EVALUATION SCHEME & SYLLABUS

FOR

B. Tech. III YEAR
Agricultural Engineering

ON

ON CHOICE BASED CREDIT SYSTEM (CBCS)

[Effective from the Session: 2018-19]
## STUDY AND EVALUATION SCHEME

**B-Tech. Agricultural Engineering**  
**YEAR: 3rd / SEMESTER-V**

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## STUDY AND EVALUATION SCHEME
### B-Tech. Agricultural Engineering
#### YEAR: 3rd / SEMESTER-VI

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### Departmental Elective course-2

1. RAG-021  Field operation and maintenance of tractor and farm Machinery
2. RAG-022 Hydraulic drives and control
3. RAG-023  Mechanics of Tillage and Traction
4. RAG-024  Precision Farming Technique for Protected cultivation
FIFTH SEMESTER

RAG-501 Irrigation & Drainage Engg.

Unit-1

Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, present status of development and utilization of different water resources of the country; measurement of irrigation water: weir, flumes and orifices and other methods.

Unit-2

Open channel water conveyance system: design and lining of irrigation field channels, on farm structures for water conveyance, control & distribution; underground pipe conveyance system: components and design.

Unit-3

Land grading: criteria for land levelling, land levelling design methods, estimation of earth work; soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants, measurement of soil moisture, moisture stress and plant response.

Unit-4

Water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET, water and irrigation requirement of crops, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface methods of water application: border, check basin and furrow irrigation- adaptability, specification and design considerations.

Unit-5

Sub-surface drainage purpose and benefits, investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc., types of use of subsurface drainage system, steady and unsteady state methods for drain depth and spacing, installation and cost estimation, drainage of salt affected soils and leaching requirement inter-relation of irrigation and drainage, canal command area, development programmes. Adaptability, merit, demerit and design consideration of Drip and sprinkler Irrigation method.

Suggested Reading


Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles, Methods and Applications. Vikas Publication House, Noida (UP)


RAG-502 Farm Machinery and Equipment-II

Unit-1

Unit-2

Unit-3

Unit-4

Unit-5

Suggested Reading
Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery.

Smith HP and LH Wilkey. Farm Machinery and Equipment.

Culpin Claude. Farm Machinery.
RAG-503 Thermodynamic, Refrigeration and Air Conditioning.

UNIT-I

UNIT-II
Entropy, physical concept of entropy, change of entropy of gases in thermodynamics process. Otto, diesel and dual cycles. Principles of refrigeration, - units, terminology, and air refrigerators working on reverse Carnot cycle and Bell Coleman cycle, open air refrigeration cycle, merit demerit of air refrigeration. Vapour refrigeration-mechanism, P-V, P-S,P-H diagrams, vapour compression cycles, dry and wet compression, super cooling and sub cooling.

UNIT-III
Vapour absorption refrigeration system. Common refrigerants and their properties. Design calculations for refrigeration system. Cold storage plants. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process. Air conditioning – principles –Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods.

UNIT-IV
Fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations, types of air conditioners – applications, Food preservation, Domestic refrigerators ,commercial refrigerators, method of Food freezing. Study of cold storage for fruits and vegetable, freezing load and time calculations for food materials, study of window air conditioners repair and maintenance of refrigeration and air conditioning systems and chilling or ice making and cold storage plants.

Suggested Reading.


RAG 011 Drying and Storage Engineering (3-1-0)4

UNIT- I
Moisture content and methods for determination, importance of EMC and methods of its determination, EMC curve and EMC model, principle of drying, theory of diffusion, mechanism of drying- falling rate, constant rate, thin layer, deep bed and their analysis, critical moisture content, drying models.

UNIT- II
Calculation of drying air temperature and air flow rate, air pressure within the grain bed, Shred’s and Hukill’s curve, different methods of drying including puff drying, foam mat drying, freeze drying, etc. Study of different types of dryers- performance, energy utilization pattern and efficiency, study of drying and dehydration of agricultural products.

UNIT- III
Types and causes of spoilage in storage, conditions for storage of perishable products, functional requirements of storage, control of temperature and relative humidities inside storage, calculation of refrigeration load; modified atmospheric storage and control of its Environment, air movement inside the storage,

UNIT- IV
Storage of grains: destructive agents, respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through natural ventilation, mechanical ventilation, artificial drying, grain storage structures such as Bukhari, Morai, Kothar, silo, CAP, warehouse - design and control of environment.

UNIT- V
Storage of cereal grains and their products, storage of seeds, hermetically sealed and air cooled storages-refrigerated, controlled atmosphere, modified atmospheric and frozen storages. Storage condition for various fruits and vegetables under cold and CAP storage system. Economic, aspects of storage.

Suggested Reading.
1. Physical properties of plant and animal materials by N.N. Mohenensin
2. Engineering properties of foods by Rao, M.A and Rizvi.,S.S.H

RAG-012 Seed Processing (3-1-0)4

Unit-1
Seed processing and its importance, principles of seed processing, seed industry and seed acts; Development of seed industry in India, Preparing seed for processing; Seed conditioning machines. Debearder machines, Hand and power operated shelling machines; Seed cleaning, machines.

UNIT- II
Seed drying, natural and mechanical, dryers for seeds. Types & operation and maintenance of seed dryers; Seed cleaning; different type of air-screen operation, & maintenance machines, Seed grading; different types of seed graders such as length and breadth separators, disc separators,Indented cylinder separator, gravity separator; De-stoner; Air classifier Magnetic separators, colour separators, etc.

UNIT- III
Seed treatment; types of treatment, methods and related equipments such as liquid treaters, slurry treaters, dust and fumigants, precautions regarding the seed treatment and ISI recommendations; Seed packaging, stitching and bag closing machines, automatic weighing machines and tagging, etc.

UNIT- IV
Seed storage; principles of seed storage, storage structures; Dehumidifiers to control temp, and moisture, changes in seed quality during storage. CAP storage of hermetically sealed storages; Grain bins and silos, drying-cum-storage bins;

UNIT- V
Seed conveyors; bucket elevators, belt conveyors, screw conveyors, trucks bagons; Repair and maintenance of different types of conveying devices; Seed plant layout design and construction. Kessler, H.G. 1981. Food Engineering and Dairy Technology Verlag A. Kessler, Freising, F.R. Germany

Suggested Reading.

RAG 014 Food Packaging Technology (3-1-0)4

Unit I
Factors affecting shelf life of food materials during storage. Interactions of spoilage agents with environmental factors as water, oxygen, light, pH, etc. And general principles of control of the spoilage agents; difference between food infection, food intoxication and allergy. Packaging of foods, requirements, importance, and scope, framework of packaging strategy, environmental considerations.

Unit II
Packaging systems types: flexible and rigid; retail and bulk; levels of packaging; special solutions and packaging machines, technical packaging systems and data management packaging systems. Different types of packaging materials their key properties and applications, metal cans manufacture of two piece and three piece cans, plastic packaging, Different types of polymers used in food packaging and their barrier properties.

Unit III

Unit IV
Relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities. Nutritional labelling on packages, CAS and MAP, shrink and cling packaging, vacuum and gas packaging; Active packaging, Smart packaging, Packaging requirement for raw and processed foods and their selection of packaging materials, Factors affecting the choice of packaging materials, Disposal and recycle of packaging waste, Printing and labelling, Lamination.

Unit V
Package testing: Testing methods for flexible materials, rigid materials and semi-rigid materials; Tests for paper (thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond test, surface oil absorption test, etc.), plastic film and laminates (thickness, pin holes, etc), glass containers (visual defects, colour, dimensions, impact strength, etc), metal containers (pressure test, product compatibility, etc).

Suggested Reading
RAG 015 Food Quality and Control (3-1-0)4

Unit-I
Basics of Food Science and Food Analysis, Concept, objectives and need of food quality. Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.

Unit-II
Sampling; purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials. Quality control, Quality control tools, Statistical quality control, Sensory evaluation methods, panel selection methods,

Unit-III
Interpretation of sensory results. Instrumental method for testing quality. Food adulteration and food safety. TQM and TQC, consumer preferences and acceptance. Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point),

Unit IV
Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series.

Unit V
CAC (Codex Alimantarious Commission),Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism.

Suggested Reading
Sharma Avanthi.A text book of food science and Technology.
Potter NN and Hotchkiss Jh,Food Science.
Dev Raj, Rakesh Sharma and Joshi V.K.Quality for Value Addition in Food Processing.

RAG 551 Irrigation & Drainage Engg Lab.
1. Measurement of soil moisture by different soil moisture measuring instruments
3. Design of underground pipe line system.
7. In-situ measurement of hydraulic conductivity.
9. Installation of piezometer and observation well.
12. Design of surface drainage systems and subsurface drainage systems.
13. Determination of chemical properties of soil and water.
14. Fabrication of drainage tiles and testing of drainage tiles.
15. Determination of gypsum requirement for land reclamation;
16. Installation of sub-surface drainage system;
17. Cost analysis of surface and sub-surface drainage system.

**RAG-552 Farm Machinery and Equipment-II Lab**

1. Familiarization with plant protection and interculture equipment.
2. Study of sprayers, types, functional components.
4. Calculations for chemical application rates.
5. Study of nozzle types and spread pattern using patternator with reference to BIS code.
7. Study of fertilizer application equipment including manure spreaders and fertilizer broadcasters.
8. Study of various types of mowers, reaper, reaper binder.
10. Familiarization with threshing systems, cleaning systems in threshers.
11. Calculations of losses in threshers with reference to BIS code.
12. Familiarization with functional units of Grain combines and their types.
13. Calculations for grain losses in a combine.
14. Study of root crop diggers and familiarization with the functional units and attachments. Familiarization with the working of cotton and maize harvesters.
15. Familiarization with vegetable and fruit harvesters.

**RAG-553 Thermodynamics, Refrigeration and Air conditioning Lab**

1. Study of vapour compression and vapour absorption systems
2. Solving problems on refrigeration on vapour absorption system
3. Experiments with the refrigeration tutor to study various components of refrigeration
4. Determination of the coefficient of performance of the refrigeration tutor
5. Experiment on humidifier for the determination of humidifying efficiency
6. Experiment on dehumidifier for the determination of dehumidifying efficiency
7. Experiment on the cooling efficiency of a domestic refrigerator
8. Experiments on working details of a cold storage plant and air conditioning unit
9. Experiments with air conditioning tutor to study various components
RAG-554 Tractor & Farm Machinery Operation and Maintenance Lab

(1) Familiarization with different makes and models of Agricultural tractors.
(2) Identification of functional systems including fuel systems, cooling system, transmission system, steering hydraulic system.
(3) Practice of operating of trillage tools (Mould board plough/disc plough) and their adjustment in the field.
(4) Study of field patterns while operating a tillage implement. Hitching and de-hitching of mounted and trail type implement of the tractor.
(5) Care and maintenance produce of Agricultural machinery during operation and off season.
(6) Repaire and maintenace of implements -adjustment of functional parameters in tillage implements.
(7) Replacement of furrow openers and change of blades of rotabators.
(8) Maintenace of cutter bar in a reaper.
(9) Adjustments in a thrasher for differant crops.
SIXTH SEMESTER

RAG-601 Tractor & Auto Motive Engine.

Unit-I


Unit-II

Study of engine components their construction, operating principles and functions. Study of engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines. Study of Engine Valve systems, valve mechanism, Valve timing diagram, and valve clearance adjustment.

Unit-III

Study of Cam profile, valve lift and valve opening area. Study of importance of air cleaning system. Study of types of air cleaners and performance characteristics of various air cleaners. Study of fuel supply system. Study of fuels, properties of fuels, calculation of air-fuel ratio. Study of tests on fuel for SI and CI engines.

Unit-IV


Unit-V


Suggested Reading :-
1. Tractors and their Power Units, John B. Lijiedahal, Paul K. Turnquist : CBS Publication

RAG-602 EPAP, Post Harvest Engg. of Horticultural, Medicinal and Aromatic Plants.

Unit-I

Classification and importance of engineering properties of Agricultural Produce, shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits
and vegetables, Thermal properties, Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion, Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance, angle of internal friction, angle of repose, Flow of bulk granular materials, Aero dynamics of agricultural products, drag coefficients, terminal velocity.

**Unit-II**


**Unit-III**

Importance of processing of fruits and vegetables, spices, condiments and flowers. Characteristics and properties of horticultural crops important for processing, Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling), Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction, etc.

**Unit-IV**

Blanching: Importance and objectives; blanching methods, effects on food (nutrition, colour, pigment, texture), Chilling and freezing: Application of refrigeration in different perishable food products, Thermophilic, mesophilic & Psychrophilic micro-organisms, Chilling requirements of different fruits and vegetables, Freezing of food, freezing time calculations, slow and fast freezing, Equipment for chilling and freezing (mechanical & cryogenic), Effect on food during chilling and freezing.

**Unit-V**

History, scope, opportunities and constraints in the cultivation and utilization of medicinal And aromatic plants in India. Importance, origin, distribution, area, production, climatic and Soil requirements, Propagation and nursery techniques, planting and aftercare, training and pruning, nutritional and water requirements. Harvesting, processing and economics of under mentioned important medicinal and aromatic plants. Medicinal Plants: pepper, cardamom, clove, ginger, turmeric, betelvine, periwinkle, Rauwolfia, Dioscorea, isabgol, Ammi majus, belladonna, Cinchona, pyrethrum and other species relevant to local conditions. Study of chemical composition of a few important medicinal and aromatic plants, their extraction and use. Therapeutic and pharmaceutical uses of important species.

**Suggested Reading**


RAG-603 Water Harvesting and Soil Conservation Structures

Unit-I


Unit-II

Long-term harvesting techniques - purpose and design criteria. Structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes. Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction.

Unit-III

Percolation pond - site selection, design and construction details. Design considerations of nala bunds. Soil erosion control structures - introduction, classification and functional requirements. Permanent structures for soil conservation and gully control - check dams, drop, chute and drop inlet spillways - design requirements, planning for design, design procedures - hydrologic, hydraulic and structural design and stability analysis.

Unit-IV

Hydraulic jump and its application. Drop spillway - applicability, types - straight drop, box-type inlet spillways - description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components and functions. Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations. Drop inlet spillway - description, functional use and design criteria.

Suggested Reading


Departmental Elective course-2
RAG-021 Field Operation and Maintenance of Tractor and Farm Machinery.

Unit-I
Familiarization with different makes and models of agricultural tractors. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems. Study of maintenance points to be checked before starting a tractor.

Unit-II
Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor. Driving practice of tractor. Practice of operating a tillage tool (mould-board plough/ disc plough) and their adjustment in the field. Study of field patterns while operating a tillage implement.

Unit-III
Hitching & De-hitching of mounted and trail type implement to the tractor. Driving practice with a trail type trolley – forward and in reverse direction. Introduction to tractor maintenance – precautionary and break-down maintenance. Tractor starting with low battery charge. Introduction to trouble shooting in tractors.

Unit-IV
Familiarization with tools for general and special maintenance. Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance of implements – adjustment of functional parameters in tillage implements.

Unit-V

Suggested Reading
Ghosh RK and S Swan. Practical Agricultural Engineering.
Southorn N. Tractor operation and maintenance.
Jain SC and CR Rai. Farm Tractor Maintenance and Repair.
Operators manuals of tractors.
Service manuals provided by manufacturers.
RAG-022 Hydraulic Drives and Control.

Unit-I

Unit-II

Unit-III

Unit-IV
Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC.

Unit-V
Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs).

Suggested Reading
Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery.
Anthony E. Fluid Power and Applications.
Majumdar. Oil Hydraulic System.
Merit. Hydraulic Control Systems.
John Deere. Fundamentals of Service Hydraulics.

RAG-023 Mechanics of Tillage and Traction

UNIT- I
Introduction to mechanics of tillage tools, methods of soil testing, engineering properties of soil, principles and concepts, stress strain relationship. Measurement of static and dynamic soil parameter and soil compaction and plant growth.

UNIT- II
Design of tillage tools principles of soil cutting, design equation, force acting on tillage tools such as MB plough & cultivator, application of dimensional analysis in soil dynamics of tillage tools. Measurement of draft of various tillage tools like passive and oscillatory.

UNIT- III
Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction.

UNIT-IV

Tyre size, tyre lug geometry and their effects, tyre testing. Variability and geo statistic, application of GIS in soil dynamics.

Unit-V

Weight transfer and tractor loading including placement and traction aids; Studies on tyres, tracks and treads under different conditions, and soil compaction and number of operations.

Suggested Reading

1. Jones, F.R. Farm Gas Engines and Tractors
2. Barger, E.L.; Lijedehl, J.B; Carleton, W.B. and Mc Kibben, E.G. Tractors and their Power Units.
5. Culpin Claude. Farm Machinery.

RAG-024 Precision Farming Technique for Protected cultivation

Unit-I

Protected cultivation: Introduction, History, origin, development, National and International Scenario, components of green house, perspective, Types of green houses, polyhouses / shed nets, Cladding materials, Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment.

Unit-II

Design and construction of green houses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment.

Unit-III


Unit-IV

Irrigation in greenhouse and net house – Water quality, types of irrigation system, components, design, installation and material requirement. Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Maintenance of irrigation and fogging systems. Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of proper application of fertilizers, fertilizer scheduling, rate of application of fertilizers, methods, automated fertilizer application.

Unit-V

Greenhouse climate measurement, control and management. Insect and disease management in greenhouse and net houses Selection of crops for greenhouse cultivation, major crops in greenhouse – irrigation requirement, fertilizer management, cultivation, harvesting and post harvest techniques; Economic analysis.
Suggested Reading

RAG-652 Post Harvest Engg. Of Horticultural, Medicinal and Aromatic Plants Lab.
(1) Performance evaluation of peeler and slicer.
(2) Performance evaluation of juicer and pulper.
(3) Performance evaluation of blanching equipment,
(4) Testing adequacy of blanching, Study of cold storage and its design,
(5) Study of CAP and MAP storage, Minimal processing of vegetables.
(6) Preparation of value added products.
(7) Visit to fruit and vegetable processing industry, Visit to spice processing plant.
(8) Study of charcteristics of differant medicinal and aeromatic plant & Identification of their economic part.
(9) Harvesting drying, grading,storage and packaging of medicinal and aeromatic plant.
(10) Study on preparation of plant materials for extraction and value added products from medicinal and aeromatic plants.

RAG-653 Water Harvesting and Soil Conservation Lab
(1) Study of different types of farm ponds.
(2) Computation of storage capacity of embankment type of farm ponds.
(3) Design of dugout farm ponds. Design of percolation pond and nala bunds.
(4) Runoff measurement using H-flume.
(5) Exercise on hydraulic jump. Exercise on energy dissipation in water flow.
(6) Hydrologic, hydraulic and structural design of drop spillway and stability analysis.
(7) Design of SAF stilling basins in chute spillway.
(8) Hydrologic, hydraulic and structural design of drop inlet spillway.
(9) Design of small earthen embankment structures.
(10) Practice on softwares for design of soil and water conservation structures.
(11) Field visit to watershed project areas treated with soil and water conservation measures / structures.

RAG 654 Engineering Properties of Agricultural Produce Lab
(1) Determination of the shape and size of grains, fruits and vegetables.
(2) Determination of bulk density and angle of repose of grains,
(3) Determination of the particle density/true density and porosity of solid grains.
(4) Finding the co-efficient of external and internal friction of different crops.
(5) Finding out the terminal velocity of grain sample and study the separating behaviour in a vertical wind tunnel.