

CERTIFICATE LEVEL CURRICULUM:

3 months full/ 6 months half; 10 credits (Practical + Agriculture Work Experience) and 5 credits (Theory)

1 Credit = 15h Theory; 1 Credit= 30h Practical/Field work

Course Code	Course Title	Credits (Theory + Practical/Field work)
CHN101	Basics of Nursery Management	1+1
CHN102	Seed Propagation	1+1
CHN103	Vegetative Propagation	2+2
CHN104	Commercial Nursery Management	1+2
		5+6 =11
CWE101	Agriculture Work Experience	0+4 =04
	Total	5+10=15

Basics of Nursery Management (CHN101): (1+1 Credits)

Theory: Introduction to nursery, Plant propagation- methods and classification, Factors affecting plant growth, Study of equipment used for bed preparations, potting operations, plant propagation and other nursery operations; Plant growth regulators, Introduction to landscaping, Study of Lawns.

Practicals: Identification of garden tools and implements; Demonstrate their operation and maintenance; Preparation of beds and ridges – furrows; Identification and use of various growth regulators; Identification of lawn grasses and lawn making.

Seed Propagation (CHN102): (1+1 Credits)

Theory: Seed as a propagule, Germination of seeds, Seed dormancy and viability, Seed production - method of collection and processing, Seed treatment, Classes of seed, Seed testing, commercial vegetable seedling production.

Practicals: Demonstration of seed germination; Raising of seedlings on beds and in trays; Demonstration of seed collection, processing, packing and storage; Demonstration of seed testing; Demonstration of seed treatment methods; chemicals and organic preparations used for seed treatment; Demonstration of commercial seedling production of vegetables (chili, knol-khol, brinjal).

Vegetative Propagation (CHN103): (2+2 Credits)

Theory: Asexual reproduction-importance, advantages; Propagation through stolons, runners, offsets, bulbs, corms, rooted crowns, division, cuttings, layering, Grafting and budding; Root stock-scion relationship; Top working; Micro-propagation (tissue culture/*in vitro* culture); Apomixis and polyembryony.

Practicals: Demonstration of various vegetative reproduction techniques as - Grafting, budding, layering, cutting; Propagation by using offsets, bulbs, crowns, stolons and runners; Propagation in major horticultural crops; Special practices in nursery management.

Commercial Nursery Management (CHN104): (1+2 Credits)

Theory: Nursery- site selection, lay out, records; Nursery structures; Potting, de-potting and re-potting; Nursery management of major crops; Mother plant orchard; Problems in nursery management and their control; Nursery registration.

Practical: Visit to a commercial nursery; Demonstration of erecting nursery structures; Demonstration of preparing potting mixture; Demonstration of potting, de-potting and re-potting; Demonstration of various nursery management practices in nursery (irrigation, weeding, spraying etc.); Identification of pests and diseases in nursery plants; demonstration of management of nursery pests and diseases; Demonstration of nursery layout and record keeping.

Agriculture Work Experience (CHN104): (2+4 Credits)

A special program of internship for 120 hours is introduced to learn the production and management works and technologies by involving the students in commercial nursery enterprises.

ADVANCE CERTIFICATE LEVEL CURRICULUM:

3 months; 10 credits (Practical + Agriculture Work Experience) and 5 credits (Theory)

1 Credit = 15h Theory; 1 Credit= 30h Practical/Field work

Course code	Course Title	Credits(Theory + Practical/Field work)
ACHO101	Fundamentals of Horticulture	1+1
ACHO102	Production technique of Fruit crops (mango and Cashew)	1+2
ACHO103	Coconut and Arecanut based Cropping System	2+2
ACAC101	Plant Nutrition	1+1
ACWE101	Agriculture Work Experience	0+4
	Total	5+10=15

1. Fundamentals of Horticulture (ACHO101): (1+1 Credits)

Theory: Introduction, meaning, branches of horticulture, Economic importance and classification of horticultural crops and their nutritive value, status of crops, agro-climatic zones of India orchards, gardens, nutrition and kitchen gardens, planning and layout of orchards, planting systems and planting densities. Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management, weed management and nutrient management, mulching; Harvesting and maturity standards; packaging and storage of horticultural produce.

Practical: Orchard tools and implements; features of orchard; training and pruning, planning and layout of orchard and nutrition garden; preparation of nursery beds, digging of pits, planting systems; Demonstration of various cultural operations in orchard; Identification and use of growth regulators; Demonstration of harvesting as per standards; packaging and storage tools and structures.

2. Production technique of Fruit crops (Mango and Cashew) (ACHO102): (1+2 Credits)

Theory: Soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including use of plant growth regulators. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of Mango and Cashew.

Practicals: Description and identification of varieties based on fruit morphology, Demonstration of grafting techniques and top working in mango and cashew; Demonstration of planting, Training and pruning, preparation and application of growth regulators in mango, Identification of pests and diseases of mango and cashew, maturity standards, harvesting, grading; ripening and packing and marketing.

3.Coconut and Arecanut based Cropping System (ACHO103): (2+2 Credits)

Theory: Cultivation technology of coconut and arecanut; *Kulagar*; Cultivation of intercrops- betel vine, black pepper, nutmeg, cardamom, cinnamon, vanilla, banana, pineapple, turmeric; Planning and layout; various models of coconut and arecanut based cropping; some successful multi-storey cropping models; Study of organic cultivation practices using crop residues; advantages and benefits of intercropping/mixed cropping; Harvesting and marketing.

Practicals: Site selection and layout of coconut and arecanut based mixed cropping orchard, Demonstration of planting as per *lakhibagh* model; Identification of pests and diseases and their management; layout of irrigation system; Practicing use of traditional and improved tools and equipments.

4. Plant Nutrition (ACAC101): (1+1 Credits)

Theory: Essential plant nutrients, their functions and mobility, deficiency symptoms, transformations and availability; integrated nutrient management, Complex and mixed fertilizers, micronutrients and their carriers. Organic manures; Different approaches for fertilizer recommendation.

Practical: Demonstrate knowledge of nutrient deficiency symptoms, Identification of manures and fertilizers, Application Methods of manure and fertilizer (bio-fertilizers and chemical fertilizers).

5. Agriculture Work Experience (ACWE101): (0+4 Credits)

A special programme of Agriculture Work Experience for 120 hours is introduced to learn the production and protection technologies by involving themselves in cultivation and farm management operations.

DIPLOMA LEVEL CURRICULUM:

Six months (1 Semester); 20 credits (Practical + Agriculture Work Experience) and 10 credits (Theory)

1 Credit = 15h Theory; 1 Credit= 30h Practical/Field work

Course Code	Course Title	Credits (Theory + Practical/Field)
DEN 101	Introductory Entomology	1 + 1
DPP 101	Introductory Plant Pathology	1 + 1
DHO101	Production technique of Vegetables	1 + 2
DHO102	Fruit Production Technology	1 + 2
DAC 101	Introduction to Soil Science	1 + 2
DEG101	Irrigation Systems	1 + 2
DEC 101	Agriculture Finance and Project Preparation	1 + 1
DEG 102	Farm Equipment and Machinery (Operation and Maintenance)	1 + 2
DPP102	Pest and Disease Management	1 + 1
DHO103	Introduction to Organic Farming	1 + 2
DAS 101	Computer Application	0 + 1
DWE101	Agriculture Work Experience	0 + 3
		10 + 20 = 30

1. Introductory Entomology (DEN 101) (1+1 Credits)

Brief Introduction, Classification of Phylum Arthropoda upto classes, viz., Synchronyphyla, Crustacea, Arachnida, Chilopoda, Diplopoda, and Insecta. Characters of class Insecta. Division of class Insecta into subclasses - Apterygota and Pterygota - orders under Apterygota. Division of Pterygota into exopterygota and endopterygota and orders under each with important examples.

Order Orthoptera - Characters, filiform antenna, biting and chewing mouth parts. Large prothorax, pterothorax, wing characters; simple or incomplete metamorphosis. Lay eggs in soil. Examples of agricultural importance.

External characters of cockroach - External characters, segmentation, body regions - head, thorax, abdomen; antenna, mouth parts.

Order Lepidoptera (Moths and Butterflies) overlapping scales on the body and appendages. Mouth parts siphoning type, head small with neck, compound eyes large, 2 ocelli, characters of wings and venation, differences between moths and butterflies. Examples of agricultural importance.

Types of injury and symptoms of damage caused by pests, Integrated Pest Management (IPM) - Introduction, importance concepts and principles of IPM; Tools of IPM - host plant resistance, cultural methods, mechanical and physical methods, legislative or quarantine measures, Biocontrol - bioagents, parasitoids and predators. Characters of parasitoids and predators.

Practicals:

1. Methods of collection and preservation of insects including immature stages.
2. External features of butterfly and moth.
3. External features of a Cockroach.
4. Types of insect legs.
5. Types of insect mouth parts and study of biting and chewing (orthopteran).
6. Study of mouth parts of Lepidoptera.
7. Types of insect larvae and pupae.
8. Study of characters of orders Orthoptera.
9. Study of characters of order Lepidoptera and its families.

2. Introductory Plant Pathology (DPP 101) (1+1 Credits)

Introduction, important plant pathogenic organisms, different groups, fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites with examples of diseases caused by them.

Practicals: Plant disease symptom identification and preservation of disease samples. Study of symptoms, etiology, host-parasite relationship and specific control measures of the following crop diseases. Presentation of disease samples survey and collection of diseases of rice, turmeric; cowpea, coconut and black pepper. Field visits.

3. Production technique of Vegetables (DHO101): (1+2 Credits)

Theory: Importance and scope of the vegetable cultivation, classification of vegetables, study of climatic and soil requirement, varieties, sowing/planting times and methods, seed rate, seed treatment, nutritional and irrigation requirement, intercultural operations, physiological disorders, harvesting of Cucurbits - pumpkin, musk melon, cucumber, Bitter gourd, ridge gourd, ash gourd, Bottle gourd; Brinjal, Chili; *Amorphophallus*, *Colocasia*, *Dioscoria*.

Practicals: Raising of nursery of Brinjal and chili, planning and layout of kitchen garden, identification of seeds and plants, demonstration of raising cucurbits, brinjal and chili and tuber crops; Extraction of seeds from important crops, intercultural operations of vegetable, stages of maturity of vegetables and harvesting.

4. Fruit Production Technology [DHO102] (1+2 Credits)

Theory: Importance and scope of fruit crops in India, important varieties, propagation methods, soil and climatic requirements for important commercial fruits. Layout and planting, manuring, irrigation, interculture, training and pruning, intercropping and physiological disorders, harvesting of important fruits like banana, pineapple, papaya, jackfruit, lemon, aonla, jamun and custard apple.

Practicals: Identification of major and minor fruits, nursery management and maintenance of grafts, lifting and packing of plants, Orchard layout and planting management. Intercultural operations, special care, use of growth regulators, post harvest handling of fruits, visit to commercial orchards.

5. Introduction to Soil Science (DAC 101) (1+2 Credits)

Soil: Pedological and edaphological concepts, Definition of Rocks and minerals. Primary and secondary minerals, Weathering, soil formation factors and processes, components of soils, Soil profile, Phases of Soil, Soil physical properties, Soil Texture and Textural Classes, Soil Structure and Classification, Soil Consistency, Soil fertility and productivity-factors. Bulk density, particle density and porosity - Soil colour – significance - causes and measurement. Soil temperature – Soil air – Soil water- Soil water potentials – Soil moisture constants – Movement of soil water – saturated and unsaturated flow – Infiltration, hydraulic conductivity, percolation, permeability and drainage Integrated nutrient management, Soil colloids – Properties, types and significance – Layer silicate clays – their genesis and sources of charges – Ion exchange – CEC, AEC and Base saturation – Factors influencing Ion exchange - significance. Soil reaction, Buffering capacity and EC. Study of different soil series found in Goa including their physical, chemical, biological characteristics and their spatial distribution.

Practicals: Identification of Rocks and Minerals, Study of Soil Profile, Collection and processing of Soil Sample, Study of physical properties and texture of different types of soil, Soil moisture determination – Gravimetric method, Gypsum block, Tensiometer. Determination of infiltration rate and hydraulic conductivity Study of soil profile in the field across different location and their characteristics.

6. Irrigation Systems (ACEG101): (1+2 Credits)

Theory: Irrigation - Meaning and methods, merits and demerits, Water saving technology (sprinkler and drip irrigation), Working principles and benefits of sprinkler and drip irrigation technology, components of sprinkler and drip irrigation systems, working and trouble shooting.

Practicals: Visit to farms to observe various irrigation methods; Planning and layout of sprinkler and drip irrigation system; demonstrate knowledge of water saving, labour saving using sprinkler and drip irrigation systems.

7. Agriculture Finance and Project Preparation (DEC101) (1+1 Credits)

Theory: Agriculture Finance and Credit, History of Agriculture Finance & Credit, Agriculture Finance Institutional setup. Nationalized Banks, Credit Societies, NABARD, APEDA, Priority lending from the Bank, Rate of Interest for Agriculture Finance, Schemes for Agriculture Finance, Requirements for obtaining Agriculture Finance, Opening of Bank Account, Social Security, Schemes for Farmers by Financial Institution, Farmers Club, Joint Liability Group, Krishi Card, Kisan Credit Card, Term Loan, Cash Credit, Cost; Benefit Ratio, Agri Business Clinic, Model Project Report for Agriculture, Ornamental and Dairy Project.

Practicals: Operation of Individual Bank Account, Documents required for obtaining Kisan Credit Card including facilitation of Kisan Credit Card for few farmers, Preparation of Project Report for small Horticulture Project, Protected Cultivation Unit, Dairy Unit and Poultry Unit.

Reference: Model Project Report Series, NABARD.

8. Farm Equipment and Machinery (Operation and Maintenance) (DEG 101) (1+2 Credits)

Theory: Use, operation and maintenance of different simple Farm Tools and Equipment's including Pick-axe, Spade, Crowbar, Sickle, Billhook (*Koyta, Kathi*), *Paal*, Hoe (*Kudal*), Axe, Mango and Chickoo Plucker, pruner for Arecanut. Garden tools and equipment's. Functioning,

use, operation and maintenance of different small farm machinery including Power Bush Cutter, Power sprayer, Power Pruner, Chain Saw, Petrol and Diesel Water Pump, centrifugal and monoblock water pump. Tillage implements- primary and secondary tillage implements – Sowing methods - seed drills, seed cum fertilizer drills - implements for intercultural operations - wet land equipment – Paddy transplanters - field and nursery requirements. Plant protection equipment - Harvesting tools and equipment- harvesters - Equipment for land development and soil conservation -Tools for horticultural crops.

Practicals: Maintenance of simple Farm Tools and equipment's including its use and operation in field. Operation and Maintenance of Power Brush Cutter, Power Sprayer, Power Pruner, Chain Saw, Petrol and Diesel Water Pump. Study of different components of IC engine, four stroke petrol engine, two stroke petrol engine.

9. Pest and Disease Management (DPP102): (1+1 Credits)

Theory: Pest – meaning and various groups; Different hosts and their pests; alternate hosts; Losses caused by pests; Tolerance Levels and Economic Thresholds; Control methods – Integrated Pest Management (IPM). Meaning of disease; Various causal organisms; Concepts of infection and infestation; tolerance levels; Study of losses caused; Integrated management practices; Congenial conditions for growth of pests and diseases.

Practicals: Identification of different pests and monitoring; Identification of different diseases and their symptoms; Collection of pests and disease specimen; Demonstration of various integrated pest and disease management measures.

10. Introduction to Organic Farming (DHO 103) (1+2 Credits)

Organic farming - Introduction, concept, relevance in present context, organic production requirements; Biological intensive nutrient management -organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers, use of *Panchgavya*; Effective microorganisms (EM); Soil improvement and amendments. Soil organic matter – Composition – decomposition and mineralization, C: N ratio, Carbon cycle – Fractions of soil organic matter – Humus formation. Soil organisms - Beneficial and harmful effects.

Practicals: Raising of vegetable crops organically through nutrient, diseases and pest management; Preparation of FYM, vermicompost, *Panchagavya*, Effective microorganisms (EM); *Amrutpani*, organic pesticides.

11. Computer Application (DAS 101) (0+1 Credits)

Introduction to Computers: Study of Computer Components; Booting of Computer and Shut Down. Operating System, Units of memory, Use of Mouse, Title Bar, 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 and Grammar) Alignment of text. Creating a Table, Merging of Cells, Column and Row width, advanced options (like Water marking, mailings).

MSEXCEL: Overview of Excel, Formatting cells, Cut, Copy, Paste, Insert, Printing, Page Setup, Use of options from Tool Bars, Entering Expressions through the formula tool bar and use of inbuilt functions, SUM, AVERAGE, and SIDEV. Data Analysis using different charts. Creating

Graphs and saving with and without data. MS Power Point: Preparation of slides on Power Point. MSACCESS: Creating Database, Structuring with different types of fields.

12. Agriculture Work Experience (DWE101): (0+4 Credits)

A special programme of Agriculture Work Experience for 90 hours is introduced to learn the production and protection technologies by involving themselves in cultivation and farm management operations.

ADVANCED DIPLOMA LEVEL CURRICULUM

One year (2 Semesters); 40 credits (Practical + Agriculture Work Experience) and 20 credits (Theory)

1 Credit = 15h Theory; 1 Credit= 30h Practical/Field work

Semester I & II

Course No.	Course Title	Course Credit
ADAC1101	Soils and Soil Fertility Management	1+2
ADAC1202	Manures, Fertilizers and Agro Chemicals	1+2
ADHO 1204	Introduction to Post Harvest Technology	1+2
ADHO1207	Introduction to Protected Cultivation	1+2
ADAB1101	Plant Physiology	2+1
ADAE1101	Agriculture Extension and Communication	1+2
ADEC1203	Agro Eco Tourism	1+2
ADHO 1205	Post-Harvest Handling and Marketing of Fruit and Vegetables	1+2
ADHO 1206	Fruit and Vegetable Processing	1+2
ADHO1101	Commercial Floriculture	1+2
ADHO1102	Landscaping and Gardening	1+2
ADHO1103	Plantation and Spice Crops	1+2
ADAB1202	Seed Production, Testing and Certification	1+2
ADEC1102	Agriculture Cooperation	1+1
ADEC1101	Production Economics and Farm Management	1+2
ADEG1101	Soil and Water Conservation	1+2
ADHO1208	Organic Farming and Certification	2+2
ADEG1201	Greenhouse Technology	1+2
ADAS1101	Communication Skills in English	0+1
ADAS1102	Computer Application	0+1
ADWE101	Agriculture Work Experience	0+4
	Total	20+40=60

1. Soils and Soil Fertility Management [ADAC1101] (1+2 Credits)

Theory: Soil: Pedological and edaphological concepts, Definition of Rocks and minerals. Weathering, soil formation factors and processes, components of soils, Soil profile, soil physical properties, soil texture, Soil fertility and productivity-factors affecting, features of good soil management, problems of supply and availability of nutrients, relation between nutrient supply and crop growth, Criteria of essentiality of nutrients, Essential plant nutrients-their functions. nutrient deficiency symptoms, transformation and dynamics of major plant nutrients,

Commercial fertilizers, composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, agronomic, chemical and physiological methods of increasing fertilizer use efficiency nutrient interactions, organic fertilizers and its advantages, relative performance of organic and inorganic manures, economics of fertilizer use, integrated nutrient management, use of vermin-compost and residual waste in crops.

Practicals: Study of physical properties and texture of soil, Soil sampling techniques, study of soil profile in the field, Determination of pH, EC, organic C, total N, available N, P, K and some micro-nutrients in soils, Determination of total N, P, K and some micro-nutrients in plants, Interpretation of interaction effects and computation of economic and yield optima.

Reference Books:

1. Chemistry of the soils – F. Bear
2. Soils and soil fertility – C. M. Thomson and F.R. Troeh
3. Soil fertility and fertilizers - S.L. Tisdale, V.L. Nelson, J.D. Beaton and J.L. Havlin
4. ICAR Publ. Fundamentals of soil science, 2nd Ed. by ISSS New Delhi.

2. Manures, Fertilizers and Agro Chemicals [ADAC1202] (1+2 Credits)

Theory: Introduction-Raw materials-Manures-Bulky and concentrated-FY'M, Composts-Different methods, Mechanical compost plants, Vermi-composting, Green manures, oil cakes, sewage and sludge-Biogas plant slurry, plant and animal refuges. Fertilizers- classification. Manufacturing processes and properties of major nitrogenous (ammonium sulphate, urea, calcium ammonium nitrate, ammonium nitrate, ammonium sulphate nitrate) Phosphatic (single superphosphate, enriched super phosphate. diammonium phosphate, ammonium poly phosphate), Potassic and complex fertilizers, their fate and reactions in the soil, Secondary and micronutrients fertilizers, fertilizer mixtures and grades, cz Amendments, Fertilizer control order, fertilizer storage, Bio-fertilizers and their advantages.

Diverse types of agrochemicals, botanical insecticides (Neem), Pyrethrum, Synthetic pyrethroids. Synthetic organic insecticides, Major classes, Properties and uses of some important insecticides under each class. Herbicides - Major classes - Properties and uses of 2, 4-D, atrazine, glyphosate; Fungicides - Major classes - Properties and uses of carbendazim, carboxin, captan, tridemorph and copper oxychloride - Insecticides Act. Plant growth regulators.

Practicals: Total nitrogen and phosphorus in manures/composts – Ammonical and nitrate nitrogen-water soluble P₂O₅), potassium, calcium, sulphur and zinc contents of fertilizers. COD in organic wastes- Adulteration in fertilizer, Compatibility of fertilizers with pesticides, Assessment of manure quality, Reading and understanding information on packings, Time and methods of manures and fertilizers application, foliar application, Use of growth regulators, Safe use of chemicals.

Reference Books:

- 1 Soil fertility and fertilizers-S.L. Tisdale, V. L. Nelson. J. D. Bemon and L. Havlin
2. 2. Manures and Fertilizers - K. S. Yawalker, J. B. Agarwal and S. Bokde
3. Soil Fertility. Theory and Practice – J. S. Kanwar

3. Introduction to Post Harvest Technology [ADHO1204] (1+2 Credits)

Theory: Overview and importance of Post-Harvest Technology (PHT) of horticultural crops, Maturity, Maturity indices, measuring quality, safety factors, harvesting systems and post-harvest handling of fruits and vegetables. Preparation for market, packing house facilities and equipment, packaging and containers, Pre Cooling, Zero energy chamber; Ripening, changes during ripening and factors affecting ripening of fruits and vegetables. Storage: methods, facilities, equipment, management of environmental conditions including Controlled Atmosphere Storage, Ethylene Treatment, Safety precautions, FSSAI regulations for ripening, Exclusion and Removal, Transport, Standardization and Inspection, Quality Evaluation and Control, Harvesting and postharvest handling for various commodity groups.

Practicals: Familiarizing with the equipments for storage, grading and packaging; Study of maturity indices of different fruit and vegetable crops; Removal of field heat and pre-cooling; Shelf life study of cut flowers; sorting and grading, ripening chambers; visit to agriculture market yard and processing unit.

Reference Books:

1. Handling of Horticultural Perishables in Developing v/s Developed Countries, A. A. Kader, 2010.
2. A hand book of post-harvest management of fruits and vegetables, Jacob John. P. 2008 Daya Publishers.
3. Sureshkumar, P. Sagar and Manish Kanwat. 2009. Post-harvest physiology and quality management of fruits and vegetables. Agrotech Publishers, Udaipur.
4. Jacob John. P. 2008. A hand book of post-harvest management of fruits and vegetables. Daya Publishers.

4. Introduction to Protected Cultivation [ADHO 1207] (1+2 Credits)

Theory: Introduction, status, scope and constraints of Protected Cultivation, establishing and operation of poly house production. Importance and scope of protected cultivation – different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house - study of environmental factors influencing protected cultivation – cladding/glazing/covering material – ventilation systems – cultivation systems including nutrient film technique/hydroponics/aeroponic culture – growing media and nutrients – canopy management – micro irrigation and fertigation systems. Recent techniques of protected cultivation of cut flowers. Chemical growth regulation of Greenhouse crops. Important diseases, pests and their control, Integrated pest and disease management. Hi-tech protected cultivation of cut roses, chrysanthemum, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers.

Practicals: Study of different kinds of protected structures – designs, components and construction – types and structures of auto control systems in green house – study of heating and cooling systems – study of different media, solarization and fumigation – study of special horticultural practices for vegetables / flowers under protected cultivation – visit to protected cultivation units. Visit to commercial units for cut flowers. Identifications of different growth media used in Green House. Studies on the post-harvest, grading and packing of important commercial cut flowers.

Reference Books:

1. Singh, D.K. 2008. Hi-tech horticulture. Agrotech publishers, Udaipur
2. Adams, C.R. K.M. Bandford and M.P. Early. 1996. Principles of Horticulture. CBS publishers and distributors. Daryaganj, New Delhi.
1. Joe. J. Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
4. Paul V. Nelson. 1991. Green house operation and management. Ball publishing USA.

5. Plant physiology [ADAB1101] (2+1 Credits)

Theory: Introduction, Definition, importance in agriculture. Growth and development- Definition, Determinate and indeterminate growth, measurement of growth, growth analysis, growth characteristics- Definition and mathematical formulae. Crop water relations: physiological importance of water to plants, Transpiration: significance, transpiration in relation to crop productivity, water use efficiency, Photosynthesis: energy synthesis, relationship of photosynthesis and crop productivity. Photorespiration: factors affecting photosynthesis and productivity, photosynthetic efficiency, dry matter partitioning, Harvest index of crops. Respiration and its significance, Nutriophysiology: Definition, functions of plant nutrients- deficiency and toxicity symptoms of plant nutrients foliar nutrition-hydroponics.

Practicals: Preparation of standard solutions, Growth analysis: Calculation of Growth parameters, Measurement of plant water status in different parts of the plant. Measurement of leaf area in crop plants. Measurement of Rate of Photosynthesis by dry weight method. Measurement of Respiration. Estimation of stomatal index and stomatal frequency. Demonstration of Transpiration. Demonstration of Effect of Osmotic pressure (Potential) on Rate of Imbibition, Optimum condition for seed germination, effect ABA on regulation of stomata, effect of ethylene on ripening of fruit.

Reference books:

1. Devlin R.M. - Plant physiology, Affiliated East-1Aest press Pvt. Ltd. New Delhi.
2. Mayer D.S. and B.D. Anderson (1988) - Plant physiology.
3. Verma V. (1987) - The book of plant physiology.
4. Crop Physiology (2008) by Agromet Publ., Nagpur.

6. Agriculture Extension and Communication [ADAE1101] (1+2 Credits)

Theory: Meaning of Education, Extension and agricultural extension Principles of Agricultural Extension, Communication, Meaning and definition of communication, Elements of Communication and their characteristics, Types and barriers of Communication, Sociology and Rural Sociology- Meaning, Definition, Scope, Importance of Rural Sociology in Agriculture Extension. Indian Rural Society- Important characteristics, Social groups-Meaning Definition, Classification, Cultural concepts- Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions. Social Control- Meaning, Definition; Social change-Meaning, Definition, Nature of Social change.

Practicals: Preparation of Interview Schedule to collect information from villager, Identifications of various social and cultural patterns of rural society through field visit, Visit to various rural institutions to study their structure and function.

Reference Books:

1. Introductory Rural Sociology - J. B. Chitamber
2. Dahama O. P. and Bhatnagar, O. P. (1980). Extension and Communication for Development.

7. Agro-Eco Tourism [ADEC1203] (1+2 Credits)

Theory: Introduction, concept, importance and scope; relevance in present context, Requirement of services for the tourists, Business promotion and ethics, various models, Various Promotional Schemes, Incredible India and Goa Tourism Development Corporation.

Practicals: Study of various Agro-eco tourism models, study of promotional schemes, Visit to GTDC, tour operators and Agro-eco tourism resort.

8. Post-Harvest Handling and Marketing of Fruit and Vegetable [ADHO 1205] (1+2 Credits)

Theory: Introduction to Fresh Handling Technologies, Pre-harvest Practices, Harvesting and preparation for markets, Packinghouse Operation and Packing Practices, Containers and Packaging material, Temperature and Relative Humidity Management, Storage Practices and Structure, Produce Transportation, Food Safety for Fresh Horticultural Produce, Introduction to Small scale Marketing Strategies, Destination Handling, Wholesale Produce, Marketing, Direct Retail Produce Marketing, Alternative Marketing Strategies.

Practicals: Maturity Indices for Mango, Jackfruit, Papaya, Banana and vegetables. Harvesting, Removal of Field Heat, Sorting, Grading, Ripening Treatment, Packaging. Stacking, Storage and Transportation.

9. Fruit and Vegetable Processing [ADHO 1206] (1+2 Credits)

Status and scope of fruit and vegetable industry in India. Composition and nutritive value of fruits and vegetable. Factor effecting composition and quality of fruits and vegetables. Study of various equipments: usage, cleaning methods, care/maintenance and precautions, Importance of fruits and vegetables in the diet. Different types of spoilages in fruits and vegetables. Spoilage during storage of fruits and vegetables and their prevention. General methods of preservation of whole fruits/vegetables and processed fruits and vegetables, Food additives and their uses in processing of fruits and vegetables, Limit of food additives in fruits and vegetables products. Study of Food safety Standards: HACCP, its benefits and application, ISO 22000. International Food Laws and Regulatory Agencies: International Organizations – FAO (Food and Agriculture Organization), WHO (World Health Organization), Codex Alimentarius, ISO, WTO. Estimation of chloride content in food products. National Organizations – ICMR, ICAR, Council for Social Welfare, International Food Control Systems including CODEX, Importance of personal Hygiene, Cleaning and Sanitary standards in Fruits and Vegetable processing industry. Good Handling Processes (GHP). Traceability aspects of processed product, Forward and backward traceability, Technology of extraction of juices from different types of fruits. Definition of Preservatives, types of preservatives commonly used in fruits and vegetables processing industry, limits of usage of preservatives. Fruit beverages: Squashes, syrups, nectars, crushes, cordial. Technology of carbonated soft drinks, Tomato products: Manufacturing process of tomato based products like tomato juice, soup, puree, sauce, ketchup, and paste. Spoilage of tomato products and preventive measures. Jams, Jellies and marmalades: selection, preparation, production and preservation. Difference between jam and

jelly. Theory of jelly formation. General principles and manufacturing processes of preserves, candied fruits, crystallized fruits. Definition of Pickles and chutneys. Raw materials for preparation of pickles and pickling process. Spoilage of pickle. Methods of preparation, curing techniques.

Practicals: Drying and dehydration of seasonal fruits and vegetables. Dehydration and rehydration of common available vegetable. Different methods of blanching. Determination of blanching time, Practical demonstration of Bottling, canning and form fills and seal machines. Formation and examination of can. Cleaning and maintenance of the equipments. Examination of the tetra pack. Testing of brine and syrups. Analysis of canned and processed products available in the market. Visit to canning industry.

10. Commercial Floriculture [ADHO1101] (1+2 Credits)

Theory: Importance and scope of floriculture, Study of climatic and soil requirements, varieties, sowing or planting times and methods, seed rate, land preparation, nutritional and irrigation requirements, intercultural operations, harvesting, pests and diseases of rose, marigold, jasmine, chrysanthemum, gladiolus, crossandra and tuberose; Floral arrangements.

Practicals: Propagation and raising of some flowers, Training and pruning of roses and pinching and disbudding in chrysanthemum, Intercultural operations in flower crops, Harvesting, Grading and packaging of flowers, Prolonging the vase life of cut flowers and flower arrangements, visit to local commercial plantations.

Reference books:

1. Bose, T K. and L.P Yadav (1986) Commercial flowers, NayaPrakosh, Calcutta.
2. Gopalswami lyenger K.S. (1970) Complete Gardening in India.
3. Hand Book of Horticulture, ICAR publication.
4. Mukhopadhyay, A. (1987) Floriculture in India. Lyal Book Depot. Ludhiana.
5. Pal, B. P. (1972) Rose in India. ICAR, New Delhi.
6. Randhawa G. S. and A.K. Mukhopadhyay (2001). Floriculture in India.

11. Landscaping and Gardening [ADHO1102] (1+2 Credits)

Theory: Importance and scope of ornamental horticulture, Types and styles of ornamental gardens, parts of garden, Study of trees, shrubs, climbers, palms, indoor plants and seasonal flowers planning of ornamental garden, house plants and seasonal flowers in garden cultivation, Propagation of flowering and ornamental plants, Lawns.

Practicals: Identification of seeds and plants (Flowers, trees, climbers, house plants, seasonal plants etc.) Layout of lawn and its maintenance. Propagation, Care and maintenance of various garden plants.

Reference Books:

1. Floriculture in India - G. S. Randhawa and A. Mukopadhyay.
2. Complete gardening in India - K. S. G. Gopalswami.
3. Vishnuswarup (1972- Garden flowers. National Book Trust, New Delhi.

12. Plantation and Spice crops [ADHO1103] (1+2 Credits)

Theory: Cultivation technology of Plantation crops - coconut, arecanut, betel vine, cashew, cocoa, coffee, oil palm.

Importance and cultivation technology of spices - ginger, turmeric, pepper, cardamom, nutmeg, Pimenta, cinnamon, coriander.

Practicals: Inter-culture operations in plantation and spice crops, selection of mother palm and seed nuts in coconut; Propagation methods in plantation crops; Propagation and planting methods in turmeric; Propagation and planting techniques in ginger; Processing and curing of spices (ginger, turmeric and black pepper); Training methods in betel vine; Rejuvenating practices in cashew nut; Products-byproducts of spices and plantation crops; Visit to local commercial plantations.

Reference books:

- 1.Kumar. N., Introduction to spices, plantation, medicinal and aromatic crops.
- 2.Kumar N. *et al.*, Spices, plantation crops, medicinal and aromatic plants, Oxford and IBH Publishers, New Delhi 1997.
- 3.Pruthi J. S., Major spices of India (Crop management), ICAR Publication 1993.
4. Handbook of Horticulture, ICAR publication.

13. Seed production, Testing and Certification [ADAB1202] (1+2 Credits)

Theory: Importance, Difference between seed and grain, Characteristics of quality seed; Process of seed, Types of seed -Nucleus, Breeder, Foundation, Certified, Truthful and Labeled seed. Principle of seed production, Isolation distance, Rouging, Synchronization, Supplementary pollination techniques, Maintenance of Physical and Genetic purity in released varieties. Seed production technique of varieties/Hybrids in Rice, Groundnut, coconut; Seed certification, Seed processing, Seed drying, Seed threshing, Seed cleaning, Seed treatment, Seed storage, Seed testing, Seed moisture, Physical purity and Genetic purity. Seed viability, Vigour, Germination. Factor influencing seed germination. Seed dormancy, Factors and method of breaking seed dormancy, seed health, Seed packing, Seed act.

Practicals: Seed sampling methods, seed moisture test and seed germination test, unfilled grains and pods identification and separation in Rice and Groundnut, seed viability test, methods to overcome seed dormancy, seed physical purity determination test, seed genetic purity determination test, visit to seed technology testing laboratory, visit to seed processing centre, visit to seed production units, seed treatment methods in Rice and Groundnut.

Reference Books:

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

14. Agriculture Co-operation [ADEC1102] (1+1 Credits)

Theory: Philosophy and principles. History of Indian cooperative Movement, pre and post-independence periods, cooperation in different plan periods.

Cooperative credit structure: PACS, FSCS; Reorganization of cooperative credit structure in Maharashtra and Single Window System. Successful cooperative systems in Gujarat, Maharashtra, etc. Co-operative structure in Dairy industry in Goa; SHG and Joint Liability Group schemes.

Practicals: Study of VKS Society, Study of State co-operative Bank, Study of primary milk co-operative society and Goa milk Union, Study of Agriculture Co-operative marketing organization, Study of SHG & JLG.

Reference Books:

1. Mamoria C. B. Rural Credit and Agricultural Co-operation in India.
2. Subba Reddy and P. Raghu Ram, Agricultural Finance and Management.
3. K. D. Theory, History and Practices of Co-operation.
4. Mamoria C. B. and R.D. Saxena, Agricultural Co-operation. India.
5. Guide to Self Help Groups and Joint Liability Groups by NABARD.

15. Production Economics and Farm Management [ADEC1101] (1+2 Credits)

Theory: Production Economics: Meaning, Definition Nature and Scope of Agricultural Production Economics. Basic concepts and terms. Concepts of Production. Production Functions: Meaning, Definition, Types. Laws of returns: Increasing, Constant and decreasing. Factor Product Relationship. Determination of optimum input and output. Factor relationship. Product relationship. Types of enterprise relationships. Returns to scale: Meaning, Definition, and Importance. Farm Management: Economic principles applied to the organizations of farm business. Types and systems of farming, Farm planning and budgeting, Risk and uncertainty, Farm budgeting.

Practicals: Computation of cost concepts; Methods of computation of depreciation; Analysis of Net worth statement; Farm inventory analysis; Preparation of farm plans and budgets; Types of farm records and accounts; Preparation of profit and loss account; Break, Even analysis; Economics analysis of different crop and livestock enterprises; Application of Farm Management Principles.

Reference Books:

1. Dhondyal. S. P. "Farm Management", Friends Publications, 90 Krishanapa, Meerut.
2. Johl S. S. and T.R. Kapur Fundamental of Farm Business.
3. Management by Kalyani Publishers, ' Rajindar Nagar, Ludhiana 141 008.
4. Singh J. J. Element of Farm Management Economics, East West Press Pvt. Ltd., New Delhi.
5. S. Subha Reddy and P. Raghu Ram Agricultural Finance and Management

16. Soil and Water Conservation [ADEG1101] (1+2 Credits)

Theory: Surveying: Survey equipments, Plan table survey, calculations of area of regular and irregular fields; Leveling-leveling equipment, terminology, methods of calculation of reduced levels, types of leveling, contouring; Soil and Water conservation - soil erosion, types of engineering control measures, run off estimation, watershed development.

Practicals: Planetable survey, Leveling equipment - dumpy level, leveling staff, temporary adjustments and staff reading; Simple and Differential leveling; Contour survey - grid method;

Plotting of contours; Types of pumping system and irrigation water measuring devices; Run off estimation; Study of soil and water conservation structures, concept of watershed development.

Reference Books:

1. Kanetkar T. P. and S.V. Kulkarni (2007 Reprint) Surveying and Leveling- Part I.
2. Michael A. M. (1999) - Irrigation Theory and Practice.
3. Michael A. M. and T. P. Ojha (1992) Principles of Agril. Engineering, Vol.II.
4. Suresh R. (1997) Soil and Water Conservation Engineering.

17. Organic Farming and Certification [ADHO1208] (2+2 Credits)

Theory: Organic farming - Introduction, concept, relevance in present context, organic production requirements; Biological intensive nutrient management -organic manures, vermin-composting, green manuring, recycling of organic residues, bio-fertilizers, use of *Panchgavya*; Soil improvement and amendments. Integrated diseases and pest management - use of bio-control agents, bio-pesticides, pheromones, trap crops, bird perches; Weed management. Quality considerations - certification, labeling and accreditation process, marketing, and export.

Practicals: Raising of vegetable crops organically through nutrient, diseases and pest management; Preparation of FYM, vermicompost, *Panchagavya*, *Amrutpani*, organic pesticides; vegetable and ornamental nursery raising; macro quality analysis, grading, packaging, post harvest management, marketing of organically raised produce; visit to bio-control lab, bio-fertilizer unit, organic farm and vermicompost unit; Study of formats used in organic certification process.

Reference Books:

1. Dahama, A.K. Organic farming for sustainable agriculture, 2005. Agrobios Publication, Jodhpur.
2. Palanippan, S.P. and Anandurai, K. 1999. Organic Farming - Theory and Practice. Scientific Publishers, Jodhpur.
3. Sharma, A.K., Handbook of Organic Farming.
4. Singh, R.P. Sustainable Development of Dryland Agriculture in India.
5. Thapa, U. and Tripathi, P. 2006. Organic Farming in India, Problems and Prospects.

18. Greenhouse Technology [ADEG1201] (1+2 Credits)

Theory: Greenhouse technology. Introduction, Types of Greenhouses; Plant response to Greenhouse environment. Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Greenhouse equipment, materials of construction for traditional and low cost greenhouses. Irrigation systems used in greenhouses; Production technology of Capsicum, cucumber, gerbera in polyhouse.

Practicals: Study of different types of green houses based on shape, construction and cladding materials, study of growth media used, Visit to commercial green houses.

Reference Books:

1. K. Radha Manohar C. Igathinathane, Green House Technology and Management, First Edition- 2000, B. S. Publications 4-4-309, Sultan Bazar, Hyderabad -500 095.
2. G. N.Tiwari, R. K. Goyal, Greenhouse Technology Fundamentals, Design, Modeling and, Applications, First Edition- 1998, Narosa Publishing House 6, Community Centre, Panchasheel Park, New Delhi 110 017.
3. B.P. Sawant, J. M. Potekar, H.W. Awari, A Text Book of Greenhouse and Post Harvest Technology, 1st Edition June 2008, Nikita Publication, C/o:Narendra Book Depot, Mukund Tara Building, Old Cloth Line, Latur 413 512.

19. Communication Skills in English [ADAS1101] (0+1 Credit)**Lab-1: Formal and Informal Introduction.**

Lab-2: Reading Comprehension: using Dictionary, reading dialogues, rapid reading, intensive reading, improving reading skills; Passages for locating main idea and supporting details; Passages for skimming and scanning, Note making, Summary.

Lab-3: Writing Skill: Mechanics of good letter, Effective business correspondence, Personal Correspondence. Preparation of Curriculum vitae (CV) and Job application The Style, Importance of professional writing- Choice of words and Phrases, precision, conciseness clichés, redundancy. jargon, foreign words. Precise writing and synopsis writing.

Lab-4: Phonetics (Sounds of English): Introduction to phonetics; vowels, consonants, long and short vowels, syllables (stressed and unstressed), intonation.

Lab-5: Building Vocabulary Skills**Lab-6: Communicative Grammar**

Lab-7: Oral Presentation of Reports: Seminars and conferences, features of oral presentation, regulating speech, physical appearance, body language, voice, audience, preparation of visual aids.

Lab-8: Theme Based Presentations (Power Point and LCD Projector)**Lab-9: Telephonic Conversation****Lab-10: Mock Meetings****Lab-11: Mock Interviews****Lab-12: Group Discussions and Debates on Current Topics- Review or Feedback****20. Computer Application [ADAS1102] (0+1 Credit)**

- a. Introduction to Computers: Study of Computer Components; Booting of Computer and its Shut Down.
- b. Practice of some fundamental DOS Commands, TIL\1E DATE, DIR, COPY, FORMAT, VOL, LABEL, and PATH.
- c. Operating System, Units of memory, Use of Mouse, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars: WIT\,JOOWS Explorer, Creating Folders, COPY and PASTE functions.
- d. MSWORD: Creating a Document, Saving and editing: MSWORD, Use of options from Tool Bars, Format Insert and Tools (Spelling & Grammar) Alignment of text.
- e. MSWORD: Creating a Table, Merging of Cells, Column and Row width, advanced options(like Water marking, mailings).

- f. MSEXCEL: Overview of Excel, Formatting cells, Cut, Copy, Paste, Insert, Printing, Page Setup, Use of options from Tool Bars.
- g. MS EXCEL: Entering Expressions through the formula tool bar and use of inbuilt functions, SUM, AVERAGE, and SIDEV.
- h. MS EXCEL: Data Analysis using different charts. Creating Graphs and saving with &without data.
- i. MS Power Point: Preparation of slides on Power Point.
- j. MSACCESS: Creating Database, Structuring with different types of fields.
- k. Internet Browsing: Browsing a Web Page and Creating of E-Mail.

Reference Books:

- 1. Computer Studies - a First course -I Shelly and R. Hunt.
- 2. Computer Fundamentals - Anita Goel.
- 3. Microsoft Windows XP Manual.
- 4. Microsoft Office XP Manual.

20. Agriculture Work Experience [ADWE101] (0+4 Credits)

A special programme of internship for 90 hours is introduced at 3rd semester to learn the production and protection technologies by involving themselves in cultivation of rain fed and irrigated crops.