COURSE STRUCTURE AND SYLLABI
B.Sc. (Agriculture)
(1st year)—2013-14
# Syllabus for B.Sc. (Agriculture)

**School of Agriculture Science, CUTM**

## SEMESTER – I

<table>
<thead>
<tr>
<th>COURSE TITLE</th>
<th>CREDIT HOURS</th>
<th>COURSE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Agriculture</td>
<td>1+0+0</td>
<td>BGAG1101</td>
</tr>
<tr>
<td>Principles of Agronomy</td>
<td>2+1+0</td>
<td>BGAG1102</td>
</tr>
<tr>
<td>Principles of Genetics</td>
<td>2+1+0</td>
<td>BGPG1101</td>
</tr>
<tr>
<td>Introduction to Soil Science</td>
<td>2+1+0</td>
<td>BGAC1101</td>
</tr>
<tr>
<td>Production Technology of Vegetables</td>
<td>2+1+0</td>
<td>BGHO1101</td>
</tr>
<tr>
<td>Fundamentals of Microbiology</td>
<td>1+1+0</td>
<td>BGPP1101</td>
</tr>
<tr>
<td>Statistics</td>
<td>1+0+1</td>
<td>BGAS1101</td>
</tr>
<tr>
<td>Fundamentals of Soil, Water and Conservation Engineering</td>
<td>2+1+0</td>
<td>BGAE1101</td>
</tr>
<tr>
<td>Insect Morphology and Systematic</td>
<td>2+1+0</td>
<td>BGEN1101</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>15+7+1 = 23</strong></td>
<td></td>
</tr>
</tbody>
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Physical Education – PE – 111 /NCC – 111 / NSS – 111 (Non – Credit) 1(0+1)

Pre – requisite – Mathematics (Non – Credit) BM – 111 (A) 3 (2+1)

Botany (Non – Credit) BB – 111 (A) 3 (2+1)
## SEMESTER – II

<table>
<thead>
<tr>
<th>COURSE TITLE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>L-P-T</td>
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</tr>
<tr>
<td>Water Management</td>
<td>2+1+0</td>
<td>BGAG1204</td>
</tr>
<tr>
<td>Agricultural Meteorology</td>
<td>1+1+0</td>
<td>BGAG1203</td>
</tr>
<tr>
<td>Principles of Plant Breeding</td>
<td>2+1+0</td>
<td>BGPG1202</td>
</tr>
<tr>
<td>Agricultural Microbiology</td>
<td>1+1+0</td>
<td>BGAC1202</td>
</tr>
<tr>
<td>Introductory Nematology</td>
<td>1+1+0</td>
<td>BGNE1201</td>
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<tr>
<td>Crop Physiology – I</td>
<td>1+1+0</td>
<td>BGPH1201</td>
</tr>
<tr>
<td>Principles of Agricultural Economics</td>
<td>2+0+0</td>
<td>BGEC1201</td>
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<tr>
<td>Dimensions of Agricultural Extension</td>
<td>1+1+0</td>
<td>BGEE1201</td>
</tr>
<tr>
<td>Introduction to Computer Application</td>
<td>1+1+0</td>
<td>BGAS1202</td>
</tr>
<tr>
<td>Farm Power &amp; Machinery</td>
<td>1+1+0</td>
<td>BGAE1202</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>13+9+0 = 22</td>
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</tr>
</tbody>
</table>

Comprehension & Communication skills in English (Non – credit) SE – 121 2 (1+1)
Pre requisite – Mathematics (Non – credit) BM – 122 (A) 3 (2+1)
Zoology (Non – credit) BZ – 121 (A) 3 (2+1)
SEMESTER – I

1. Introductory Agriculture [BGAG 1101] 1(1+0+0)

Theory: Art, Science and business of crop production. Factors affecting crop production. Brief history of agricultural development:- Chronological Agricultural Technology development in India. Indian Agriculture, Agricultural growth, Balance sheet (DATA). Diversity in Physiography, Soil groups, Marine, Livestock and Water. Dry land agriculture; Farming Systems approach; value addition requirements in new technology; Women in Agriculture: multifaceted roles and tasks, work stress factors, Nutritional and rural life standards, role in house hold design making, drudgery reduction for farm women, women friendly agricultural technology. Empowerment of women; Group dynamics for farm women and rural women- the nucleus of agricultural extension and training.

Reference Book:
2. Rainfed Agriculture in India:Research and development Scenario. J. Venkataswarelu
3. Concise History of Science in India, Agriculture - S.P. Rayachaudhury, D.M. Bose, S.N. Sen and B.V.A. Subbarayappa
4. Women in Agriculture – B. Wasnik

2. Principles of Agronomy [BGAG 1102] 3(2+1+0)


Practical: Identification of field crops and under utilized crops and their growth stages; Study of tillage implements; Practice of ploughing; Practice of puddling; Study of seeding equipments; Different methods of sowing; Study of manures, fertilizers and green manure crops / seeds (including calculations); Study of inter-cultivation implements and practice; Practice of methods of fertilizer application; Preparation of fertilizers mixture and spray solutions; Compost making; Participation in ongoing field operations.

Reference Book:
5. Soil Conditions and Plant Growth –E.W.Russeland E.J. Russell

3. Principles of Genetics [BGPG 1101] 3(2+1+0)

Theory: Mendel’s laws of inheritance and exceptions to the laws; Types of gene action, Multiple alleles, Pleiotropism, Penetrance and expressivity; Quantitative traits, Qualitative
traits and differences between them; Multiple factor hypothesis; Cytoplasmic inheritance, it’s characteristic features and difference between chromosomal and cytoplasmic inheritance; Mutation and it’s characteristic features; Methods of inducing mutations and C / B technique; molecular basis of gene mutation; Mechanisms of sex determination; Gene expression and differential gene activation; operon concept and Fine structure of Gene; DNA and it’s structure, function, types, modes of replication and repair; RNA and its structure, function and types; Transcription, Translation, Genetic code and outline of protein synthesis; Crossing over and factors affecting it; Mechanism of crossing over and Cytological proof of crossing over; Linkage, Types of linkage and estimation of linkage; Hardy-Weinberg equilibrium; Changes in gene and genotype frequencies; Genetic disorders and gene therapy.

**Practical:** Gametogenesis and fertilization; Monohybrid ratio and its modifications; Dihybrid ratio and its modifications; Trihybrid ratio; Chi-square analysis and Interaction of factors; Epistatic factors, Supplementary factors and Duplicate factors; Complementary factors, Additive factors and Inhibitory factors; Blood grouping and PTC test in human; Linkage – Two point test cross; Linkage – Three point test cross; gene order and genetic map.

**Reference Book:**
1. Genes - B. Lewin
2. Fundamentals of Genetics -B. D. Singh
3. Genetics - M. W. Strickberger
5. Principles of Genetics - E. J.Gardner, M. J.Simmons and D. P. Snustad

**4. Introduction to Soil Science [BGAC 1101] 3(2+1+0)**

**Theory:** Soil: Pedological and edaphological concepts, Origin of the earth, Earth’s crust: Composition: Rocks and minerals, Weathering, soil formation factors and processes, components of soils, Soil profile, soil physical properties, soil texture, textural classes, particle size analysis, soil structure, classification, soil aggregates, significance, soil consistency, soil crusting, Bulk density and particle density of soils & porosity, their significance and manipulation, soil compaction, soil colour, elementary knowledge of soil classification and soils of India; soil water, Retention and potentials, soil moisture constants, movement of soil water, Infiltration, Percolation, Permeability, Drainage, Methods of determination of soil moisture. Thermal properties of soil, soil temperature, Soil air, Gaseous exchange, influence of soil temperature and air on plant growth; Soil colloids, properties, Nature, Types & significance; Layer silicate clays, their genesis and sources of charges, adsorption of ions, ion exchange, CEC and AEC ,factors influencing ion exchange and its significance. Soil organic matter, composition, decomposability, Humus, Fractionation of organic matter, carbon cycle, C:N ratio, Soil biology, Biomass, Soil Organisms & their beneficial & harmful roles.

**Practical:** Determination of Bulk density & Particle density, Aggregate analysis, Soil strength, soil moisture determination, Soil moisture constants-Field capacity, Infiltration rate, Water holding capacity, Soil Texture & Mechanical analysis-Soil temperature, Analytical chemistry-Basic concepts, Techniques & calculations-collection & processing of soil for analysis-Organic carbon, pH, EC, Soluble cations and anions-Study of a soil profile-Identification of rocks and minerals.

**Reference Book:**
- The nature and properties of soils-N.C.Brady and Ray R.Weil
- Fundamentals of Soil Science – Indian Society of Soil Science
- Conception,Application of Pedology – J.L. Sehgal
- Soil Physics – B.P.Ghildyal and R.P.Tripathy
5 Production Technology of Vegetables [BGHO 1101] 3(2+1+0)

Theory: Importance and scope of the vegetable cultivation, classification of vegetables, types of vegetable farming. Study of vegetable crops with respect to their origin, distribution, climate and soil requirement, sowing and planting, varieties, nutrient requirement, irrigation, intercultural operations, harvesting, important insect pests diseases and disorders crop improvement and seed production techniques of Solanaceous vegetables (tomato, Brinjal and chilli, Capsicum) Cole crops (cauliflower and cabbage and Kholkhol), Cucurbits (Pumpkin, Cucumber, gourd and melons). Legumes (pea, beans, Cowpea and Guanr), Okra, Bulb crops (onion and garlic), Root crops (radish, turnip, beet and carrot), Potato, Topical tuber crops (sweet potato yams, colocasia, cassava and amorphophallus) Leafy vegetables (amaranthus, basela, spinach and fenugreek), perennials (drum stick, curry leaf).

Practical: Raising of vegetable seedlings in the nursery, seed germination planning and layout of kitchen garden. Identification of vegetable seeds and plant parts, Seed rate, fertilizer calculation Physiological disorders, transplanting, irrigation, weeding and intercultural operations of vegetable crops. Use of growth regulators in vegetable crops, seed extraction of tomato, brinjal, visit to commercial vegetable farms, Research Stations, Vegetable Markets.

Reference Book:
1. Vegetable Crops - T.K. Bose and M.G. Som
2. Vegetable for the tropical region - Prem Nath, S. Velayadhan and D.P. Singh
3. Technology for vegetable production and improvement - P. Hazra and M.G. Som
4. Principles of Vegetable production - S.P. Singh
5. Text book of Vegetable Tuber Crops and spices - S. Thamburaj and N. Singh

6. Fundamentals of Microbiology [BGPP 1101] 2(1+1+0)


probable number method. III- Enumeration of bacteria by pour plate method and spread plate method.

**Reference Book:**
2. Microbiology - N. P. Saxena and D. K. Awasthi
3. Microbiology - R.P. Singh

7. **Statistics [BGAS 1101]**

Theory: *Introduction*: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves; Measures of Central Tendency: Characteristics of Ideal Average, Arithmetic Mean; Median, Mode, Merits and Demerits of Arithmetic Mean; Measures of Dispersion: Standard Deviation, Variance and Coefficient of Variation; Probability: Definition and concept of probability; Normal Distribution and its properties; Introduction to Sampling: Random Sampling; the concept of Standard Error; Tests of Significance- Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom, Steps involved in testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples; Small Sample Test for Means - Student’s t-test for Single Sample, Two Samples and Paired t test. F test; Chi-Square Test in 2x2 Contingency Table, Yates’ Correction for continuity; Correlation: Types of Correlation and identification through Scatter Diagram, Computation of Correlation Coefficient ‘r’ and its testing. Linear Regression: of Y on X and X on Y. Inter-relation between ‘r’ and the regression coefficients, fitting of regression equations. Experimental Designs: Basic Designs, Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis, Latin Square Design (LSD), Layout and analysis.

**Tutorial:** Construction of Frequency Distribution Tables and Frequency Curves; Computation of Arithmetic Mean for Un-Grouped and Grouped data; Computation of Median for Un-Grouped and Grouped data; Computation of Mode for Un-Grouped and Grouped data; Computation of Standard Deviation, Variance and Coefficient of Variation for Un-Grouped and Grouped data; SND test for Means, Single Sample; SND test for Means, Two Samples; Student’s t-test for Single Sample; Student’s t-test for Two Samples; Paired t test and F test; Chi-Square Test in 2x2 Contingency Table, Yates’ Correction for continuity; Computation of Correlation Coefficient ‘r’ and its testing; Fitting of regression equations- Y on X and X on Y; Analysis of Completely Randomized Design (CRD); Analysis of Randomized Block Design (RBD); Analysis of Latin Square Design (LSD).

**Reference Book:**
1. A First Course in Statistics with Applications- AKPC Swain

8. **Fundamentals of Soil, Water and Conservation Engineering [BGAE 1101]**

Theory: Surveying: survey equipment, chain survey, cross staff survey, plotting procedure, calculations of area of regular and irregular fields. Levelling - levelling equipment, terminology, methods of calculation of reduced levels, types of levelling, contouring. Irrigation, classification of projects, flow irrigation and lift irrigation. Water source, Water lifting devices - pumps (shallow and deep well), capacity, power calculations. Irrigation water measurement- weirs, flumes and orifices and methods of water measurement and instruments. Water conveyance systems, open channel and underground pipeline. Irrigation methods - drip and sprinkle irrigation systems. Soil and water conservation - soil erosion,
types and engineering control measures.

**Practical:** Acquaintance with chain survey equipment; Ranging and measurement of offsets; Chain triangulation; Cross staff survey; Plotting of chain triangulation; Plotting of cross staff survey; Levelling equipment - dumpy level, levelling staff, temporary adjustments and staff reading; Differential leveling; Profile leveling; Contour survey grid method; Plotting of contours; Study of centrifugal pumping system and irrigation water measuring devices; Study of different components of sprinkler irrigation systems; Study of different components of drip and sprinkler irrigation systems; Uniformity of water application in drip and sprinkler systems; Study of soil and water conservation measures.

**Reference Book:**

1. A Text Book of Surveying and Levelling – P.C. Purnima
2. Land & Water Management Engineering – V.V.N. Murty

9. **Insect Morphology and Systematic [BGEN 1101]**


**Practical:** Methods of collection and preservation of insects including immature stages: External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs, wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper): Dissection of male and female reproductive systems in insects (Grasshopper). Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thyssanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance.

**Reference Book:**

1. Insects, Structure and Function – R.F. Chapman
SEMESTER-II

1. Water Management and Micro Irrigation [BGAG 1204] 3(2+1+0)

Theory: Irrigation: definition and objectives, water resources and irrigation development in India and Orissa; Soil plant water relationships; Methods of soil moisture estimation, soil water movement, evapotranspiration and crop water requirement; effective rainfall, scheduling of irrigation; Methods of irrigation: surface and subsurface, Micro irrigation, sprinkler and drip irrigation; Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sun flower, mustard, pulses, sugarcane, cotton, potato, mango, banana and tomato); Agricultural drainage, Onfarm water management.

Practical: Determination of bulk density; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water through flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, bicarbonates, Ca++ and Mg++ in irrigation water (quality parameters)

Reference Book:
1. Irrigation Principles and Practices - O.W. Israelsen and V.E. Hansen
2. Irrigation and Drainage - D. Lenka
5. Micro-irrigation for cash crops – M.L. Choudhary

2. Agricultural Meteorology [BGAG 1203] 2(1+1+0)


Practical: Site selection for Agromet observatory; Measurement of temperature; Measurement of rainfall; Measurement of evaporation (atmospheric/soil); Measurement of atmospheric pressure; Measurement of sunshine duration and solar radiation; Measurement of wind direction and speed and relative humidity; Study of weather forecasting and synoptic charts: Study of remote sensing.
3. **Principles of Plant Breeding [BGPG 1202]**

**Theory:**
Classification of plants. Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Variation – heritable and non-heritable, Methods of breeding – introduction and acclimatization. Selection, Mass selection, Johannson’s pure line theory, genetic basis of pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis - inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, recurrent selection, synthetics and composites; Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; significance in crop improvement.

**Practical:**
Botanical description and floral biology; Study of megasporogenesis and microsporogenesis; Fertilization and life cycle of an angiospermic plant; Plant Breeder’s kit; Hybridization techniques and precautions to be taken; Floral morphology, selfing, emasculation and crossing techniques of Rice, Sorghum, Maize, Wheat, Bajra, ragi; Sugarcane, coconut, Groundnut, Castor, Safflower, Sesamum, Redgram, Bengalgram Greengram, Soybean, blackgram, Chillies, Brinjal, Tomato, Bhendi, Onion, Bottle gourd, Ridge gourd, Cotton, Mesta, Jute and Sunhemp; Study of male sterility and incompatibility in field plots.

**Reference Book:**
1. Principles of Plant Breeding - R.W. Allard
2. Plant Breeding Principles and Methods - B. D. Singh
3. Plant Breeding - (Ed.) V. L. Chopra
4. Plant Breeding. Analysis and Exploitation of Variation - D. Roy

4. **Agricultural Microbiology [BGAC 1202]**

**Theory:**
Soil microbiology, Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur. Biological nitrogen fixation, Microflora of Rhizosphere and phyllosphere microflora, microbes in composting, microbiology of water, Microbiology of food; microbial spoilage and principles of food preservation. Beneficial microorganisms in Agriculture; Biofertilizer (Bacterial, Cyanobacterial and fungal), microbial insecticides, Microbial agents for control of plant diseases, Biodegradation, biogas production.

**Practical:**
5. **Introductory Nematology** [BGNE 1201]  

**Theory:** Introduction on Nematode. Economic Importance of Nematodes, History of Phytonematology, Structure of a typical plant parasitic nematode. General morphology on various organ systems and organelles. Modification of stoma and oesophagus in soil and plant nematodes. Biology of nematode, Classification of economically important nematode genera up to family level with identification marks.

**Practical:** Study of Nematological laboratory appliances, study of bionocular stereoscopic and Research Microscopes, collection of soil and plant samples, Extaction of nematodes from soil by Cobb’s sieving and decantation technique followed by modified Baermann technique, killing and fixing of nematodes, processing and mounting of nematodes, mouth parts and oesophagus of soil and plant nematodes. Identification of *Hoplolaimus, Helicotylenchus, Tylenchorhynchus, Criconemella, Caloosia.*

**Reference Book:**  
2. A Treatise on Phytonematology – P.P. Reddy  
3. Introduction to Plant Nematology – V.H. Dropkin

6. **Crop Physiology-I** [BGPH 1201]  


**Practical:** Preparation of solutions, measurement of water status in roots, stems and leafs, measurement of water potential by Chardakov’s method, measurement of Osmotic potential by Plasmolytic method, measurement of water potential by Gravimetric method, measurement of absorption spectrum of chloroplastic pigments and fluorescence, measurement of chlorophyll a, b and total chlorophyll, measurement of carotinoid pigments, measurement of stomatal
frequency and index, measurement of respiration, study of leaf anatomy of C_3, and C_4 plants, measurement of transpiration, imbibitions of seed, optimum conditions of seed germination. Seed viability test, breaking of seed dormancy by chemical and mechanical methods, yield analysis, seed Vigour test.

Reference Book:
1. Principles of seed technology - G.N.Kulkarni
2. Plant physiology - R.G.S. Bidwell
5. Plant physiology - R.K.Shinha
6. Plant Physiology -K.N.Vatia and A.N.Parasar
7. The physiology and biochemistry of seed development, dormancy and germination - A.A.Khan
8. Seed Physiology – K. Vanangamudiet al

7. Principles of Agricultural Economics [BGEC 1201] 2(2+0+0)


Reference Book:
1. Elementary economic theory - K.K. Dewett and J.D. Verma
2. International Economics - B. Mishra
3. Fundamentals of Agricultural Economics - A.N. Sadhu and A. Singh
4. Economics - Paul A. Samelson and W.D. Nordhans

8. Dimensions of Agricultural Extension [BGEE 1201] 2(1+1+0)


**Practical:** Visits to a village and kisanmandal to study the ongoing development programmes. Visits to Panchayat Raj Institutions to study the functioning of Gram Panchayaat (GP) &ZillaPrajaParishad (ZPP). Visit and study the District Rural Development Agency (DRDA). Participation in monthly workshops of Training and Visit (T&V) System. Visit to Watershed Development Project area. Visit to a village to study the Self Help Groups (SHGs) of DWCRA. Visit to a voluntary organization to study the developmental activities. Organizing PRA techniques in a village to identify the agricultural problems. Visit to villages.

**Reference Book:**
2. Extension Communication & Management- G.L.Ray
3. Defining Agricultural Extension for 1990s- D.C. Misra
6. Rural Extension Hand book- V. Singh & M.S. Vasistha
7. New Dimension and Approaches in Extension – J. Vasanthakumar

**9. Introduction to computer application [BGAS 1202] 2(1+1+0)**


**Practical:** Study of Computer Components; Booting of Computer and its Shut Down; Practice of some fundamental DOS Commands, TIME, DATE, DIR, COPY, FORMAT, VOL, LABEL, PATH; Practicing WINDOWS Operating System, Use of Mouse, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars; WINDOWS Explorer, Creating Folders, COPY and PASTE functions; MSWORD: Creating a Document, Saving and Editing; MSWORD. Use of options from Tool Bars, Format, Insert and Tools (Spelling & Grammar) Alignment of text; MSWORD, Creating a Table, Merging of Cells, Column and Row width; MSEXCEL: Creating a Spreadsheet, Alignment of rows, columns and cells using Format tool bar; MSEXCEL: Entering Expressions through the formula tool bar and use of inbuilt functions, SUM, AVERAGE, STDEV; MSEXCEL: Data Analysis using inbuilt Tool Packs, Correlation & Regression; MSEXCEL: Creating Graphs and Saving with & without data; MSACCESS: Creating Database, Structuring with different types of fields; MS Power Point: Preparation of slides on Power Point; Transforming the data of WORD, EXCEL and ACCESS to other formats; Internet Browsing: Browsing a Web Page and Creating of E-Mail ID.

**Reference Book:**
2. Programming in BASIC – E.Balagurusamy

10. Farm Power and Machinery [BGAE 1202] 2(1+1+0)

**Theory:** Farm power in India: sources, I.C engines, working principles, two stroke and four stroke engines, I.C. engine terminology, different systems of I.C. engine. Tractors, Types, Selection of tractor and cost of tractor power. Tillage implements: Primary and Secondary tillage implements, Implements for intercultural operations, seed drills, paddy transplanters, plant protection equipment and harvesting equipment; Equipment for land development and soil conservation.

**Practical:** Study of different components of I.C. Engine; Study of working of four stroke engine; Study of working of two stroke engine; Study of M.B. plough, measurement of plough size different parts, horizontal and vertical suction, determination of line of pull etc.; Study of disc plough; Study of seed--cum-fertilizer drills-furrow opener, metering mechanism and calibration; Study, maintenance and operation of tractor; Learning of tractor driving; Study, maintenance and operation of power tiller; Study of different parts, registration alignment and operation of mower. Study of different inter cultivation equipment in terms of efficiency, field capacity; Repairs and adjustments and operation of sprayers; Repairs and adjustments and operation of dusters; Study of paddy transplanters.

**Reference Book:**
2. Farm Machinery and Equipment – C.P. Nakra
3. Elements of Farm Machinery – J. Sahay