

Study and Evaluation Scheme
B. Tech. (Agricultural Engineering)
[Effective from Session 2016-17]
Fourth Year, Semester VII

S. No.	Subject Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CA	TA	Total			
Theory Subjects											
1	NAG011-013	Open Elective other Depts -1	2	0	0	15	10	25	50	75	2
2	NAG021-023	Open Elective other Depts -2	3	1	0	30	20	50	100	150	4
3	NAG703	Soil & water conservation structure	3	1	0	30	20	50	100	150	4
4	NAG704	Drying & Storage Engg	3	1	0	30	20	50	100	150	4
5	NAG031-033	Depts Elective III	3	1	0	30	20	50	100	150	4
Practical											
6	NAG751	Soil & water conservation structure Lab	0	0	2	10	10	20	30	50	1
7	NAG752	Industrial Training	0	0	3		75	75		75	2
8	NAG753	Project	0	0	8		50	50	100	150	4
9	NGP701	GP						50		50	
		Total	14	4	13					1000	25

Open Elective other Depts. -1

- (1) NAG-011 Plastic Applications in Agriculture
- (2) NAG-012 Precision Agriculture and System Management
- (3) NAG-013 Food Quality & Control

Open Elective other Deptts -2

- (1) NAG-021 Design of Agricultural Machinery
- (2) NAG-022 Micro Irrigation System Design
- (3) NAG-023 Seed Process Engg

Deptt Elective- III

- (1) NAG-031 Testing Agricultural Machinery & Tractor
- (2) NAG-032 Ground water & well pump Engg
- (3) NAG-033 Food Packaging Technology

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B. Tech. (Agricultural Engineering)
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S. No.	Subject Code	SUBJECT	PERIODS			Evaluation Scheme			Subject Total	Credit	
			L	T	P	Sessional Exam					ESE
						CA	TA	Total			
Theory Subjects											
1	NAG061-063	Open Elective other Depts-3	3	1	0	30	20	50	100	150	4
2	NAG801	Mechanics of Tillage & Traction	3	1	0	30	20	50	100	150	4
3	NAG041-043	Depts Elective IV	3	1	0	30	20	50	100	150	4
4	NAG051-053	Depts Elective V	3	1	0	30	20	50	100	150	4
Practical											
5	NAG851	Seminar	0	0	3		100	100		100	2
6	NAG852	Project			12		100	150	150	250	7
7	NGP801	GP						50		50	
		Total	12	4	15					1000	25

Open Elective other Depts-3

- (1) NAG-061 Precision Farming Techniques for Protected Cultivation
- (2) NAG-062 Waste & by Product Utilization
- (3) NAG-063 Remote Sensing & GIS

Depts Elective –IV

- (1) NAG-041 Post- Harvest Engineering of Horticultural, Medicinal and Aromatic Crops
- (2) NAG-042 Agricultural Structure & Environmental Control
- (3) NAG-043 Wasteland Development

Depts Elective –V

- (1) NAG-051 Renewable Energy Sources
- (2) NAG-052 Crop process Engg
- (3) NAG-053 Tractor Design Principle

Open Elective other Depts. -1

1- Plastic Applications in Agriculture (NAG-011)

2 (2+0)

Unit-1

Introduction of plasticulture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management. Quality control measures. Present status and future prospective of plasticulture in India. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir.

Unit-II

Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Drip and sprinkler irrigation systems. Use of polymers in control of percolation losses in fields. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation. Nursery management - Use of plastics in nursery raising, nursery bags, trays etc. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers. Plastic nets for crop protection - anti insect nets, bird protection nets. Plastic fencing. Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products. Plastic cap covers for storage of food grains in open.

Unit-III

Use of plastics as alternate material for manufacturing farm equipment and machinery. Plastics for aquacultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Silage film technique for fodder preservation. Agencies involved in the promotion of plasticulture in agriculture at national and state level. Human resource development in plasticulture applications.

Suggested Reading

Brahma Singh, Balraj Singh, Naved Sabir and Murtaza Hasan. 2014.Advances in Protected Cultivation. New India Publishing Agency, New Delhi.

Brown, R.P. 2004. Polymers in Agriculture and Horticulture. RAPRA Review Reports : Vol. 15, No. 2, RAPRA Technology Limited, U.K.

Central Pollution Control Board. 2012. Material on Plastic Waste Management. Parivesh Bhawan, East Arjun Nagar, Delhi-110032.

Charles A. Harper. 2006. Handbook of Plastics Technologies. The Complete Guide to Properties and Performance. McGraw-Hill, New Delhi.

Dubois. 1978. Plastics in Agriculture. Applied Science Publishers Limited, Essex, England.

Manas Chanda, Salil K. Roy. 2008. Plastics Fundamentals, Properties, and Testing. CRC Press.

Ojha, T.P. and Michael, A.M., 2012, Principles of Agricultural Engineering - I. Jain Brothers, Karol Bagh, New Delhi.

Pandey, P.H. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana, India.

Shankar, A.N. 2014. Integrated Horticulture Development in Eastern Himalayas, Plasticulture in Agri-Horticulture Systems, 241-247.

Srivastava, R.K., R.C. Maheswari, T.P. Ojha, and A. Alam. 1988. Plastics in Agriculture. Jain Brothers, Karol Bagh, New Delhi.

2- Precision Agriculture and System Management (NAG-012) 2 (0+0)2

Unit-I

Precision Agriculture – need and functional requirements. Familiarization with issues relating to natural resources. Familiarization with equipment for precision agriculture including sowing and planting machines.

Unit-II

Power sprayers, land clearing machines, laser guided land levellers, straw-chopper, straw-balers, grain combines, etc. Introduction to GIS based precision agriculture and its applications. Introduction to sensors and application of sensors for data generation.

Unit-III

Database management. System concept. System approach in farm machinery management, problems on machinery selection, maintenance and scheduling of operations. Application to PERT and CPM for machinery system management

Suggested Reading

Kuhar J E. The Precision Farming Guide for Agriculturist.

Dutta SK. Soil Conservation and land management.

Sigma and Jagmohan. Earth Moving Machinery.

Wood and Stuart. Earth Moving Machinery.

DeMess MN. Fundamentals of Geographic Information System.

Hunt Donnell. Farm Power and Machinery Management.

Sharma DN and S Mukesh. Farm Power and Machinery Management Vol I.

3-Food Quality & Control (NAG-013) 2 (0+0)2

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. Sampling; purpose, sampling techniques, sampling procedures for liquid, powdered and granular materials.

Unit-II

Quality control, Quality control tools, Statistical quality control, Sensory evaluation methods, panel selection methods, Interpretation of sensory results. Instrumental method for testing quality. Food adulteration and food safety. TQM and TQC, consumer preferences and acceptance.

Unit-III

Food Safety Management Systems GAP, GHP, GMP, Hazards and HACCP (Hazard analysis and critical control point), Sanitation in food industry (SSOP), Food Laws and Regulations in India, FSSAI, Food grades and standards BIS, AGMARK, PFA, FPO, ISO 9000, 22000 Series.

CAC (Codex Alimentarius Commission), Traceability and Quality Assurance system in a process plant, Bio safety and Bioterrorism

Suggested Reading

Ranganna S. Hand book of Analysis and Quality Control for Fruit and Vegetable Products.

Srilakshmi B, Food Science.

Sharma Avanthi. A text book of Food Science and Technology.

Mudambi Sumati R, Rao Shalini M and Rajagopal M.V. Food Science.

Potter NN and Hotchkiss JH, Food Science.

Dev Raj, Rakesh Sharma and Joshi V.K, Quality for Value Addition in Food Processing.

The Food Safety and Standards Act along with Rules & Regulations. Commercial Law Publishers (India) Pvt. Ltd.

Open Elective other Depts. -2

1- Design of Agricultural Machinery (NAG-021)

4 (3+1)

Unit-I

Materials of construction of agricultural farm machinery and tractor - their composition and properties.

Unit-II

Force analysis of primary tillage tools and their hitching systems, design of tillage implements- M B plough, disk plough, disk harrow, rotavator

Unit-III

Design of seed-drill, happy seed-drill, seed metering device, power transmission and furrow opener such as double disc, Inverted T type and roto type (rotavater).

Unit-IV

Design of planter such as maize, cotton, sugar cane planter, vegetable planter.

Unit-V

Design considerations of threshing machines, combines.

2- Micro Irrigation Systems Design (NAG-022)

4 (3+1)

UNIT- I

Past, present and future need of micro-irrigation systems, Role of Govt. for the promotion of micro-irrigation in India, Merits and demerits of micro-irrigation system,

UNIT- II

Types and components of micro-irrigation system, Micro-irrigation system- design, design synthesis, installation, and maintenance.

UNIT- III

Sprinkler irrigation - types, planning factors, uniformity and efficiency, laying pipeline, hydraulic lateral, sub-mains and main line design.

UNIT- IV

Pump and power unit selection. Drip irrigation –drip irrigation layout, potential, automation, crops suitability. Fertigation – Fertilizer application criteria, suitability of fertilizer compounds, fertilizer mixing, injection duration, rate and frequency, capacity of fertilizer tank.

UNIT- V

Quality control in micro-irrigation components, design and maintenance of polyhouse; prospects.

3-Seed Process Engg (NAG-023)

4 (3+1)

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, grading and separating machines& their design.

UNIT- II

Seed drying, natural and mechanical, dryers for seeds. Types & operation and maintenance of seed dryers; Seed cleaning; different type of air-screen cleaning/ separating 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 and operation, care & maintenance of cleaners and graders.

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, RH and moisture, changes in seed quality during storage. CAP storage of hermetically sealed storages; Grain bins and silos, drying-cum-storage bins and their design.

UNIT- V

Seed conveyors; bucket elevators, belt conveyors, screw conveyors, trucks Wagons; Repair and maintenance of different types of conveying devices; Seed plant layout design and construction.

Soil and Water Conservation Structures (NAG-703)

4 (3+1)

UNIT- I

Introduction; classification of structures, functional requirements of soil erosion control structures; flow in open channels-types of flow, state of flow, regimes of flow, energy and momentum principles, specific energy and specific force; hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of Energy;

UNIT- II

Runoff measuring structures-parshall flume, H - flume and weirs; straight drop spillway - general description, functional use, advantages and disadvantages, structural parts and functions; components of spillway, hydrologic and hydraulic design, free board and wave free board, aeration of weirs, concept of free and submerged flow,

UNIT- III

Structural design of a drop spillway-loads on headwall, variables affecting equivalent fluid pressure, determination of saturation line for different flow conditions, seepage under the structure, equivalent fluid pressure of triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension;

UNIT- IV

Chute spillway general description and its components, hydraulic design, energy dissipaters, design criteria of a SAF stilling basin and its limitations,

UNIT- V

Drop inlet spillway- general description, functional use, design criteria; design of diversions; small earth embankments-their types and design principles, farm ponds and reservoirs, cost estimation of structures.

Drying and Storage Engineering (NAG-704) 4 (3+1)

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.

Depts Elective- III

(1) Testing of Agricultural Machinery and Tractor (NAG-031)

4 (3+1)

UNIT- I

Basic objectives of testing of agricultural equipment; concept and importance. Different terminology used in testing of agricultural equipment, I.C engines and tractors. Different types of transducer and their uses, instrumentation for draft, slip, sinkage, soil resistance, sound and vibration.

UNIT- II

Test codes: Nebraska, OECD, RNAM, ISO, BIS etc., basis difference. Testing of primary and secondary equipment as per BIS Code. Test codes and procedures for testing of Ferti seed drills and fertilizer applicator.

UNIT- III

Harvesting machinery such as combine, mower reaper, sprayers and dusters etc. as per BIS standard.

UNIT- IV

Test codes for paddy transplanter, Sugar cane planter and other equipment used in sugar cane production, potato and vegetable transplanter as per BIS Code.

UNIT- V

Test code and procedure of testing of tractors, engines and irrigation pumps.

(2) GROUNDWATER, WELLS AND PUMPS ENGG (NAG-032)

4 (3+1)

Unit I

Occurrence and movement of ground water, aquifer and its types, classification of wells, familiarization of various types of bore wells, design of open well, groundwater exploration techniques, methods of drilling of wells.

Unit II

Design of assembly and gravel pack, installation of well screen, completion and development of well, groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's etc.

Well interference, multiple well systems, surface and subsurface exploitation and estimation of ground water potential, quality of ground water, artificial groundwater recharge planning, modeling, ground water project formulation.

Unit III

Pumping Systems: Water lifting devices; different types of pumping machinery, classification of pumps, parts of centrifugal pumps; pump selection, installation and troubleshooting; design of centrifugal pumps,

Unit IV

Performance curves, effect of speed on head capacity, power capacity and efficiency curves, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics.

Unit V

Priming, self priming devices, roto-dynamic pumps for special purposes such as deep well turbine pump and submersible pump.

(3)Food Packaging Technology (NAG-033)

4 (3+1)

Unit I

Factors affecting shelf life of food materials during storage, difference between food infection, food intoxication and allergy. Importance, requirements and scope of packaging of foods & environmental considerations.

Unit II

Different types of packaging materials: flexible and rigid, retail and bulk; levels of packaging, packaging machines. Properties and application of metal cans, manufacture of two piece and three piece cans, plastic packaging, different types of polymers used in food packaging and their barrier properties, blown film/sheet extrusion, blow moulding injection blow moulding, stretch blow moulding, injection moulding.

Unit III

Glass container, types of glass used in food packaging, manufacture of glass container, closures for glass containers. Characteristics of paper and paper board packaging, Relative advantages and disadvantages of different packaging materials. Nutritional labelling on packages, CAS and MAP, shrink and wrap packaging, vacuum and gas packaging; active packaging Smart packaging.

Unit IV

Testing methods for flexible material, rigid material and semi rigid materials; plastic film and laminated (thickness, tensile strength, gloss, haze, burning test to identify polymer etc.), aluminium foil (thickness, pin holes, etc.), glass containers (visual defects, colour, dimensions, impact strength, etc.), metal containers (pressure test, product compatibility).

Unit V

Study of tensile/ compressive strength of different packages, destructive and non-destructive properties of glass containers, vacuum packaging of agricultural products, tearing strength of paper and board, thickness of packaging materials. Bursting strength of packaging material, water-vapour transmission rate, shrink wrapping of various horticultural produce, chemical resistance of packaging materials, and of drop test of food packages and visit to relevant industries.

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			L	T	P	Sessional Exam					ESE
						CA	TA	Total			
Theory Subjects											
1	NAG061-063	Open Elective other Depts-3	3	1	0	30	20	50	100	150	4
2	NAG801	Mechanics of Tillage & Traction	3	1	0	30	20	50	100	150	4
3	NAG041-043	Depts Elective IV	3	1	0	30	20	50	100	150	4
4	NAG051-053	Depts Elective V	3	1	0	30	20	50	100	150	4
Practical											
5	NAG851	Seminar	0	0	3		100	100		100	2
6	NAG852	Project			12		100	150	150	250	7
7	NGP801	GP						50		50	
		Total	12	4	15					1000	25

Open Elective other Depts-3

- (1) NAG-061 Precision Farming Techniques for Protected Cultivation
- (2) NAG-062 Waste & by Product Utilization
- (3) NAG-063 Remote Sensing & GIS

Depts Elective –IV

- (4) NAG-041 Post- Harvest Engineering of Horticultural, Medicinal and Aromatic Crops
- (5) NAG-042 Agricultural Structure & Environmental Control
- (6) NAG-043 Wasteland Development

Depts Elective –V

- (4) NAG-051 Renewable Energy Sources
- (5) NAG-052 Crop process Engg
- (6) NAG-053 Tractor Design Principle

Open Elective other Depts-3

1-Precision Farming Techniques for Protected Cultivation (NAG061) 4 (3+1)

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

Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fan-pad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc. Greenhouse heating – necessity, components, methods, design of heating system. Root media – types – soil and soil less media, composition, estimation, preparation and disinfection, bed preparation. Planting techniques in green house cultivation.

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

Singh Brahma and Balraj Singh. 2014. Advances in protected cultivation, New India Publishing Company.

Sharma P. 2007. Precision Farming. Daya Publishing House New Delhi.

2- Waste and By-Products Utilization (NAG062)

4 (3+1)

Unit-I

Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc.,

Unit-II

Concept, scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues.

Unit-III

Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization.

Unit-IV

Waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermin-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation.

Unit-V

Secondary treatments: Biological and chemical oxygen demand for different food plant waste–trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters , phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation, Effluent treatment plants, Environmental performance of food industry to comply with ISO-14001 standards

Suggested Reading

Markel, I.A. 1981. Managing Livestock Waste, AVI Publishing Co.

Pantastico, ECB. 1975. Post Harvest Physiology, Handling and utilization of Tropical and Sub-tropical fruits and vegetables, AVI Pub. Co.

Shewfelt, R.L. and Prussi, S.E. 1992. Post-Harvest Handling – A Systems approach, Academic Press Inc.

USDA. 1992. Agricultural Waste Management Field Hand book. USDA, Washington DC.

Weichmann J. 1987. Post Harvest Physiology of vegetables, Marcel and Dekker Verlag.

V.K. Joshi & S.K. Sharma. Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency.

Vasso Oreopoulou and Winfried Russ (Edited). 2007. Utilization of By-products and Treatment of waste in the Food Industry. Springer Science & Business media, LLC 233 New York.

Prashar, Anupama and Bansal, Pratibha. 2007-08. Industrial Safety and Environment. S.K. Kataria and sons, New Delhi

Garg, S K. 1998. Environmental Engineering (Vol. II) – Sewage Disposal and Air Pollution Engineering. Khanna Publishers, New Delhi

Bhatia, S.C.. 2001. Environmental Pollution and Control in Chemical Process Industries. Khanna Publishers, New Delhi.

Unit-I

Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water; spectral signatures.

Unit-II

Different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation- interpretation elements;

Unit-III

photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices.

Unit-IV

Microwave remote sensing. GIS basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties.

Unit-V

Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.

Suggested Reading

- Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
- Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
- George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
- Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
- Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
- Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.

Sahu, K.C. 2008. Text Book of Remote Sensing and Geographic Information Systems. Atlantic Publishers and Distributors (P) Ltd., New Delhi.

Shultz, G.A. and E.T. Engman. 2000. Remote Sensing in Hydrology and Water Management. Springer, New York.

Mechanics of Tillage and Traction (NAG801)

4 (3+1)

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.

Depts Elective –IV

Post- Harvest Engineering of Horticultural, Medicinal and Aromatic Crops 4(3-1-0)

(NAG041)

Unit – I

Introduction and importance of post - harvest processing and handling of horticultural crops (fruits, vegetables, flowers), medicinal (pepper, cardamom, clove, ginger, turmeric, betel vine, dioscorea, stevia, coleus, ashwagandha, tulsi, isabgol, safed musli, senna, aloe vera, catharanthus etc.) and aromatic plants (davana, mint, rosemary, rose, khus grass, sweet flag (bach), citronella grass, lavender, jasmine, geranium, patchouli, bursera, mentha, muskdana (musk mallow) and other relevant to local conditions) for various post -harvest operations such as cleaning, peeling, washing, slicing, sorting, grading, and precooling for value addition and packing for effective marketing and reducing losses. Characteristics of above crops important for processing and value addition.

Unit –II

Factors affecting post-harvest losses of fruits, vegetables and flowers; medicinal and aromatic plants. Dehydration and technology of preservation for fruits, vegetables, Preservation technology for flowers. Compositions and quality characteristics of fruits and vegetables. Study of different peeling methods and devices for manual, mechanical, chemical and thermal peeling; slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction, blanching: importance and objectives of blanching, blanching methods, effect of blanching on nutrition, colour, pigment, and texture etc.

Unit III

Chilling and freezing: application and effect of different levels of refrigeration in different perishable food products, study of equipment for chilling and freezing (mechanical and cryogenic). Cold storage design and heat load calculations, refrigerated vehicle and cold chain system,

Unit - IV

Drying and dryers for fruits and vegetables, osmo-dehydration, packaging of horticultural, medicinal and aromatic commodities, packaging requirements (in terms of light transmittance, heat, moisture, and gas proof, micro-organisms, and mechanical strength), different types of packaging materials commonly used for raw and processed products of above commodities, bulk and retail packages and packaging machines, pack house technology, minimal processing, common methods of storage, low temperature storage, evaporative cooled storage, controlled atmospheric storage, modified atmospheric packaging and preservation technology, general methods of preservation of fruits and vegetables, medicinal and aromatic products, Brief description, and advantages and disadvantages of different methods of preservation, flow charts for preparation of different finished products, parameters, Extraction and analysis of active principles using TLC/ HPLC /GC. Distillation, solvent extraction from aromatic plants- davana, mint, rosemary, rose, citronella, lavender, jasmine, etc. Study of aroma compounds and value addition. Nano-processing technology in medicinal and aromatic plants.

Unit –V

Performance evaluation of peelers, slicers, juicers, pulpers and blanching equipment. Study of cold storage and its design suiting to requirements of different perishables, medicinal and aromatic plants. Study of CAP, and MAP storage. Minimal processing of fruits, vegetables and flowers. Preparation of value added products, Study processing of medicinal plants, their drying and storage. Extraction of active ingredients for different spices and medicinal plants using TLC, HPLC, GC, GC-MS technology. Distillation, solvent extraction from aromatic plants – davana, mint, rosemary, citronella, lavender, jasmine, etc. Identification of different odoriferous in essential oils with GLC/GCMS. Physico-chemical and sensory evaluation of oils and oleoresin. Design of crates and packaging etc., Visit to study the fruits, vegetables and flowers, medicinal and aromatic plants processing industry.

2- Agricultural Structures and Environmental Control (NAG-042) 4 (3+1)

Unit I

Planning and layout of farmstead. Scope, importance and need for environmental control, physiological reaction of livestock environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods.

Unit II

B.I.S standard for dairy, poultry, piggery and other farm structures. Design, construction, building materials, methods of cost estimation and cost estimation of farm residence, farm structures; animal shelters, compost pits, fodder silos, fencing and implements sheds, barn for cows, buffalos, and poultry etc.

Unit III

Rural living and development, rural roads, their construction cost and repair and maintenance, sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community.

Unit IV

Importance of storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage, Moisture and temperature changes in grain bins; Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins),

Unit V

Design considerations for grain storage godowns, Bag storage structures, Shallow and Deep bins, Calculation of pressure in bins, Storage of seeds, Site and orientation of building in regard to sanitation, community sanitation system; sewage system and its design, cost and maintenance, design of septic tank for small family, Estimation of domestic power requirement, source of power supply and electrification of rural housing.

3-Wasteland Development (NAG-043) 4(3+1)

Unit-I

Land degradation – concept, classification - arid, semiarid, humid and sub-humid regions, denuded range land and marginal lands. Wastelands - factors causing, classification and mapping of wastelands, planning of wastelands development - constraints, agro-climatic conditions, development options, contingency plans.

Unit-II

Conservation structures - gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods.

Unit-III

Afforestation - agro-horti-forestry-silvipasture methods, forage and fuel crops - socioeconomic constraints. Shifting cultivation, optimal land use options.

Unit-IV

Wasteland development – hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands. Mine spoils- impact, land degradation and reclamation and rehabilitation, slope stabilization and mine environment management.

Unit-V

Micro-irrigation in wastelands development. Sustainable wasteland development - drought situations, socio-economic perspectives. Government policies. Participatory approach. Preparation of proposal for wasteland development and benefit-cost analysis.

Suggested Reading

Abrol, I.P., and V.V. Dhruvanarayana. 1998. Technologies for Wasteland Development. ICAR, New Delhi.

Ambast, S.K., S.K. Gupta and Gurcharan Singh (Eds.) 2007. Agricultural Land Drainage - Reclamation of Waterlogged Saline Lands. Central Soil Salinity Research Institute, Karnal, Haryana.

Hridai Ram Yadav. 2013. Management of Wastelands. Concept Publishing Company. New Delhi.

Karthikeyan, C., K. Thangaraja, C. Cinthia Fernandez and K. Chandrakandon. 2009. Dryland Agriculture and Wasteland Management. Atlantic Publishers and Distributors Pvt. Ltd., New Delhi.

Rattan Lal and B.A. Stewart (Ed.). 2015. Soil Management of Smallholder Agriculture. Volume 21 of Advances in Soil Science. CRC Press, Taylor and Francis Group, Florida, USA.

Robert Malliva and Thomas Missimer. 2012. Arid Lands Water Evaluation and Management. Springer Heidelberg, New York.

Swaminathan, M.S. 2010. Science and Integrated Rural Development. Concept Publishing Company (P) Ltd., Delhi.

The Energy and Resources Institute. 2003. Looking Back to Think Ahead-Green India 2047. Growth with Resource Enhancement of Environment and Nature. New Delhi.

Virmani, S.M. (Ed.). 2010. Degraded and Wastelands of India: Status and Spatial Distribution. ICAR, New Delhi.

Depts Elective –V

1-Renewal energy resources (NAG051) 4 (3+1)

UNIT-1

Conventional & non conventional sources, feasibility& assessment of animate and inanimate sources, introduction of renewable energy sources biomass ,wind, Solar, characterization of biomass.

UNIT-2

Solar thermal power and it's conversion, Solar collectors, Flat plate, solar pumping, solar cooking, Greenhouses, Solar power plants.different solar thermal devices, principals of natural forces convection drying system, solar photovoltaic, solar cell, PV system, grid connected solar

power station. Wind energy energy available from wind general formula lift and drag, basis of wind energy conversion

UNIT-3

Type of Biogas plants, Biogas production technique, materials used for biogas production, handling of slurry, optimization of solid waste Ratio for maximum Biogas production. Various types of biomass cooks stoves rural energy needs.

UNIT-4

Agro forestry for Bio-Energy, biomass, uses, energy from solid waste and Agri waste. Biomass gasification, types of grassfire.

UNIT-5

Calculations of Energy throw photovoltaic power generation and cast economics

2-Crop Process Engg (NAG052)

4(3+1)

UNIT- I

Scope and importance of food processing, principles and methods of food processing. Processing of farm crops; cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed. Processing of animal products for food and feed.

UNIT- II

Principle of size reduction, grain shape, Size reduction machines; crushers, grinders, cutting machines etc. - operation, efficiency and power requirement – Rittinger's, Kick's and Bond's equation, fineness modulus.

UNIT- III

Theory of mixing, types of mixtures for dry and paste, materials, rate of mixing and power requirement, mixing index. Theory of separation, size and upsized separation, Types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation.

UNIT- IV

Theory of filtration, study of different types of filters, rate of filtration, pressure drop during filtration. Scope & importance of material handling devices,

UNIT- V

Study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, pneumatic conveying, gravity conveyor- design consideration, capacity and power requirement.

3-Tractor Design Principles (NAG053)

4 (3+1)

UNIT- I

Procedure for design and development of agricultural tractor, study of parameters for balanced design of tractor for stability weight distribution.

UNIT- II

Hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors.

UNIT- III

Design of Ackerman Steering and tractor hydraulic systems. Design of seat and controls of an agricultural tractor. Tractor Testing.

UNIT- IV

Study of special design features of tractor engines and their selection.

UNIT- V

Design of Standard power transmission components use in agriculture mechanics Mechanical & hydraulic units. Introduction of safety in power transmission