. G 1940. InsectsTransmission of Plant Diseases. McGraw I Hill Book. Co.

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| **Course number**  | **:**  | **CST-317** |
| **Course title**  | **:**  | **Genetics and Plant Breeding – II (Practical)**  |
| **Number of credits**  | **:**  | **2** |
| **Total marks**  | **:**  | **50** |

**Rationale**

The course focuses on the practical aspects of plant genetics for crop hybridization.

**Objectives**

* Provide knowledge to identify and maintain different generations of crop plants
* Explain the mechanisms of solving problems involve one, two and three pairs of genes controlling traits
* Demonstrate the goodness of fit of experimental data obtained from different breeding programs
* Construct a genetic map for linked genes

**Learning outcome**

* Identify the parents, F1 and segregating generations
* Explain the pattern of inheritance & variations in segregating generations
* Test the fitness of field experiment results with Mendelian and Non Mendelian ratios
* Calculate the frequency of crossing over and construct a physical gene map

**Course content**

* + - 1. Prerequisites for an ideal tissue culture laboratory
			2. Media preparation
			3. Preparation of explants
			4. Sterilization of media and explants.
			5. Problems on Chi‑square test: Collecting F2 data from GPB experimental farm to perform Chi‑square test for goodness of fit to Mendelian and Non Mendelian ratios.
			6. Estimation of heterosis.
			7. Problems on quantitative inheritance: Collection of data from genetic populations such as P1, P2, F1 and F2 to study quantitative inheritance.
			8. Hybridization techniques in crop plants.
			9. Problems on gene interaction.
			10. Data analysis for variety testing. Collection of data from te GPB experimental field following statistical analysis.

**Teaching strategy**

* Lecture
* Demonstration
* Field visit
* Group discussion

**Assessment strategy**

* Written examination
* Quiz
* Problem solving
* Data analysis & interpretation

**Books recommended**

Application of Plant in *vitro* technology. 1993. Malaysian Biochemical society.

Brown, T. A. 2002. Gene cloning and DNA analysis: An introduction 4th edition. Blackwell science.

Dixon, R. A. 1987. Plant cell culture: a practical approach IRL Press. Oxford, Washington DC.

Gamborg, 0. L. and Phillips. G. C. 1995. Plant cell. tissue and organ culture, Fundamental methods. Narosa Pub. House. New Delhi, Bombay. Loud. Madras, Calcutta.

Ignacimuthee. S.S.J. 1998. Plant Biotechnology IBH. Pub. Co. Pvt. Oxford.

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| **Course number** | : **CST-318** |
| **Course title** | : **Agricultural Extension- II ( Practical)** |
| **Number of credits** | : **2** |
| **Total marks** | : **50** |

**Rationale**

The course is designed to familiarize the students about basic facts about agricultural in Bangladesh acquaint extension organization and methods of data collection.

**Objectives**

* Acquaint students with various aspects of data collection methods, data analysis and processing.
* Develop skills to prepare research report based on empirical data.
* Develop presentation skills of the students.

**Learning outcomes**

* Describe different methods of data collection
* Prepare data collecting tools (interview schedule/questionnaire/checklist)
* Explain the process of farmers’ interviewing and agricultural survey
* Acquaint farm and home visit.
* Prepare questionnaire.

**Course content**

1. Demonstration: conducting method and result demonstration.
2. Teaching aid: preparation and use of poster, flash cards, leaflet, circular letter, flash cards and computer aided slide.
3. Preparation and presentation of farm radio talk.
4. Use and handling of different aids in extension teachings: OHP, Slide projector, Multimedia,
5. Preparation and use of different charts and graphs for presentation of data.
6. Survey and collection data of regarding agricultural activities.
7. Compilation, tabulation and analysis of data.
8. Preparation and presentation of survey report.
9. Tools for diffusion of innovation: Radio & TV programme, Field day, Farmers rally and Agricultural fair.
10. Extension field trip: field trip to nearby Upzila for a week and submission of its report

**Teaching strategy**

● Discussion

● Assignment

● Exercise

● Group Discussion

● Reporting

**Assessment strategy**

● Written examination

● Assignment

**Books recommended**

Beal, G. M., Bholem, J.M. and Raudabaugh, J. N. 1962. Leadershipo and Dynamic Group Action. Iowa State University Press.

Berlo, D.K. 1960. The Process of Communication. New York: Holt, Rinehart and Winston Inc.

Bernard, H. W. 1975. Psychology of Learning and Teaching. McMillan Hill Books Co. N.Y.

Kreitlow, B. W., Aiton, E. W. and Lorrenes A. I. 1966. Leadership of Action in Rural Communities. Dauville, Illinois. The Interstate Printers and Pub. Inc.

McQuail, D. and Windahl, S 1981. Communication Models for the Study of Mass Communication. London: Longman.

Morgan, B.G., E. Holmes and C. L. Bundy. 1963. Methods in Adult Education. Ulinois. The Interstate Printers and Pub. Inc.

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| **Course number** | **: CST-319**  |
| **Course title** | **: Agricultural Chemistry (Practical)** |
| **Number of credits** | **: 2** |
| **Total marks** | **: 50** |

**Rationale**

This course covers the aspects of sophisticated analytical instruments and their calibration techniques to analyze fertilizers and water samples.

**Objectives**

* Calibration and operation of analytical and nuclear equipments.
* Develop skills on sampling and analyses of fertilizers to identify commonly used fertilizers and their adulterations.
* Categorize water on the basis of physical and chemical properties.
* Acquaint with radioisotopes applications in institutional installations.

**Learning outcomes**

* Operate and calibrate laboratory equipments.
* Collect and process water, plant and fertilizer samples.
* Analyze manures and fertilizers for quality control.
* Determine water quality parameters for different usage.
* Apply radioisotopes in agricultural research.

**Course content**

1. **Operation and calibration of laboratory equipments:** Analytical/electronic balance; pH meter; Conductivity meter; Colorimeter/Spectrophotometer; Flame photometer and Atomic absorption spectrophotometer.
2. Analytical techniques of titrimetry, colorimetry, spectrophotometry, flame emission and atomic absorption spectrophotometry.
3. **Manure and fertilizer analysis:** Moisture and nutrient contents in cow dung, FYM, poultry manure, compost, urea, SSP, TSP, DAP, MOP, gypsum, zinc sulphate, borax, copper sulphate and ferrous sulphate
4. Preparation of Plant Extract by dry and wet oxidation (di and tri acid mixture) method.
5. Estimation of N, P, K, Ca, Mg, S, Zn, Cu, Fe and Na from plant extract, water and fertilizer samples by flame photometer and Atomic Absorption Spectrophotometer.
6. Analysis of available and total micronutrients Zn, Fe, Cu, Mn, B, Mo & Co in soil and plant.
7. Techniques of pesticide formulation and residue analysis.
8. Field visit for survey and identification of micronutrient deficiency symptoms in field and horticultural crops.

**Teaching strategy**

* Lecture
* Demonstration
* Experiment
* Field trip

**Assessment strategy**

* Short question
* MCQ
* Experiment
* Assignment

**Books recommended**

Alexander, M. 1999. Biodegradation and Bioremediation. 2nd ed., Academic Press, California, USA.

Deublein, D. and Steinhauser, A. 2008. Biogas from Waste and Renewable Resources: An Introduction. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

Dhingra, K.C. 1984. Hand Book on Rubber and Rubber Goods Industries. Small Industry Research Institute, New Delhi.

Hou, C.T. and Shaw, J.F. 2008. Biocatalysis and Bioenergy. John Wiley and Sons, Inc., Hoboken, New Jersey.

Jain, N.K. (ed.). 1999. Global Advances in Tea Science. Aravali Books International Pvt. Ltd., New Delhi, India.

Manahan, S.E. 2010. Environmental Chemistry. 9th ed., CRC Press LLC, Boca Raton, Florida, USA.

Mathur, R.B.L. 1987. Hand Book of Cane Sugar Technology. Oxford and IBH Publishing Co. Calcutta, India.

Mital, K.M. 1997. Biogas System - Policies, Progress and Prospects. Taylor & Francis, New York, USA.

Olguin, E.J., Sanchez, G. and Hernandez, E. (eds.) 2000. Environmental Biotechnology and Cleaner Bioprocesses. Taylor & Francis Inc., London.

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| **Course number** | : **CST-320** |
| **Course title** | : **Agricultural Statistics (Practical)** |
| **Number of credits** | : **2** |
| **Total marks** | : **50** |

**Rationale**

This course deals with different statistical tools and techniques and their application in experimental design and survey data

**Objectives**

* Explain the techniques of data collection
* Demonstrate statistical methods for analyzing experimental and survey data
* Explain uncertainty in making correct decision about agricultural products and their production

**Learning outcomes**

* Construct frequency distribution and select appropriate graphs.
* Measure the location, dispersion and shape characteristics of a frequency distribution.
* Assess the laws and distributions of probability.
* Measure linear relationship between two variables.
* Test hypotheses regarding the parameters of the population.
* Perform appropriate experimental design and analysis of variance

**Course content**

1. Construction of frequency distribution table and graphical representation of data, calculations of various measures of central tendency and dispersion.
2. Fitting simple linear regression and correlation co-efficient to observe data.
3. Testing hypothesis regarding population mean and variance. Testing significance of simple correlation coefficient and regression coefficients. Use of chi-square for testing goodness of fit and test of independence of two attributes in a contingency table.
4. Layout plan and analyses of variance for Completely Randomized Design, Randomized complete Block Design, Latin Square Design including multiple comparison tests (LSD and DMRT).

**Teaching strategy**

* Lecture
* Problem-based learning
* Interactive learning

**Assessment strategy**

* Creative questions
* MCQ
* Written test
* Oral test
* Assignment

Recommended Books

Ahmed A. Rashid, M. A. A. Bhuiya and M. Z. Hossain: Experimental Designs Theory and Application.

Barnett, V. 1979. Sample surveys: Principles and Methods, Edward Arnold, London.

Blackburn, D.J.(ed) 1994. Extension Handbook: Processes and Practice. Toronto Thomprson. Educational Pub. Inc.

Chudhuri, A. and H. Stenger 1992. Survey sampling Methods and Thorey.

Cochran & Cox. 2000. Experimental Design, 2nd Ed, Wiley, New York.

Cochran, W.G. 2002. Sampling Technique, 4th ed, Wiley, N.Y.

**B. Sc. Ag. (Hons.) Part – 4**

**THEORY COURSES**

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| **Course number** | **:** | **CST-401**  |
| **Course title** | **:** | **Agronomy – IV (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

The course is designed to provide knowledge on agro-ecosystems, cropping practices, land use pattern, farm management and technologies related to production and quality improvement of industrial crops.

**Objectives**

* Describe production technology and quality improvement of industrial crops.
* Provide knowledge on planning and management of agricultural farm.
* Familiarize students with land use systems and crop statistics of Bangladesh.
* Impart knowledge on agro-ecosystems and management of stress of crop production in Bangladesh.

# Learning outcomes

* Explain the production technology and quality improvement of crops.
* Describe the planning and management of agricultural farm.
* Illustrate the land use systems and crop statistics of Bangladesh.
* Explain the agro-ecosystems.

# Course content

* 1. **Crop growth and development:** Concept of growth and development, different growth phases and stages of rice and wheat plants. Factors affecting growth, development and yield of crops.
	2. **Water management:** water use efficiency under irrigated farming. Water management in rainfed /dryland farming. Irrigation scheduling.
	3. **Fertilizer management:** Balanced fertilization. Fertilizer management in relation to varietal characteristics, growth phases, cropping system and irrigation.
	4. **Stress agriculture:** Moisture, drought and flood, cold, heat, salinity and alkalinity stress and their management for crop production.
	5. **Production technology of crops:** Origin, climate and soil requirements, characteristics of species, sub species and cultivars, cultivation practices, post-harvest operation and cost of production of the following crops:
	6. **Cereal crops:** Barley and millets
	7. **Sugar crops:** Sugarcane and sugarbeet.
	8. **Fibre crops:** Jute, cotton, and kenaf.
	9. **Oil crops:** Groundnut, soybean, linseed, sunflower, safflower and castor.
	10. **Pulse crops:** Grass pea, pea, chickpea, pigeon pea and blackgram.
	11. **Forage crops:** Maize, sorghum, napier grass, guinea grass and paragrass.
	12. **Legume species:** Dhaincha, sunhemp, clovers and cowpea.
	13. **Quality control of crops:** Factors affecting the quality of crops. Agronomic means of improving quality of crops.

## Teaching strategy

* Lecture
* Video clips
* Tutorial

# Assessment strategy

* Written test
* Quiz
* Assignment
* Presentation

**Books recommended**

Arakeri. H.R. and Donahue, R. 1988. Conservation and Water Management Oxfordand IBH Pub. Co. Pvt. Ltd Calcutta, Bombay and New Delhi. India.

Beets, C.W. 1983. Multiple Cropping and Tropical Farming Systems. Westview Press.

Chatterjee, B.N.; Mati. S. and Mandal. B.N. 1989. Cropping systems‑ Theory and Practice (2nd Ed.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Francis. C. A. 1986. Multiple Cropping System. Macmillan Publishing Co. New York.

Hossain, S.M.A. 1988. Agricultural and Rural Development in Bangladesh‑ Evolution of Cropping Systems in Mymensingh and Comilla Regions. JSARD Pub. No. 12. Japan International Cooperation Agency, Dhaka, Bangladesh.

Kipps, M.S. 1978. Production of Field Crops. 6th Edition. Tata McGraw‑Hill Publishing Company Ltd. New Delhi, India.

Martin, J.H.; Leonard, W.H. and Stamp, D.L. 1976. Principles of Field Crop Production. 3rd Edn, McMillan Pub., New York.

Mudaliar. V.I.S. 1984. Principles of Agronomy. 5th Edition. The Bangalore Printing and Pub., India.

Seizwo, M. 1967. Crop Science in Rice. Theory of Yield Determination and its application. Fuji Pub. Co. Tokyo,

Shyte, R.O. 1980. Crop Production Environment. Faber and Faber Ltd. 24, Russel Square, London, W.C.I.

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| **Course number**  | **:** | **CST-402** |
| **Course title**  | **:** | **Soil Science – IV (Theory)**  |
| **Number of credits**  | **:** | **3** |
| **Total marks**  | **:** | **100** |

**Rationale**

This course provides knowledge on soil fertility, productivity, soil evaluation and in organic fertilizers.

**Objectives**

* Explain the abundance and functions of soil fertility and productivity.
* Describe fertility and evaluation.
* Elucidate soil fertility management.

**Learning outcomes**

* Describe soil fertility and productivity.
* Identify soil fertility evaluation.
* Explain soil fertility management.
* Formulate suitable organic and inorganic fertilizers.
* Production methods of BGA, azolla, vermi compost and tricoderma.

**Course content**

**Soil Fertility and Nutrient Management**

1. **Introduction to soil fertility and plant nutrition:** Definition and distinction between soil fertility and productivity. Concepts of essential clements. Depletion and conservation of soil fertility in Bangladesh. Interaction effects between different elements. Concept of integrated nutrient management.
2. **Organic and in organic fertilizers:** Concept, kinds and composition of important organic manures; concept, types and significance of bio-fertilizers; distinction between organic matter and humus; OM decomposition–actions, enzymes involves, factors influence of C/N ratio and significance of C/N ratio, Himus formation process- modern theory. Chemical fertilizers–name, chemical composition and properties of fertilizers, major behabiur of important fertilizers, Organic matter replenishment- green manure, farm yard manure and animal manures, compost, vermicompost and organic waste management.
3. **Soil fertility evaluation:** Concept of soil fertility evaluation, soil analytical data and their interpretation for the recommendation of fertilizers.
4. **Nitrogen:** N in soil and plants, N-cycle, forms of N; Mineralization and immobilization process, Nitrification, Denitrification, NH3–volatilization, and chemo-denitrification, N-fertilizers and fertilization.
5. **Phosphorous:** Occurrence of P in soil, forms of soil P, P-fixation, factors affecting P-Fixation, P-Fertilizers and fertilization, P-cycle.
6. **Potassium:** Occurrence of K, forms and distribution of K in soil. K-fixation, factors affecting K-fixation, Laxury comsumption of K, K-cycle, K-fertilizers.
7. **Sulphur:** Occurrence and sources of S, S oxidation and reduction, factors affecting S availability in soils, S-fertilizers and fertilization, S-cycle.
8. **Calcium and Magnesium:** Sources and behaviour, forms utilized by plants, Losses, fertilizers and fertilization.
9. **Iron and Zinc:** Iron-occurrence and forms of soil Fe, factors affecting Fe availability, Fe-fertilizers and fertilization. Zinc–occurrence and forms of soil Zn, factors affecting Zn availability, Zn-fertilizer and fertilization.
10. **Boron and Molybdenum:** Occurrence and forms of soil B, B in plants, factors affecting B availability, relative sensitivity of selected corps to B deficiency, B-fertilizers and fertilization. Molybdenum: Occurrence in soils, soil solution of Mo, factors affecting Mo availability, Mo toxicities, Mo Sensitive corps, Mo fertilizers and fertilization.
11. **Nutrient uptake theories:** Brief account of important nutrient uptake theories

**Teaching strategy**

* Lecture
* Tutorial
* Self-study/e-learning

**Assessment strategy**

* MC
* Short type questions
* Essay type questions
* Assignment

**Books recommended**

Alexander, M., 1977. Introduction to Soil Microbiology. John Willy and Sons, New York.

Brady, N.C. 1990. The Nature and Properties of Soil. McMillan Pub. Co. New York.

Donahue, R.L., R.W. Miller & J.C. Shickluna. 1983. Soil An Introduction to Soil and Plant Growth. Prentice-Hall Inc. New Jersey.

Fertilizer Recommendation Guide-1997. Bangladesh Agricultural Research Council.

Jackson, M.L. 1965. Soil Chemical Analysis. Prentice Hall. Inc. New York.

Meugel, K. and E.A. Kirkov. 1987. Principles of Plant Nutrition. Inst. Potash Inst. Pub. Switzerland.

Miller, R.W. and R.L. Donhue. 1992. Soils–An Introduction to Soils and Plant Growth. Prentice - Hall Pvt. Ltd., New Delhi.

N.K. Fageria, V.C. Baligar, C.A. Jones. 1991. Growth and Mineral Nutrition of Field Crops. Marcel Dekker Inc., New York.

Stevenson, F.J. 1986. Cycles of Soil–Carbon, Nitrogen, Phosphorus, Sulphar and Micronutrients. John Wiley and Sons. New York.

Thompson, L.M. and F.R. Troch. 1978. Soils and Soil Fertility. McGraw Hill Inc. New York.

Tisdale, S., W.L. Nelson, J.D. Beaton and J.L. Havlin. 1997. Soil Fertility and Fertilizer. Prentice-Hall of India Private Ltd.

Tisdale, S.L., Nelson, W.L. and Beaton, J.D. 1990. Soil Fertility and Management. McMillan Pub.Co. New York.

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| **Course number** | **:** **CST-403** |
| **Course title** | **:** **Horticulture – IV (Theory)**  |
| **Number of credits** | **: 3** |
| **Total marks** | **: 100** |

**Rationale**

This course focuses on basic knowledge on different aspects of fruits including production technology, propagation practices, physiology and postharvest technology.

**Objectives**

* Provide knowledge on production technology of fruits and management of fruit orchards
* Describe different methods of plant propagation including micropropagation
* Explain the postharvest management strategies of different fruits

**Learning outcomes**

* Explain scope, importance, classification, distribution of fruits, and major fruit growing regions of the world
* Interpret physiological and anatomical aspects of vegetative propagation, stionic relationship and micropropagation
* Establish and manage fruit orchards and homestead gardens
* Describe techniques of producingdifferent fruit crops
* Illustrate physiology of flowering, fruit setting and fruit development
* Explain postharvest management strategies of fruits

**Course content**

###### Pomology and Plantation Crops

1. **Introduction to pomology:** Definition, nomenclature and classification of fruits on the basis of their edible portion.
2. **Geographical distribution of fruits:** Major fruit growing regions of the world, their climatic features and distribution of fruit plants.
3. **General aspects of fruit production in Bangladesh:** Scope, importance, area, production and regional distribution of the common fruits. Factors affecting the production and distribution of the major fruit plants. Application of plant growth regulators in improving production and quality of fruits.
4. **Propagation of fruit plants:** Methods of propagation, seedage, apomixes and polyembryony, cuttage, layerage, graftage & buddage; Stionic relationshiop and incompatibility in grafting, micropropagation, its principles and techniques.
5. **Fruit nursery management:** Definition, establishment and management of modern nursery, plant-propagating structures with short decription of greenhouse, lathhouse, nethouse, hotbed, cold frame and mist propagating unit, growing and propagating nursery plants; protection measures in them with related equipment.
6. **Establishment and management of fruit orchards and homestead gardens:** Site selection; land development and planting plans, fertilizing and manuring, controlling soil erosion in the orchard, irrigation and drainage, training & pruning, intercropping and other management practices.
7. **Fruit tree management practices:** Molecular mechanism of floral induction of fruit development and maturity; unfruitfulness of fruit trees; causes and remedies; use of growth regulators in fruit industry and methods of their application.
8. **Study of the following fruits:** Morphology, production, statistics, soil, climate, varieties, propagation, improvement management and harvesting; banana, pineapple, papaya, mango, jackfruit, litchi, guava, jujube, coconut, citrus fruits and some important minor and exotic fruits.
9. **Introduction to plantation crops:** Definition and nomenclature, importance, problems and scope of plantation crops in Bangladesh.
10. **Production, management and processing of plantation crops:** Tea, rubber, oil palm, coffee, cocoa, betel leaf, betel nut and bamboo.
11. **Post harvest handling of horticultural crops**: Sorting, grading, packing, transportation and marketing of horticultural crops.
12. **Shelf life of fruits**: Factors affecting shelf life of fruits, methods of extension of shelf life, spoilage: definition, causes of spoilage of fruits and its remedies, Disorder: physiological disorder.

**Teaching strategy**

* Lecture
* Group discussion
* Video clips

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Assignment

**Books recommended**

Adriance and Brison, 1955. Propagation of Horticultural Plants. McGraw Hill Book Company, New York.

Berrie, A.M.M. 1977. An Introduction to the Botany of Major Crop Plants Moyden & Sons Ltd. London.

Bose T.K. and S.K. Mitra. 1995. Fruits: Tropical and Subtropical. Naya Prokash, 206, Pidhan Sarani, Calcutta-6, India.

Bose T.K., S.K. Mitra and M.K. Sadhu. 1990. Propagation of tropical and subtropical horticultural crops, Naya Prokash, 206, Bidhan Sarani, Calcutta-6. India.

De, K.K. 1992. An Introduction to plant tissue culture, New Crntaral Book Agency, Calcutta.

Gardner, V.E., F.C. Bradford and M.D. Hooker 1952. Fundamentals of fruit Production, McGrraw Hill Book Company, New York.

Hartmann, H.T., D.E. Kester and F.T. Davies Jr. 1990 plant propagation principle and practices. Prentice-Hall, Iner, Editions.

Hayes, W.D. 1960 Fruit Growing in India, Kitabistan, Allahabad.

Naik, K.C. 1963. South Indian fruits and their culture, P. Varadachary & Co., 8. Longhi Chetty Street, Madras.

S. Prasad and U. Kumar.1999. Principles of Horticulture. Agrobotanica. 4E 176 Jn. Vyas Nagar, Bikaner, India.

Samson, J.A. 1980. Tropical Fruits. Longman, London & New York.

Singh: R.B. 1961. Fruits. National Book Trust, New Delhi.

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| **Course number** | **:** | **CST-404** |
| **Course title** | **:** | **Entomology – III (Theory)**  |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

This course provides knowledge on insect, ecology their biology, damage and appropriate control measures.

**Objectives**

* Impart knowledge on insect, ecology their nature of damage and control measures.
* Discuss insect transmission of plant pathogens.
* Describe rearing techniques of industrial insects and processing their products.

**Learning outcomes**

* Describe insect ecology, influence of environmental factors on insect population.
* Describe the characteristics, life cycle and nature of damage of major field crop pests, horticultural crop pests, forest pests and storage pests.
* Construct and design pest management strategy.
* Identify the insects carrying plant pathogen.
* Explain rearing techniques of industrial insects and address the processing problems.

**Course content**

#### Insect ecology: Influence of environmental factors on the insect population in agro-ecosystem, growth forms of insect populations. Survillance, forecasting and warning Systems in insect pest management.

#### Disease transmission: Disease and vectors; types and mechanisms of transmission of insect borne diseases in plants.

#### Economic entomology and vertebrate pests: Bioecology, nature of damage and control measures of major insect and mite pests of field crops (rice, jute, wheat, sugarcane, cotton, tobacco, mustard, soybean and groundnut) and forest plants. Bioecology, damage assessment and control of vertebrate pests laying emphasis on the rodents of field crops and in storage.

* 1. **Integrated Pest Management:** Definitions, Descriptions of different methods with their relative merits and demerits.
1. **Management tactics**: Plant resistance; components of resistance, mechanism of resistance, development of insect resistant varieties.
2. **Cultural control**: various types of mechanical control and their merits and demerits.
3. **Mechanical control**: various types of mechanical control and their merits and demerits.
4. **Physical control:** various types of mechanical control and their merits and demerits.
5. **Biological control**: Use of parasitoids and predators. Ecological back grounds.Advantages and disadvantages, procedures and techniques.
6. **Behavioral control**: Semiochemicals - pheromones and allelochemicals. Constraints of semiochemicals employment.
7. **Phytochemicals and natural dusts**: Botanical pesticides and nutural dusts (DE).
8. **Chemical control**: Use of synthetic and pesticides in pest management, classification, formulation, mode of action etc.

### 5. Industrial Entomology: Concept of apiculture, sericulture and lac culture; their classification and implement in Bangladesh.

**Teaching strategy**

* Lecture
* Video clips

**Assessment strategy**

* Written test
* Quiz test
* Assignment

**Books recommended**

Alam, M.Z. 1965. Modern insecticides and their uses. Agril. Intform. Serv., Publ., Dhaka.

Chishester, C.O.1965. Research in pesticides, Academic press, New York.

Dent, D.1991. Insect pest management. CAR International.

Evans, 1994. Advances in Insect physiology.Vol.25, Intercept Ltd. London.

Leach, J.G. Insect Transmission of Plant Diseases. McGraw Hill Book Co. Inc. New York.

Metcalf, R.L.1966-70. Advances in pest control research. Vols. 1, 2, 3, 4 and 5 Inter science

O-Brien, R.D. 1967. Insecticides action and Management. Academic Press. New York.

Patton, H.R.1963. Introductory insect physiology saunder phila.

Posamentier, H. adn A.V. Elsen. 1984. Rodent Pests- Their Biology and Control in Bangladesh. BARC Printers, Dhaka, Bangladesh.

Price, P.W. 1984. Insect Ecology (2nd Ed.), John Willy and Sons. New York.

publisher, New York and London.

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| **Course number** | **:** | **CST-405** |
| **Course title** | **:** | **Plant Pathology – III (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

This course is intended to impart knowledge of crop diseases and pathogen/disease cycle to plan strategy for adopting both preventive and curative measures against crop diseases.

**Objectives**

* Provide knowledge on the concept of diseases of fruits, vegetables, cash crops and agroforest trees and their management.
* Discuss about post harvest pathology and their management.

**Learning outcomes**

* Describe diseases of fruits, vegetables, cash crops and their management.
* Explain defense mechanism in plant.
* Discuss post harvest pathology.

**Course content**

1. **Diseases of fruits:** Mango, banana, papaya, coconut, pineaple, jackfruit, citrus and guava and their management.
2. **Diseases of vegetables:** Potato, tomato, sweet potato, cabbage, cauliflower, chilli, brinjal, lady's finger, amaranth, cucurbits & beans and their management.
3. **Diseases of cash crops:** Tobacco, tea, betelnut, betelvine, turmeric, ginger, onion & garlic and their management.
4. **Nursery diseases:** Diseases of agroforest trees. Root rots, dieback, wilts and cankers of important forest trees and their management.
5. **Introduction to Seed Pathology:** Importance of Seed‑borne diseases in Bangladesh, significance, mechanism of transmission of pathogens, seed health testing methods, parasites of seed‑borne diseases.
6. **Assessment of Crop loss owing to plant diseases:** Importance, methods of crop loss assessment, simulation of crop loss assessment through mathematical point model, critical point model and multiple point models.

**Teaching strategy**

* Lecture
* Demonstration
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Essay type question
* Assignment

**Books recommended**

Anderson, H. N. 1979. Diseases of fruit crop. McGraw Hill Book Co.

Ashrafuzzaman, M. H. 1976. 1st ed. Laboratory Manual of Plant Pathology. Department of Plant Pathology.

Barnett. H. L. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Company.

Boyce. J. S. 1961. Forest Pathology 3rd ed. McGraw Hill Book Co.

Chester, K. S. 1941. Nature and Prevention of plant diseases. Blakiston.

Fergus. C, L. 1966. Illustrated Genera of Wood Decay Fungi. Burgess Publishing Company.

Fulton .J. P., D. A. Slack. N. D. Fulton, J I. Dale. M. J.I. Eoodeand and G, F. Templeton. 1965, Plant pathology Laboratory Manual. Burgess Publishing Company.

Meah, M. B. and A. A. Khan. 1985. Check list of Fruit and Vegetable diseases in Bangladesh. Dept. of Plant Pathology, Bangladesh Agricultural University. Mymensingh.

Meah, M. B. and A. A. Khan. Mango diseases. Dept. of Plant Pathology. Bangladesh Agricultural University,

Pathak, V. N. 1986. Diseases or Fruit Crops. Published by Mohan Primlani, Oxford & IBH Publishing Co., Janpath, New Delhi 110001.

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| **Course number**  | **:**  | **CST-406** |
| **Course title**  | **:**  | **Genetics and Plant Breeding – III (Theory)** |
| **Number of credits**  | **:**  | **3** |
| **Total marks**  | **:**  | **100** |

**Rationale**

The course covers knowledge on principles and methods of genetics and plant breeding essential for crop improvement.

**Objectives**

* Discuss about objectives of plant breeding and plant genetics resources.
* Provide knowledge on principles, methods and tools for plant breeding
* Explain population structures and selection responses in plant breeding
* Describe the ideas on plant breeding approaches and strategies

**Learning outcomes**

* Explain the plant breeding principles.
* Assess pollination behavior of crop plants.
* Describe conservation and management of plant genetic resources.
* Construct and modify need-based breeding strategies.
* Describe breeding achievements of important crops.

**Course content**

1. **Introduction:** Concept and objectives of Plant Breeding**.**
2. **Plant genetic resources:** Types of PGR, centre of origin of cultivated crop plants, genetic erosion & genetic vulnerability, conserving PGR, land races.
3. **Plant introduction:** Definition, objectives, types, sources, procedure, advantages and disadvantages.
4. **Evolution of crop plants:**  Pattern of crop evolution, evolution of some major cultivated crop plants-wheat, rice*, brassica* & triticale.
5. **Plant breeding methods for self-pollinated crops:** Pedigree, single seed descent, bulk population and backcross methods.
6. **Plant breeding methods** **for cross‑pollinated crops:** Mass selection, back cross method, development of hybrid and synthetic varieties.
7. **Plant breeding methods** **for vegetative propagated crops**: characteristics of clone, differences among clone, pure line and inbred, procedure and merits and demerits of clonal selection.
8. **Mutation breeding**: Definition, Mutagentic agent. Generalised scheme for mutation breeding of polygenic and oligogenic traits, role of mutation breeding in crop improvement, factors influencing mutation spectrum.
9. **Polyploid breeding**: Introduction and use of auto and allo‑polyploids in crop improvement. Achievement of polyploidy.
10. **Genetic variation and recombination:** Concept, causes, importance of genetic variation. Concept and form of genetic recombination.
11. **Status of breeding achievements of important field crops in Bangladesh:** Rice, wheat, maize, jute, sugarcane, mustard, groundnut, soybean, lentil, chickpea and tomato.
12. **Ideotype breeding:** Concept, characteristic, ideotype of selected crops-rice, wheat, maize, barley, *Brassica sp*. Steps in ideotype breeding, traditional breeding vs ideotype breeding.
13. **Breeding for quality:** Concept of quality traits, important quality traits of rice, wheat, maize, cotton and tomato. Sources of quality traits, breeding approaches and breeding for nutritional quality.
14. **Breeding for drought resistance**: Concept, plant characters associated with drought resistance. Generalised scheme of breeding for drought resistance.
15. **Breeding for disease resistance:** Mechanism, nature, sources, genetic basis, breeding methods and achievement of disease resistance in plant, vertical resistance vs horizontal resistance.
16. **Breeding for heat resistance:** Concept, mechanism, selection criteria for heat resistance.
17. **Hybrid seed production:** Concept of inbred, hybrid, single cross, double cross, three ways cross, techniques of hybrid seed production, hybrid seed production technique of rice and maize.
18. **Wide hybridization:** Application in crop improvement, alien addition, alien substitution and transfer of segment of chromosomes, transfer of cytoplasm, prospects and limitations.
19. **Variety release:** Principles and practices relating to evaluation and release of new crop varieties.

**Teaching strategy**

* Lecture
* Video clips
* Discussion

**Assessment strategy**

* Written exam.
* Short and broad question
* Assignment
* Field trip report
* Group presentation

**Books recommended**

Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and Sons, Inc. New York.

Bhojwani, S. S. and Razdan. M. K. 1983. Plant Tissue Culture: Theory and Practice. Elsevier Science Pub. Amsterdam.

Bhuiya. M. S.R. 1999. Udvid Projanan. 2nd edn. Bangla Academy. Dhaka (In Bangla).

Chopra, V. L. 1989. Plant Breeding: Theory and Practices. Oxford and IBH Pub., New Delhi.

Chopra, V. L. and Nasirn. A. 1990. Genetic Engineering and Biotechnology. Oxford and IBH Pub. , New Delhi.

David . W. R. 1995. Pollination of Cultivatied Plants in the Tropics, FAO, Rome.

Falconer, D,S. and Mackay . T. F. C. 1996. Introduction to Quantitative Genetics. Longman Essex, UK,

Ferhr, W.R. and Hadley, II.II. 1980. Hybridization in crop plants. American Soc. Agron. & Crop Sci. Soc. America, Madison.

Gamborg, OL. and Phillips. GC 1995. Plant cell. tissue and organ culture, Fundamental methods. Narosa Pub. House, New Delhi.

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| **Course number** | **:** | **CST-407** |
| **Course title** | **:** | **Agricultural Extension – III (Theory)** |
| **Number of credits** | **:** | **3** |
| **Total marks** | **:** | **100** |

**Rationale**

 This course provides understanding of various aspects of extension programme planning organization monitoring and evaluation of extension education.

**Objectives**

● Conceptualize and describe various issues of extension organizations including their management and organizational decision making

● Describe the important aspects of extension programme planning, as well as monitoring and evaluation of extension programmes

● Explain extension programmes for special interest groups such as rural youth, rural women and landless farmers.

**Learning outcomes**

* Characterize different agricultural organizations and personnel involved in these.
* Illustrate the elements of management and associated problems and aspects of organizational decisions.
* Describe the basic concepts of extension organizations.
* Explain the important issues of an extension programme.
* Clarify basic concepts, importance and procedures of monitoring and evaluation in extension programmes.
* Describe suitable extension programmes for rural youth and rural women, their role in agriculture and extension programmes

**Course content**

1. **Extension Programme Planning:** Definition, types, principles and steps in extension programme planning, characteristics of a good programme. Definition of plan of work and calendar of work. Partnership programme in extension, different types of partnership programmes.
2. **Monitoring and Evaluation:** Meaning, definition, purpose and importance of monitoring and evaluation, types of evaluation, principles, steps of evaluation, contribution of evaluation to programme building, comparison between monitoring and evaluation.
3. **Extension organization:** Concept of organization and extension organization, objectives and features of extension organization, categories of personnel in extension organization, qualification and duties of extension administrator, specialists, supervisor and field workers. Basic concept of Non Government Organization and its types.Advantages and disadvantages of NGO.
4. **Management function of organization:** Concept of management, function, elements of management, management problems of an organization, concept of human resource development of an organization and its objectives, training and types of training, concept of decision-making, steps in decision-making, factors affecting decision-making, constraints in decision making in an extension organization.
5. **Sustainable agricultural development:** Concept, criteria and elements of sustainability in agriculture, managing and practicing towards environment friendly and sustainable agricultural development-Indigenous Technical Knowledge (ITK), Integrated Pest Management (IPM), Organic Farming (OM) and Integrated Crop Management (ICM).
6. **Technology transfer in agriculture and poverty alleviation:** Concept and featureof a technology, technology transfer process in Bangladesh, technology transfer model, constraints in technology transfer. Roles of BARC in technology transfer.
7. **Participatory approaches of agriculture and rural development:** Concept of participation, participatory technology development (PTD), Concept and characteristics of Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA).

**Teaching strategy**

● Lecture

● Discussion

● Self study

**Assessment strategy**

● Short questions

● Essay questions

● Assignment

**Books recommend**

Beal, G.M., Bholem, J.M.and Raudabaugh, J.N.1962. Leadershipo and Dynamic Group Action.Iowa State University Press.

Berlo, D.K.1960. The Process of Communication.New York: Holt, Rinehart and Winston Inc.

Bernard, H.W.1975. Psychology of Learning and Teaching.McMillan Hill Books Co.N.Y.

Delhi.

Kashem, M.A. 1992. Samprasaron Biggan.Dhaka: The Bangladesh Packing Press.

Kreitlow, B.W., Aiton, E.W.and Lorrenes A.I. 1966. Leadership of Action in Rural Communities.Dauville, Illinois.The Interstate Printers and Pub.Inc.

McQuail, D.and Windahl, S 1981. Communication Models for the Study of Mass Communication. London: Longman.

Sandhu, A.S.1993. Textbook on Agricultural Communication: Process and Methods.Kolkata: Oxford & IBH Publishing Co.PVT.LTD.

Singh, R, 1987. A Text of Extension Education.Sahityakala Prakashan, Ludhiana, India.

Supe, S.V.1983. An Introduction to Extension Education.Oxford and IBH Pub.Co.Pvt.Ltd.New

Swanson, B.E.R.P.Bentz and A.J.Sofranko (1997). Improving Agricultural Extension: A Reference Manual.Rome: FAO of the United Nations.

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| **Course number** **Course title** **Number of credits** **Total marks** | **:****:****:****:**  | **CST-408****Agro forestry (Theory)** **3****100** |

**Rationale**

This course covers the areas of agroforestry technologies for sustainable farm production, combating the adverse climatic situations and conserving natural resources.

**Objectives**

* Acquaint students with the concepts, components and attributes of agroforestry.
* Distinguish conventional forestry, social forestry and agroforestry.
* Understand the integrated production systems with multiple components.
* Realize the significant role of trees towards soil and water conservation.
* Analyze cost-benefit and economic aspects of different agroforestry systems.
* Develop skills to design appropriate agroforestry model for rural development and nature conservation.

**Learning outcomes**

* Explain agroforestry, forestry and social forestry with their characteristics, benefits and attributes.
* Categorize agroforestry practices; suggest appropriate agroforestry practices for different land types with suitable MPTS.
* Demonstrate tree management techniques
* Determine tree-crop interaction effect and Land Equivalent Ratio (LER)
* Design agroforestry practices for erosion control and reclaiming degraded soil
* Analyze marketing channel and cost-benefit of agroforest products

**Course content**

**Fundamentals of Agroforestry**

1. **Agroforestry:** Concept, characteristics, components, history, historical development in Bangladesh, advantages and limitations, scope and traditional agroforestry systems practiced in Bangladesh and their economic and social aspects
2. **Classification:** Agroforestry systems and practices.
3. **Bangladesh forest:** Introduction, definition of forest, conventional forestry and forest community, forest types of Bangladesh and their characteristics, locations and selected species and contribution to national economy.
4. **Social forestry:** Concept, types, progress, prospects in Bangladesh, people’s participation, criticism, and constraints of social forestry.
5. **Choice of species in agroforestry systems:** Factors affecting species selection; concept of multipurpose trees (MPTs); role of multipurpose trees and shrubs in agroforestry development; limitations in the uses of multipurpose trees and shrubs; management of multipurpose trees.
6. **Species compatibility:** Species compatibility in different agro-ecological zones with special reference to salinity, drought, marshy and degraded lands.
7. **Tree-crop interactions in agroforestry land use systems:** Introduction to tree-crop interactions, types of interactions, environment and tree-crop interaction, methods of quantification of tree-crop interactions, resource sharing, comparison among the ideal agroforestry, common forestry and agricultural systems.
8. **Homestead agroforestry:** Concept, characteristics, classifications, structures, principles, planning & layout, planning of homestead. Benefits, role and scope of homestead agroforestry.
9. **Farmland agroforestry:** Principles, practices, classifications, planning, layout and management.

**Teaching strategy**

* Lecture
* Video clip
* Assignment
* Field visit

**Assessment strategy**

* Short question
* MCQ
* Essay
* Project

**Books recommended**

Alam, M.K. and M.Mohiuddin 1992: Some Potential Multipurpose Trees for Homesteads in Bangladesh. BARC Winrock International.

Bhuiya, M.S.U., M.N. Bari, F. Ahmed, and G.M. Miah. 2000. Krishi Banyan.111, Irina Press, Fakirapul, Dhaka, P.A. to controller, BAU, Mymensingh.

Bhuiyan, A.A. 1994: Forest Land Agroforestry: The North Bengal Experience. BARC Winrok International.

Chowdhury, M.K and Tej B.S Mahat 1993 (ed).Agroforestry Farming System linkages in Bangladesh.BARC-Winrock International.

Chowdhury, R.A., A.A. Bhuiyan and S.K. Bose. 1994. Agroforestry for the Degrade Sal Forest. Asia Pacific Agrotorestry Net work.

CHTDB.1996.Cultivation in Hill by SALT Methods.Chittagong Hill Tract Development Board, Khagrashari,

Chundawat, B.S. and S.K.Gautam.1999.A Text Book of Agroforestry.Oxford & IBH publishing co.Pvt.Ltd., New Delhi.

**B. Sc. Ag. (Hons.) Part – 4**

**PRACTICAL COURSES**

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| **Course number** | **:** | **CST-409** |
| **Course title** | **:** | **Agronomy – IV (Practical)** |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course covers practical aspects of crop production, farm management and field experimentation and report writing.

**Objectives**

* Demonstrate experimental work and project report writing.
* Explain layout of an agricultural farm and farm records
* Demonstrate crop cutting experiment and crop reporting
* Explain the land use systems and crop statistics of Bangladesh
* Acquaint students with the economics of crop production

**Learning outcomes**

* Conduct experimental work and write project report.
* Layout an agricultural farm and maintain farm records
* Perform crop cutting experiment and crop reporting
* Illustrate the land use systems and crop statistics of Bangladesh
* Compute the production cost and benefit of crop cultivation

**Course content**

1. **Project paper:** Conduction of a simple experiment to study the effect of agronomic practices on crop production and to prepare a report on the same.
2. Conduction of a crop cutting experiment.
3. Practicing different methods of planting sugarcane
4. Raising a forage crop in individual plot.
5. Irrigation scheduling for a crop.
6. Raising a green manure crop and its incorporation in the soil.
7. Raising a crop and studying its different growth phases and stages.
8. Growing intercrops and evaluation of their performance.
9. Study on the nodulation in different legumes, pulses, ground nut, sunhemp, *dhaincha* from pot culture
10. Computation of production cost of different agronomic crops.

### Teaching strategy

* Lecture
* Practice
* Demonstration

## Assessment strategy

* Written test
* Quiz
* Assignment
* Field visit
* Presentation

**Books recommended**

Arakeri. H.R. and Donahue, R. 1988. Conservation and Water Management Oxfordand IBH Pub. Co. Pvt. Ltd Calcutta, Bombay and New Delhi. India.

Beets, C.W. 1983. Multiple Cropping and Tropical Farming Systems. Westview Press.

Chatterjee, B.N.; Mati. S. and Mandal. B.N. 1989. Cropping systems‑ Theory and Practice (2nd Ed.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Francis. C. A. 1986. Multiple Cropping System. Macmillan Publishing Co. New York.

Hossain, S.M.A. 1988. Agricultural and Rural Development in Bangladesh‑ Evolution of Cropping Systems in Mymensingh and Comilla Regions. JSARD Pub. No. 12. Japan International Cooperation Agency, Dhaka, Bangladesh.

Kipps, M.S. 1978. Production of Field Crops. 6th Edition. Tata McGraw‑Hill Publishing Company Ltd. New Delhi, India.

Martin, J.H.; Leonard, W.H. and Stamp, D.L. 1976. Principles of Field Crop Production. 3rd Edn, McMillan Pub., New York.

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| **Course number**  | **:** | **CST-410** |
| **Course title**  | **:** | **Soil Science – IV (Practical)**  |
| **Number of credits**  | **:** | **2** |
| **Total marks**  | **:** | **50** |

**Rationale**

The course covers practical aspects of soil fertility assessment, fertilizer recommendation and test of nutrient.

**Objectives**

* Describe different standard laboratory methods of soil analysis
* Determine nutrient concentration in soil and plant samples
* Isolate and characterize N2-fixing microorganisms
* Prepararation and use of biofertilizers

**Learning outcomes**

* Perform rapid assessment of nutrients in soil
* Estimate urea demand for crop production
* Quantify TSP demand for crop production
* Determination of MoP and Gypsum demand for crop production
* Design biofertilizer production technology

**Course content**

1. Problems and calculation about different fertilizers.
2. Rapid test of NPK in soil and plant samples using kits.
3. Determination of total N in soil and plant samples by Kjeldahl method.
4. Determination of available P by Olsen method.
5. Determination of exchangeable K in soil by ammonium acetate method.
6. Determination of available S by calcium chloride extraction method.
7. Determination of zinc in soil by HCl extraction method.
8. Determination of available soil B by hot water method.
9. Effect of chemical, organic and/or bio-fertilizers on growth and yield of (selected) crop (field /pot experiment).
10. Studying root growth of different crops under varied soil conditions.
11. Methods and production of compost and vermicompost.

**Teaching strategy**

* Lecture
* Tutorial
* Self-study/e-learning

**Assessment strategy**

* MCQ
* Short questions
* Essay type questions
* Assignment

**Books recommended**

Alexander, M., 1977. Introduction to Soil Microbiology. John Willy and Sons, New York.

Brady, N.C. 1990. The Nature and Properties of Soil. McMillan Pub. Co. New York.

Donahue, R.L., R.W. Miller & J.C. Shickluna. 1983. Soil An Introduction to Soil and Plant Growth. Prentice-Hall Inc. New Jersey.

Fertilizer Recommendation Guide-1997. Bangladesh Agricultural Research Council.

Jackson, M.L. 1965. Soil Chemical Analysis. Prentice Hall. Inc. New York.

Meugel, K. and E.A. Kirkov. 1987. Principles of Plant Nutrition. Inst. Potash Inst. Pub. Switzerland.

Miller, R.W. and R.L. Donhue. 1992. Soils–An Introduction to Soils and Plant Growth. Prentice - Hall Pvt. Ltd., New Delhi.

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| **Course number** | : **CST-411** |
| **Course title** | : **Horticulture – IV (Practical)** |
| **Number of credits** | : **2** |
| **Total marks** | : **50** |

**Rationale**

This course deals with different practical aspects of fruit production including planting systems, propagation practices, cost of production and determination of quality of fruits.

**Objectives**

* Discuss the important fruit plants of Bangladesh
* Illustrate designing different orchard plans
* Demonstrate different methods of plant propagation
* Demonstrate hands-on practice techniques of assessing fruit quality

**Learning outcomes**

* Identify the common fruit plants of Bangladesh
* Sketch diagram of morphological features of important fruit plants
* Prepare layout of different planting plans for orchards
* Practice planting, fertilizing, training, pruning and other cultural operations of orchards.
* Apply different vegetative propagation methods of common fruit plants of Bangladesh

**Course content**

1. Field visit for identification of common fruits and plantation crops in different areas of Bangladesh and preparation of album.
2. Morphological features of important fruit plants.
3. Preparation of different planting plans for orchards.
4. Practices on layout, planting, manuring, fertilizing and other cultural operations of orchards.
5. Practices on common nursery techniques including preparation of nursery bed, raising of fruit saplings in the nursery bed and pots. Accelerating seed germination preparation and application of starter and hormone solutions.
6. Practicing vegetative propagation methods of common fruit plants of Bangladesh.
7. Pruning and training practices of different important fruit plants.
8. Costing exercises on mango, papaya, banana, pineapple and baukul.
9. Performance records of some selected fruit tree.
10. Visiting important of major fruit growing region in Bangladesh.

######  Market evaluation and observation of some selected fruit commonly produced in Bangladesh.

**Teaching strategy**

* Lecture
* Group discussion
* Video clip

**Assessment strategy**

* Short question
* Essay type question
* MCQ
* Assignment

**Books recommended**

Adriance and Brison, 1955. Propagation of Horticultural Plants. McGraw Hill Book Company, New York.

Berrie, A.M.M. 1977. An Introduction to the Botany of Major Crop Plants Moyden & Sons Ltd. London.

Bose T.K. and S.K. Mitra. 1995. Fruits: Tropical and Subtropical. Naya Prokash, 206, Pidhan Sarani, Calcutta-6, India.

Bose T.K., S.K. Mitra and M.K. Sadhu. 1990. Propagation of tropical and subtropical horticultural crops, Naya Prokash, 206, Bidhan Sarani, Calcutta-6. India.

De, K.K. 1992. An Introduction to plant tissue culture, New Crntaral Book Agency, Calcutta.

Gardner, V.E., F.C. Bradford and M.D. Hooker 1952. Fundamentals of fruit Production, McGrraw Hill Book Company, New York.

Hartmann, H.T., D.E. Kester and F.T. Davies Jr. 1990 plant propagation principle and practices. Prentice-Hall, Iner, Editions.

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| **Course number** | **:** | **CST-412** |
| **Course title** | **:** | **Entomology – III (Practical)**  |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course is designed to demonstrate techniques and procedures of pest diagnoses of major crops and loss assessment.

**Objectives**

* Demonstrate major pests of field crops.
* Identify insect canying disease organisms.
* Study on commonly used pesticides in Bangladesh.
* Discuss crop loss assessment.
* Describe the rearing technique of industrial insets.
* Discuss precautionary measures of pesticide application.

**Learning outcomes**

* Identification of insects carrying disease organism of major crops in Bangladesh.
* Discuss methods of crop-loss assessment in pest infested fields and estimation of economic threshold level.
* Demonstrate rearing techniques of industrial insects.
* Compute commonly used pesticides in Bangladesh.
* Develop IPM model.

**Course content**

1. **Pesticides:** Study of commonly used pesticides for controlling insects, mites and rodents. Precautionary measures to be taken during handling and using pesticides.
2. **Economic Entomology:** Survey of the major pests of rice, wheat, sugarcane, jute, cotton, vegetables, fruit, stored grain and preparation of a report indicating their nature of damage and recommended control measures.
3. Development of a programme of integrated pest management (IPM) for any one of these major crops.
4. Identification of insects carrying disease organism of major crops in Bangladesh.
5. Methods of crop-loss assessment in pest infested fields and estimation of economic threshold level.
6. Rearing techniques of industrial insects.
7. Visit to important places having impact of apiculture, sericulture and lac culture.
8. Identification of beneficial insect and mites.

**Teaching strategy**

* Lecture
* Reading assignment
* Video clips

**Assessment strategy**

* Test
* Assignment
* Group presentation

**Books recommended**

Alam, M.Z. 1965. Modern insecticides and their uses. Agril. Intform. Serv., Publ., Dhaka.

Chishester, C.O.1965. Research in pesticides, Academic press, New York.

Dent, D.1991. Insect pest management. CAR International.

Evans, 1994. Advances in Insect physiology.Vol.25, Intercept Ltd. London.

Leach, J.G. Insect Transmission of Plant Diseases. McGraw Hill Book Co. Inc. New York.

Metcalf, R.L.1966-70. Advances in pest control research. Vols. 1, 2, 3, 4 and 5 Inter science

O-Brien, R.D. 1967. Insecticides action and Management. Academic Press. New York.

Patton, H.R.1963. Introductory insect physiology saunder phila.

Posamentier, H. adn A.V. Elsen. 1984. Rodent Pests- Their Biology and Control in Bangladesh. BARC Printers, Dhaka, Bangladesh.

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| **Course number** | **:** | **CST-413** |
| **Course title** | **:** | **Plant Pathology – III (Practical)** |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

The course is designed to demonstrate techniques and procedure of disease diagnosis and issuing prescription for the farmers.

**Objectives**

* Demonstrate different clinical equipment and microscopic examination of diseased specimen.
* Demonstrate isolation and identification of disease causing organisms
* Explain writing prescription.

**Learning outcomes**

* Handle different clinical equipment.
* Enlist diseased specimen.
* Identify plant diseases with their respective causal organisms.
* Suggest remedy of plant diseases.
* Prepare pictorial archives of plant diseases.

**Course content**

1. Methods of collection and preservation of diseased plant‑materials.
2. Preparation of herbarium of diseased specimen of important crops.
3. Field and Laboratory studies of plant diseases.

**(a)** Detailed study of the following diseases:

1. Late blight and early blight of potato and tomato.
2. Anthracnose of chilli, okra, guava and amaranth.
3. Fruit rot of chilli, alternaria leaf spot of cabbage.
4. Alternaria leaf spot and stemphylium blight of onion.
5. Powdery and downy mildew of cucurbits.
6. Rhizopus fruit rot of jackfruit and kul.
7. Brown spot and frogeye leaf spot of tobacco.
8. Antracnose and taphrina leaf spot of turmeric.
9. Antracnose and leaf spot of betelvine.

**(b)** Brief study of the following diseases:

1. Dry rot, hollow heart, black heart and scab of potato.
2. Yellow vein mosaic of okra little leaf and fruit rot of brinjal.
3. Anthracnose, stem end rot and malformation of mango.
4. Bud rot and leaf spot of coconut
5. Leaf spot, wilt, bunchytop,
6. Anthracnose and fruit rot of banana.
7. Anthracnose, stem end rot and mosaic of papaya.
8. Wilt of guava
9. Scab, canker, die back and greening of lemon.
10. Tobacco mosaic.
11. Blister blight and grey blight of tea.
12. Foot rot and leaf rot of betelvine.
13. Phanerogamic parasites (*Cuscuta, Loranthus* and *Orobanche*).
14. Damping‑off and seedling blight.
15. **Seed health testing:** Dry inspection, incubation methods (Blotter and agar plate methods) and growing on test.
16. **Chemical control**
	1. Handling of plant protection equipments.
	2. Preparation and application of foliar fungicides. calculation of its concentration, percentage of active ingredients, and rates of application.
	3. Students in groups are required to conduct a spray experiment with foliar fungicides for controlling specific foliar diseases of a crop.
	4. Seed and soil treatment.
	5. Prescription for control of some important diseases.
		1. **Field excursion for plant disease study:** Each student is required to submit a comprehensive report on the prepared herbarium, spray experiment and field excursion.

**Teaching strategy**

* Lecture
* Demonstration and practice
* Group discussion

**Assessment strategy**

* MCQ
* Short question
* Practical job
* Assignment

**Books recommended**

Anderson, H. N. 1979. Diseases of fruit crop. McGraw Hill Book Co.

Ashrafuzzaman, M. H. 1976. 1st ed. Laboratory Manual of Plant Pathology. Department of Plant Pathology.

Barnett. H. L. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Company.

Boyce. J. S. 1961. Forest Pathology 3rd ed. McGraw Hill Book Co.

Chester, K. S. 1941. Nature and Prevention of plant diseases. Blakiston.

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| **Course number**  | **:**  | **CST-414** |
| **Course title**  | **:**  | **Genetics and**  **Plant Breeding – III (Practical)**  |
| **Number of credits**  | **:**  | **2** |
| **Total marks**  | **:**  | **50** |

**Rationale**

The course provides practical knowledge on special plant breeding approaches and techniques to enhance varietal improvement of crops.

**Objectives**

* Demonstrate special breeding approaches to solve field oriented problems
* Explain advanced breeding approaches for inbred line development and hybrid seed production
* Describe wide hybridization techniques to improve yield and nutritional quality

**Learning outcomes**

* Identify, maintain and use different breeding materials
* Develop haploids, double haploids for enhancing breeding cycles
* Demonstrate hybridization method with distance species
* Utilize polyploids in appropriate breeding to improve crop yield
* Assess parental lines, identify suitable parents, their maintenance for hybrid seed production
* Explain breeding programs of National Research Institutions of the Country

**Course content**

1. Hybridization techniques: Floral biology, pollination system and crossing techniques in crop plants, such as rice, wheat, maize, tomato, beans, peas, groundnut, mustard and jute.
2. Preparation of culture media, sterilization techniques and handling of equipment related to in vitro culture and demonstration of embryo culture.
3. Demonstration of field experiments:

a) Demonstration of parental, hybrid and segregating populations and data collection,

b) Demonstration of breeding research activities in experimental farm.

1. Statistical analysis of plant breeding and genetic experiments:

a) Data analysis for variety testing and other experiments using c RBC design-anova, test of significant and mean separation.

b) Plant characters association-correlation and regression analysis

c) Estimation of heritability and no. of genes controlling quantitative characters.

1. Demonstration of mutant, polyploids and hybrids in research fields
2. Interspecific hybridization
3. Study on flow chart representing various breeding methods
4. Evaluation and maintenance of parental lines in hybrid seed production
5. Visit to different crop breeding stations and reporting.

**Teaching strategy**

* Lectures
* Field visit
* Lab works

**Assessment strategy**

* Written test
* Field visit reports
* Assignments
* Group presentation

**Books recommended**

Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and Sons, Inc. New York.

Bhojwani, S. S. and Razdan. M. K. 1983. Plant Tissue Culture: Theory and Practice. Elsevier Science Pub. Amsterdam.

Bhuiya. M. S.R. 1999. Udvid Projanan. 2nd edn. Bangla Academy. Dhaka (In Bangla).

Chopra, V. L. 1989. Plant Breeding: Theory and Practices. Oxford and IBH Pub., New Delhi.

Chopra, V. L. and Nasirn. A. 1990. Genetic Engineering and Biotechnology. Oxford and IBH Pub. , New Delhi.

David . W. R. 1995. Pollination of Cultivatied Plants in the Tropics, FAO, Rome.

Falconer, D,S. and Mackay . T. F. C. 1996. Introduction to Quantitative Genetics. Longman Essex, UK.

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| **Course number** | **:** | **CST-415** |
| **Course title** | **:** | **Agricultural Extension – III (Practical)** |
| **Number of credits** | **:** | **2** |
| **Total marks** | **:** | **50** |

**Rationale**

This course is designed to make students familiar with community-based organizations

**Objectives**

To conceptualize the practical experiences about the management of community-based organizations in Bangladesh

**Learning outcomes**

* Get exposure from different community -based organizations

**Course content**

1. Methods and procedure of office management.
2. Preparation of a logical framework for an extension programme.
3. Preparation of an extension programme on agricultural development and socio-economic condition in Bangladesh.
4. Writing on qat least two community based organizations- one from GO and other from NGO, Term papers.

**Teaching strategy**

* + Visit
	+ Study tour
	+ Case study
	+ Group Presentation

**Assessment strategy**

* Test and
* Report submission
* Group Presentation

**Books recommended**

Beal, G.M., Bholem, J.M.and Raudabaugh, J.N.1962. Leadershipo and Dynamic Group Action.Iowa State University Press.

Berlo, D.K.1960. The Process of Communication.New York: Holt, Rinehart and Winston Inc.

Bernard, H.W.1975. Psychology of Learning and Teaching.McMillan Hill Books Co.N.Y.

Delhi.

Kashem, M.A. 1992. Samprasaron Biggan.Dhaka: The Bangladesh Packing Press.

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| **Course number** **Course title** **Number of credits** **Total marks** | **:****:****:****:**  | **CST-416****Agro forestry (Practical)** **2****50** |

**Rationale**

The course is designed to cover the aspects of agroforestry components, land-use systems and characterize socioeconomic conditions related to sustainable agroforestry models.

**Objectives**

* Identify and describe common Multipurpose Trees and Shrubs (MPTS) used in Agroforestry in the tropics and subtropics.
* Demonstrate above and below ground tree-crop interactions.
* Design an ideal agroforestry nursery and seedlings/saplings growing techniques.
* Determine and analyze the growth and biomass yield of trees.
* Assess and interpret land use problems and socioeconomic conditions when designing different agroforestry practices.

**Learning outcomes**

* Identify multipurpose trees and shrubs (MPTS) in different categories, their diversified uses and mode of propagation.
* Describe the possible tree-crop interactions and their effect measurement in integrated farming system
* Design and calculate the required material for an ideal forest nursery to raise tree seedlings/saplings.
* Describe tree management techniques for maximizing the farm productivity.
* Determine tree growth and calculate its tentative timber volume and price.
* Develop agroforestry model for the different land category.
* Categorize conventional forestry, agroforestry and social forestry activities

**Course content**

1. Identification of multipurpose trees species and their seeds.
2. Study of silvans feature of multipurpose tree species commonly used in Bangladesh.
3. Study on the development of live fences.
4. Preparation and establishment of a forest nursery for raising samplings and studing of different trees species.
5. Preparation and establishment of a poly-bag nursery and methods of planting of a sapling raised in poly-bag nursery.
6. Study of tree shoots and roots management and incising of curve stem in crop field.
7. Study of root spread and root mass of trees in crop field and homestead
8. Determination of growth and biomass yields of tree crops.

**Teaching strategy**

* Lecture
* Field visit
* Demonstration
* Video clip

**Assessment strategy**

* Identification
* Observation
* MCQ
* Assignment
* Experiment

**Books recommended**

Alam, M.K. and M.Mohiuddin 1992: Some Potential Multipurpose Trees for Homesteads in Bangladesh. BARC Winrock International.

Bhuiya, M.S.U., M.N. Bari, F. Ahmed, and G.M. Miah. 2000. Krishi Banyan.111, Irina Press, Fakirapul, Dhaka, P.A. to controller, BAU, Mymensingh.

Bhuiyan, A.A. 1994: Forest Land Agroforestry: The North Bengal Experience. BARC Winrok International.

Chowdhury, M.K and Tej B.S Mahat 1993 (ed).Agroforestry Farming System linkages in Bangladesh.BARC-Winrock International.

Chowdhury, R.A., A.A. Bhuiyan and S.K. Bose. 1994. Agroforestry for the Degrade Sal Forest. Asia Pacific Agrotorestry Net work.

**The End**