Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Undergraduate program
w.e.f. Session 2020-2021

B. Tech. Agricultural Engineering

Semester – V

Course Code	Course Title	Periods Per h/week/sem			Evaluation Scheme Theory Mid sem			Evaluation Scheme Practical Examination					End sem Theory Exam	Subject total	Credit	Total Credit Points	Attributes						
								Sessional			End sem exam	Sub Total (sessional + exam)					Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
		L	T	P	CT	TA	Total	CT	TA	Total	Total													
AE355	**Tractor Systems and Controls**	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**2:0:1**	**3**	√		√			√	
AE356	**Agricultural Structures and Environmental Control**	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**2:0:1**	**3**	√		√		√	√	
AE357	**Post Harvest Engineering of Cereals, Pulses and Oil Seeds**	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**2:0:1**	**3**	√		√			√	
AE358	**Soil and Water Conservation Engineering**	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**2:0:1**	**3**	√		√		√	√	
AE359	**Watershed Planning and Management**	1	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**1:0:1**	**2**	√	√	√		√	√	√
AE360	**Drainage Engineering**	1	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**1:0:1**	**2**	√		√		√	√	
AE361	**Renewable Power Sources**	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	**50**	**100**	**2:0:1**	**3**	√		√		√	√	
AE362	**Skill Development Training-I**	0	0	10	-	-	-	-	-	-	-	-	-	**100**	**0:0:5**	**5**	√	√	√		√	√	√
	Total															**24**							

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Tractor Systems and Controls
Course Code: AE355
W.e.f. Session 2020-21

3 (2+1)

Theory

Unit-I

Study of need for transmission system in a tractor. Transmission system – types, major functional systems. Study of clutch – need, types, functional requirements, construction and principle of operation. Familiarization with single plate, multi-plate, centrifugal and dual clutch systems.

Unit-II

Study of Gear Box – Gearing theory, principle of operation, gear box types, functional requirements, and calculation for speed ratio. Study of differential system – need, functional components, construction, calculation for speed reduction. Study of need for a final drive. Study of Brake system – types, principle of operation, construction, calculation for braking torque. Study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius.

Unit-III

Familiarization with Ackerman steering. Steering systems in track type tractors. Study of Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the Hydraulic system adjustments and ADDC. Study of tractor power outlets – PTO. PTO standards, types and functional requirements.

Unit-IV

Introduction to traction. Traction terminology. Theoretical calculation of shear force and rolling resistance on traction device. Study of wheels and tyres –Solid tyres and pneumatic tyres, tyre construction and tyre specifications. Study of traction aids. Study of tractor mechanics – forces acting on the tractor.

Unit-V

Determination of CG of a tractor. Determination and importance of moment of inertia of a tractor. Study of tractor static equilibrium, tractor stability especially at turns. Determination of maximum drawbar pull. Familiarization with tractor as a spring-mass system. Ergonomic considerations and operational safety. Introduction to tractor testing. Deciphering the engine test codes.

Practical

Introduction to transmission systems and components; Study of clutch functioning, parts and design problem on clutch system; Study of different types of gear box, calculation of speed ratios, design problems on gear box; Study on differential and final drive and planetary gears; Study of brake systems and some design problems; Steering geometry and adjustments; Study of hydraulic systems in a tractor, hydraulic trainer and some design problems; Appraisal of various controls in different makes tractors in relation to anthropometric measurements. Determination of location of CG of a tractor, Moment of Inertia of a tractor. Traction performance of a traction wheel.

Suggested Readings

- Liljedahl J B and Others. Tractors and Their Power Units.
- Rodichev V and G Rodicheva. Tractors and Automobiles.
- Singh Kirpal. Automobile Engineering – Vol I.
- Heitner Joseph. Automotive Mechanics: Principles and Practices.
- C.B.Richey. Agricultural Engineering Handbook.
- John Deere. Fundamentals of Service Hydraulics.

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Agricultural Structures and Environmental Control
Course Code: AE356
w.e.f. Session 2020-21

3 (2+1)

Theory

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, Livestock production facilities.

Unit-II

BIS Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc. 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-III

Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins, Storage of seeds. 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

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.

Practical

Measurements for environmental parameters and cooling load of a farm building, Design and layout of a dairy farm, Design and layout of a poultry house, Design and layout of a goat house/ sheep house, Design of a farm fencing system, Design of a feed/fodder storage structures, Design of grain storage structures, Design and layout of commercial bag and bulk storage facilities, Study and performance evaluation of different domestic storage structure, Estimation of a Farm building.

Suggested Readings

- Pandey, P.H. Principles and practices of Agricultural Structures and Environmental Control, Kalyani Publishers, Ludhiana.
- Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag, New Delhi.
- Nathonson, J.A. Basic Environmental Technology, Prentice Hall of India, New Delhi.
- Venugopal Rao, P. Text Book of Environmental Engineering, Prentice Hall of India, New Delhi.
- Garg, S.K. Water Supply Engineering, Khanna Publishers, New Delhi-6.
- Dutta, B.N. Estimating and Costing in Civil Engineering, Duttta & CO, Lucknow.
- Khanna, P.N. Indian Practical Civil Engineer’s Hand Book, Engineer’s Publishers, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Post Harvest Engineering of Cereals, Pulses and Oil Seeds
Course Code: AE357
w.e.f. Session 2020-21

3(2+1)

Theory

Unit-I

Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens. Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone, shape graders. Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing).

Unit-II

Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Elevators: bucket, Cranes & hoists. Trucks (refrigerated/ unrefrigerated), Pneumatic conveying. Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Psychrometric chart and its use in drying.

Unit-III

Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Mass and energy balance, Shedd's equation, Dryer performance, Different methods of drying, batch-continuous; mixing-non-mixing, Sunmechanical, conduction, convection, radiation, superheated steam, tempering during drying, Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray.

Unit-IV

Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes. Milling of rice: Conditioning and parboiling, advantages and disadvantages, traditional methods, CFTRI and Jadavpur methods, Pressure parboiling method, Types of rice mills, Modern rice milling, different unit operations and equipment. Milling of wheat, unit operations and equipment.

Unit-V

Milling of pulses: traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods. Pulse milling machines, Milling of corn and its products. Dry and wet milling. Milling of oilseeds: mechanical expression, screw press, hydraulic press, solvent extraction methods, preconditioning of oilseeds, refining of oil, stabilization of rice bran., Extrusion cooking: principle, factors affecting, single and twin screw extruders. By-products utilization.

Practical

Performance evaluation of different types of cleaners and separators, Determination of separation efficiency, Study of different size reduction machines and performance evaluation, Determination of fineness modulus and uniformity index, Study of different types of conveying and elevating equipments, Study of different types of mixers. Measurement of moisture content: dry basis and wet basis, Study on drying characteristics of grains and determination of drying constant, Determination of EMC (Static and dynamic method), Study of various types of dryers, Study of different equipments in rice mills and their performance evaluation, Study of different equipments in pulse mills and their performance evaluation, Study of different equipments in oil

mills and their performance evaluation, Type of process flow charts with examples relating to processing of cereals pulses and oil seeds, Visit to grain processing industries.

Suggested Readings

- Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
- Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi.
- Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
- Geankoplis C. J. Transport processes and unit operations, Prentice Hall of India Pvt Ltd, New Delhi.
- Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
- Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London.
- McCabe, W.L., Smith J.C. and Harriott, P. Unit operations of Chemical Engineering. McGraw Hill.
- Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Soil and Water Conservation Engineering
Course Code: AE358
w.e.f. Session 2020-21

3(2+1)

Theory

Unit-I

Soil erosion - Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion. Water erosion - Mechanics and forms - splash, sheet, rill, gully, ravine and stream bank erosion.

Unit-II

Gullies - Classification, stages of development. Soil loss estimation – Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity - estimation by KE>25 and EI30 methods. Soil erodibility - topography, crop management and conservation practice factors.

Unit-III

Measurement of soil erosion - Runoff plots, soil samplers. Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching. Engineering measures- Bunds and terraces. Bunds - contour and graded bunds - design and surplussing arrangements.

Unit-IV

Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stonewall and trenching. Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains. Grassed waterways and design.

Unit-V

Wind erosion- Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes. Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks.

Practical

Study of different types and forms of water erosion. Exercises on computation of rainfall erosivity index. Computation of soil erodibility index in soil loss estimation. Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSLE. Exercises on soil loss estimation/measuring techniques. Study of rainfall simulator for erosion assessment. Estimation of sediment rate using Coshocton wheel sampler and multislot devisor. Determination of sediment concentration through oven dry method. Design and layout of contour bunds. Design and layout of graded bunds. Design and layout of broad base terraces. Design and layout of bench terraces. Design of vegetative waterways. Exercises on rate of sedimentation and storage loss in tanks. Computation of soil loss by wind erosion. Design of shelterbelts and wind breaks for wind erosion control. Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures.

Suggested Readings

- Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service, New Delhi.
- Mal, B.C. 2014. Introduction to Soil and Water Conservation Engineering. 2014. Kalyani Publishers.

- Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
- Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
- Norman Hudson. 1985. Soil Conservation. Cornell University Press, Ithaka, New York, USA.
- Frevert, R.K., G.O. Schwab, T.W. Edminster and K.K. Barnes. 2009. Soil and Water Conservation Engineering, 4th Edition, John Wiley and Sons, New York.
- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Watershed Planning and Management
Course Code:AE359
w.e.f. Session 2020-21

2 (1+1)

Theory

Unit-I

Watershed - introduction and characteristics. Watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors.

Unit-II

Watershed management - concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds – sediment yield index. Water budgeting in a watershed.

Unit-III

Management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage, water harvesting and recycling. Dry farming techniques- inter-terrace and inter-bund land management. Integrated watershed management - concept, components, arable lands - agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry.

Unit-IV

Effect of cropping systems, land management and cultural practices on watershed hydrology. Watershed programme - execution, follow-up practices, maintenance, monitoring and evaluation. Participatory watershed management - role of watershed associations, user groups and self-help groups. Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.

Practical

Exercises on delineation of watersheds using toposheets. Surveying and preparation of watershed map. Quantitative analysis of watershed characteristics and parameters. Watershed investigations for planning and development. Analysis of hydrologic data for planning watershed management. Water budgeting of watersheds. Prioritization of watersheds based on sediment yield index. Study of functional requirement of watershed development structures. Study of watershed management technologies. Practice on softwares for analysis of hydrologic parameters of watershed. Study of role of various functionaries in watershed development programmes. Techno-economic viability analysis of watershed projects. Visit to watershed development project areas.

Suggested Readings

- Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
- Katyal, J.C., R.P. Singh, Shriniwas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field Manual on Watershed Management. CRIDA, Hyderabad.
- Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.
- Sharda, V.N., A.K. Sikka and G.P. Juyal. 2006. Participatory Integrated Watershed Management: A Field Manual. Central Soil and Water Conservation Research and Training Institute, Dehradun.

- Singh, G.D. and T.C. Poonia. 2003. Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.
- Singh, P.K. 2000. Watershed Management: Design and Practices. E-media Publications, Udaipur.
- Singh, R.V. 2000. Watershed Planning and Management. Yash Publishing House, Bikaner.
- Tideman,E.M. 1999. Watershed Management: Guidelines for Indian Conditions. Omega Scientific Publishers, New Delhi.

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Drainage Engineering
Course Code: AE360
w.e.f. Session 2020-21

2(1+1)

Theory

Unit-I

Water logging- causes and impacts; drainage, objectives of drainage, familiarization with the drainage problems of the state; surface drainage coefficient.

Unit-II

Types of surface drainage, design of surface drains; sub-surface drainage: purpose and benefits, investigations of design parameters hydraulic conductivity, drainable porosity, water table; derivation of Hooghoudt's and Ernst's drain spacing equations.

Unit-III.

Design of subsurface drainage system; drainage materials, drainage pipes, drain envelope; layout, construction and installation of drains; drainage structures; vertical drainage;

Unit-IV

Bio-drainage; mole drains; salt balance, reclamation of saline and alkaline soils, leaching requirements, conjunctive use of fresh and saline water.

Practical

In-situ measurement of hydraulic conductivity by single auger hole and inverse auger hole method; Estimation of drainage coefficients; installation of piezometer and observation wells; preparation of iso-bath and isobar maps; determination of drainable porosity; design of surface drainage systems; design of gravel envelop; design of subsurface drainage systems; determination of chemical properties of soil and water; study of drainage tiles and pipes; installation of sub-surface drainage system; cost analysis of surface and sub-surface drainage system.

Suggested Readings

- Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles , Methods and Applications. Vikas Publication House, Noida (UP).
- Ritzema H.P.1994 Drainage Principles and Applications, ILRI Publication 16, Second Edition (Completely Revised).
- Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II 5th Edition. Jain Brothers Publication, New Delhi.
- Kadam U.S., Thokal R.T., Gorantiwar S.D. and Powar A.G. 2007. Agricultural Drainage-Principles and Practices, Westville Publishing House.
- FAO Irrigation and Drainage Paper No. 6, 9, 15, 16, 28 and 38. Rome, Italy.

B. Tech. Agricultural Engineering
SEMESTER-V
Course Title: Renewable Power Sources
Course Code: AE361
w.e.f. Session 2020-21

3(2+1)

Theory

Unit-I

Energy consumption pattern & energy resources in India. Renewable energy options, potential and utilization. Biogas technology and mechanisms, generation of power from biogas.

Unit-II

Power generation from urban, municipal and industrial waste. Design & use of different commercial sized biogas plant.

Unit-III

Solar thermal and photovoltaic Systems for power generation. Central receiver (Chimney) and distributed type solar power plant, OTEC, MHD, hydrogen and fuel cell technology.

Unit-IV

Wind farms. Aero-generators. Wind power generation system. Power generation from biomass (gasification & Dendro thermal), Mini and micro small hydel plants. Fuel cells and its associated parameters.

Practical

Performance evaluation of solar water heater; Performance evaluation of solar cooker; Characteristics of solar photovoltaic panel; evaluation of solar air heater/dryer; Performance evaluation of biomass gasifier engine system (throatless & downdraft), Performance evaluation of a fixed dome type biogas plant; Performance evaluation of floating drum type biogas plant; Estimation of calorific value of biogas & producer gas; Testing of diesel engine operation using dual fuel and gas alone.

Suggested Readings

- Garg H.P. 1990. Advances in Solar Energy Technology; D. Publishing Company, Tokyo.
- Alan L: Farredbruch & R.H. Buse. 1983. Fundamentals of Solar Academic Press, London.
- Bansal N.K., Kleemann M. & Meliss Michael. 1990. Renewable Energy Sources & Conversion Technology; Tata Mecgrow Publishing Company, New Delhi.
- Rathore N. S., Kurchania A. K. & N.L. Panwar. 2007. Non Conventional Energy Sources, Himanshu Publications.
- Mathur, A.N. & N.S. Rathore. 1992. Biogas Production Management & Utilization. Himanshu Publications, Udaipur.
- Khandelwal, K.C. & S.S. Mahdi. 1990. Biogas Technology.
- Rai, G.D. 2013. Non-Conventional Energy Sources, Khanna Publishers, Delhi.
- Mathur A.N. & N.S. Rathore. Renewable Energy Sources Bohra Ganesh Publications, Udaipur.