Integral University, Lucknow
Integral Institute of Agricultural Science and Technology
Evaluation Scheme of Undergraduate program
B. Tech. Agricultural Engineering
w.e.f. Session 2020-2021
Semester – V

Course Code	Subject	Periods Per h/week/ sem			Evaluation Scheme Theory Mid sem			Evaluation Scheme Practical Examination					End sem Theory Exam	Subject total	Credit	Total Credit Points
								Sessional			End sem exam	Sub Total (sessional + exam)				
		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(2+1)
AE356	Agricultural Structures and Environmental Control	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
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(2+1)
AE358	Soil and Water Conservation Engineering (CE)	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE359	Watershed Planning and Management (CE)	1	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	1:0:1	2(1+1)
AE360	Drainage Engineering (CE)	1	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	1:0:1	2(1+1)
AE361	Renewable Power Sources (ME)	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE362	Skill Development Training-I (Student READY) Registration only	0	0	10	-	-	-	-	-	-	-	-	-	**100**	0:0:5	5(0+5)
	Total														**12:0:12**	**24(12+12)**

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Tractor Systems and Controls
Paper 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.
- Relevant BIS Test Codes for Tractors.

Course Objective:

1. To impart knowledge on various systems and their controls in Agricultural Tractors.
2. To gain basic knowledge of tractor operation with safety precautions.
3. To know the working principles of various systems of tractor i.e. transmission system, cooling system, hydraulic system etc.
4. To gain the basic knowledge of care and maintenance of tractor.
5. To impart knowledge tractor chassis mechanics and design for tractor stability.

Course Outcome:

At the completion of the course the student will:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Have knowledge on various systems and their controls in Agricultural Tractors.
CO2	Be able to know the tractor operation with safety precautions.
CO3	Be able to know the working principles of various systems of tractor i.e. transmission system, cooling system, hydraulic system etc.
CO4	Have the basic knowledge of care and maintenance of tractor.
CO5	Have the basic knowledge tractor chassis mechanics and design for tractor stability.

CO-PO MAPPING:

CO	CO1	CO2	CO3	CO4	CO5
	Have knowledge on various systems and their controls in Agricultural Tractors.	Be able to know the tractor operation with safety precautions.	Be able to know the working principles of various systems of tractor i.e. transmission system, cooling system, hydraulic system etc.	Have the basic knowledge about care and maintenance of tractor.	Have the basic knowledge tractor chassis mechanics and design for tractor stability.
PO1. Knowledge of Applied Science in Agricultural Engineering.	3	3	3	2	2
PO2. Knowledge of Basic Engineering.	3	3	2	2	3
PO3. Problem Solving.	3	2	2	3	2
PO4. Field Experimentations.	2	3	3	3	2
PO5. Knowledge of Soil and Water Conservation Engineering.	-	-	-	-	-
PO6. Knowledge of Irrigation and Drainage Engineering.	-	-	-	-	-
PO7. Knowledge of Farm Machinery, equipment and techniques.	3	3	3	3	3
PO8. Knowledge of Process and Food Engineering equipment and techniques.					
PO9. Knowledge of Renewable Energy Engineering.					
PO10. Environment and sustainability.					
PO11. Ethics.					
PO12. Individual and team work	2	3	3	2	1
PO13. Communication and skill development.					
PO14. Lifelong learning.	2	2	2	3	2

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Agricultural Structures and Environmental Control
Paper 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.
- Sahay, K.M. and Singh, K.K. Unit Operations of Agricultural Processing, Vikas publishing pvt. Ltd, Noida.
- Banerjee, G.C. A Text Book of Animal Husbandry, Oxford IBH Publishing Co, New Delhi.

Course Objective

1. To impart knowledge about Planning and layout of farmstead.
2. To understand the Physiological reactions of livestock to solar radiation
3. To learn Sources of water supply, norms of water supply for human being and animals
4. To understand the concept of ecosystem, biodiversity of its conservation, environmental pollution
5. To analysis the estimation of power requirement for domestic and irrigation, source of power supply

Course Outcome:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Understand the basic concepts of Planning and layout of farmstead
CO2	Understand the mechanism of solid waste management system, BOD and COD of food plant waste
CO3	Acquaint with the community sanitation system; sewage system its design, cost and maintenance
CO4	Understand Scope, importance and need for environmental control, renewable and non-renewable resources and their equitable use
CO5	Acquaint with estimation of power requirement for domestic and irrigation

CO-PO MAPPING:

CO	CO1	CO2	CO3
	Understand the basic concepts of Planning and layout of farmstead	Understand the mechanism of solid waste management system, BOD and COD of food plant waste	Acquaint with the community sanitation system; sewage system its design, cost and maintenance
PO1 Knowledge of Applied Science in Agricultural Engineering	3	3	3
PO2 Knowledge of Basic Engineering	3	3	3
PO3 Problem Solving	3	3	2
PO4 Field Experimentations	-	-	-
PO5 Knowledge of Soil and Water Conservation Engineering	2	2	3
PO6 Knowledge of Irrigation and Drainage Engineering	2	2	3
PO7 Knowledge of Farm Machinery, equipments and techniques	-	-	-
PO8 Knowledge of Process and Food Engineering equipments and techniques	-	-	-
PO9 Knowledge of Renewable Energy Engineering	-	-	-
PO10 Environment and sustainability	3	2	3
PO11 Ethics	2	2	2
PO12 Individual and team work	2	3	3
PO13 Communication and skill development	-	-	-
PO14 Lifelong learning	-	-	-

CO4	Understand Scope, importance and need for environmental control, renewable and non-renewable resources and their equitable use	3	3	3	-	3	2	-	-	-	2	2	3	-	-
CO5	Acquaint with estimation of power requirement for domestic and irrigation	3	3	2	-	3	3	-	-	-	3	2	3	-	-
3: Strong contribution, 2: average contribution, 1: Low contribution															

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Post Harvest Engineering of Cereals, Pulses and Oil Seeds
Paper 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.

Course objective:

1. To give knowledge about importance and scope of food processing and different unit operations.
2. To provide the knowledge about the size reduction and its application in processing of farm crops: cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed and horticultural crops.
3. To educate the students about concept of drying and its methods for Horticultural and spices crops.
4. To aware the students about the mixing of horticultural crops.
5. To provide Knowledge regarding milling of horticultural crops.

Course Outcomes

After completion of course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students able to understand about importance and scope of food processing and different unit operations
CO2	Able to know about the size reduction and its application in processing of farm crops: cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed and horticultural crops.
CO3	Student able to understand about concept of drying and its methods for Horticultural and spices crops.

CO4	Able to know about the mixing of horticultural crops.
CO5	Students able to understand the basic Knowledge regarding milling of horticultural crops.

	CO	
		PO1 Knowledge of Applied Science in Agricultural Engineering
		PO2 Knowledge of Basic Engineering
		PO3 Problem Solving
		PO4 Field Experimentations
		PO5 Knowledge of Soil and Water Conservation Engineering
		PO6 Knowledge of Irrigation and Drainage Engineering
		PO7 Knowledge of Farm Machinery, equipments and techniques
		PO8 Knowledge of Process and Food Engineering equipments and techniques
		PO9 Knowledge of Renewable Energy Engineering
		PO10 Environment and sustainability
		PO11 Ethics
		PO12 Individual and team work
		PO13 Communication and skill development
		PO14 Lifelong learning

CO-PO MAPPING:

CO1	Students able to understand about importance and scope of food processing and different unit operations	3	3	3	2	-	-	-	3	-	3	3	2	3	2
CO2	Able to know about the size reduction and its application in processing of farm crops: cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed and horticultural crops.	3	3	3	2	-	-	-	3	-	2	2	3	2	3
CO3	Student able to understand about concept of drying and its methods for Horticultural and spices crops.	3	3	2	2	-	-	-	3	-	3	2	3	2	3
CO4	Able to know about the mixing of horticultural crops.	3	3	3	1	-	-	-	3	-	3	2	3	2	3
CO5	Students able to understand the basic Knowledge regarding milling of horticultural crops.	3	3	2	3	-	-	-	3	-	3	2	3	2	3
3: Strong contribution, 2: average contribution, 1: Low contribution															

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Soil and Water Conservation Engineering
Paper 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.

Course Objective:

1. To introduce the basic concept of Soil and water conservation and erosion control structures.
2. To impart basic knowledge of flow in open channel.
3. To introduce basic knowledge of hydraulic jump and its application.
4. To know about design of different permanent structure of soil erosion control.
5. To know about design of diversions and earth embankment and its type.

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	know the basic knowledge of soil and water conservation and erosion control structures.
CO2	have the ability to have the knowledge of flow in open channel
CO3	Know the practical application of hydraulic jump.
CO4	have the ability to design of different permanent structure of soil erosion control.
CO5	have the basic knowledge for designing of diversions and earth embankment and its type.

CO-PO MAPPING:

CO4	CO3	CO2	CO1	
have the ability to design of different permanent structure of soil erosion control.	Know the practical application of hydraulic jump.	have the ability to have the knowledge of flow in open channel	know the basic knowledge of soil and water conservation and erosion control structures.	CO
3	3	3	3	**PO1** Knowledge of Applied Science in Agricultural Engineering
3	3	3	3	**PO2** Knowledge of Basic Engineering
3	2	3	3	**PO3** Problem Solving
-	-	-	-	**PO4** Field Experimentations
3	3	3	3	**PO5** Knowledge of Soil and Water Conservation Engineering
2	3	2	3	**PO6** Knowledge of Irrigation and Drainage Engineering
-	-	-	-	**PO7** Knowledge of Farm Machinery, equipments and techniques
-	-	-	-	**PO8** Knowledge of Process and Food Engineering equipments and techniques
-	-	-	-	**PO9** Knowledge of Renewable Energy Engineering
2	1	1	1	**PO10** Environment and sustainability
2	2	2	2	**PO11** Ethics
3	3	3	2	**PO12** Individual and team work
-	-	-	-	**PO13** Communication and skill development
-	-	-	-	**PO14** Lifelong learning

CO5	have the basic knowledge for designing of diversions and earth embankment and its type.	3	3	2	-	3	3	-	-	-	1	2	3	-	-
3: Strong contribution, 2: average contribution, 1: Low contribution																

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Watershed Planning and Management
Paper 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.

COURSE OBJECTIVES:

1. To understand basic concept of watershed management, characteristics and factors affecting watershed management.
2. To understand basic concept of hydrological data for watershed planning and hydraulic design of earthen embankment s and diversion structures.
3. To understand basic concept of sediments yield and their measurement and design of water harvesting tank and ponds
4. To understand the evaluation and monitoring of watershed programs

COURSE OUTCOMES (CO):

CO	DESCRIPTION
CO1	Students are able to understand basic concept of watershed management, characteristics and factors affecting watershed management
CO2	Students are able to understand the basic concept of hydrological data for watershed planning and hydraulic design of earthen embankment and diversion structures.
CO3	To understand the concept of sediments yield and their measurement and design of water harvesting tank and ponds
CO4	Students are able to understand the concept of evaluation and monitoring of watershed programs and planning and formulation of project proposal and cost benefits analysis of watershed programs.

	CO	PO1 Knowledge of Applied Science in Agricultural Engineering	PO2 Knowledge of Basic Engineering	PO3 Problem Solving	PO4 Field Experimentations	PO5 Knowledge of Soil and Water Conservation Engineering	PO6 Knowledge of Irrigation and Drainage Engineering	PO7 Knowledge of Farm Machinery, equipments and techniques	PO8 Knowledge of Process and Food Engineering equipments and techniques	PO9 Knowledge of Renewable Energy Engineering	PO10 Environment and sustainability	PO11 Ethics	PO12 Individual and team work	PO13 Communication and skill development	PO14 Lifelong learning
CO1	Students are able to understand basic concept of watershed management, characteristics and factors affecting watershed management	3	2	3	2	2	2	3	0	0	1	1	2	2	3
CO2	Students are able to understand the basic concept of hydrological data for watershed planning and hydraulic design of earthen embankment and diversion structures.	3	2	3	2	3	3	2	0	0	2	1	3	3	3
CO3	To understand the concept of sediments yield and their measurement and design of water harvesting tank and ponds	2	3	2	3	3	2	3	0	0	3	1	2	2	3
CO4	Students are able to understand the concept of evaluation and monitoring of watershed programs and planning and formulation of project proposal and cost benefits analysis of watershed programs.	2	2	2	2	2	3	2	0	0	3	1	3	3	3

CO5																

3: Strong contribution, 2: average contribution, 1: Low contribution

CO-PO MAPPING:

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Drainage Engineering
Paper 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.

COURSE OBJECTIVES:

1. To understand basic concept of Objective of Drainage, Types and design of channel.
2. To understand basic concept of design parameters and concept of ellipse and Ernst's drain spacing equations.
3. To understand basic concept of drainage material and design of surface drainage.
4. To understand the basic concept of salt balance, leaching requirement and consumptive use of fresh and saline water.

COURSE OUTCOMES (CO):

CO	DESCRIPTION
CO1	The Students will learn the basic concept of Objective of Drainage, Types and design of channel.
CO2	The Students will learn the basic concept of design parameters and concept of ellipse and Ernst's drain spacing equations.
CO3	The students will learn the basic concept of concept of drainage material and design of surface drainage
CO4	The Students will learn the basic concept of salt balance, leaching requirement and consumptive use of fresh and saline water.

CO-PO MAPPING:

	CO	PO1 Knowledge of Applied Science in Agricultural Engineering	PO2 Knowledge of Basic Engineering	PO3 Problem Solving	PO4 Field Experimentations	PO5 Knowledge of Soil and Water Conservation Engineering	PO6 Knowledge of Irrigation and Drainage Engineering	PO7 Knowledge of Farm Machinery, equipments and techniques	PO8 Knowledge of Process and Food Engineering equipments and techniques	PO9 Knowledge of Renewable Energy Engineering	PO10 Environment and sustainability	PO11 Ethics	PO12 Individual and team work	PO13 Communication and skill development	PO14 Lifelong learning
CO1	The Students will learn the basic concept of Objective of Drainage, Types and design of channel.	3	2	2	2	3	3	2	1	0	1	1	2	3	3
CO2	The Students will learn the basic concept of design parameters and concept of ellipse and Ernst's drain spacing equations.	2	3	2	2	2	2	2	1	0	2	1	2	3	3
CO3	The students will learn the basic concept of concept of drainage material and design of surface drainage	2	3	3	2	2	3	2	1	0	2	1	2	2	3
CO4	The Students will learn the basic concept of salt balance, leaching requirement and consumptive use of fresh and saline water.	2	2	3	1	2	2	2	1	0	2	1	2	2	3
	3: Strong contribution, 2: average contribution, 1: Low contribution														

B. Tech. (Agricultural Engineering)
SEMESTER-V
Syllabus: Renewable Power Sources
Paper 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.

Course Objective:

1. To introduce the basic concept of Energy sources, Introduction, Classification, Energy from Biomass.
2. To impart basic knowledge of gasifiers and Briquetting
3. To introduce basic knowledge of Solar energy, Solar flat plate and focusing plate collectors

4. To know about Brief introduction to wind energy, hydroelectric energy, ocean energy
5. To know about biomass combustion, biodiesel preparation and energy conservation in agriculture.

Course Outcome:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	know the basic knowledge of Energy from Biomass, Types of biogas plants, constructional details
CO2	have the ability to have the knowledge of Constructional details and application of wind mills
CO3	Know the practical application of Solar energy applications / Solar energy gadgets, Solar cookers,
CO4	have the ability to understand biomass combustion, biodiesel preparation
CO5	have the basic knowledge for Solar photo voltaic systems, solar lantern

CO-PO MAPPING:

	CO	**PO1** Basic Agriculture knowledge	**PO2** Problem Solving	**PO3** Field Experimentations	**PO4** Modern implements usage	**PO5** Modern Agricultural / Horticultural implements	**PO6** Modern plant protection implements	**PO7** Extension Programme	**PO8** Environment and sustainability	**PO9** Ethics	**PO10** Individual and team work	**PO11** Communication	**PO12** Lifelong learning
CO1	know the basic knowledge of Energy from Biomass, Types of biogas plants, constructional details	3	2	3	2	2	2				2		3
CO2	have the ability to have the knowledge of Constructional details and application of wind mills	2	3	1	3	3					3		2
CO3	Know the practical application of Solar energy applications / Solar energy gadgets, Solar cookers	3	2	3	3	3	3				2		3

CO4	have the ability to understand biomass combustion, biodiesel preparation	2	1	1	2	2	3				2		3
CO5	have the basic knowledge for Solar photo voltaic systems, solar lantern	2	1	2	3	2	2				2		2
3: Strong contribution, 2: average contribution, 1: Low contribution													

Integral University, Lucknow

Integral Institute of Agricultural Science and Technology

Evaluation Scheme of Undergraduate program

B. Tech. Agricultural Engineering

w.e.f. Session 2020-21

Semester – VI

Course Code	Subject	Periods Per h/week/ sem			Evaluation Scheme Theory Mid sem			Evaluation Scheme Practical Examination					End sem Theory Exam	Subject total	Credit	Total Credit Points
								Sessional			End sem exam	Sub Total (sessional + exam)				
		L	T	P	CT	TA	Total	CT	TA	Total	Total					
CA342	Computer Programming and Data Structures	1	0	4	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	1:0:2	3(1+2)
AE365	Farm Machinery and Equipment-II	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE366	Post-Harvest Engineering of Horticultural Crops	1	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	1:0:1	2(1+1)
AE367	Water Harvesting and Soil Conservation Structures	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE368	Groundwater, Wells and Pumps	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE369	Tractor and Farm Machinery Operation and Maintenance	0	0	4	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	0:0:2	2(0+2)
AE370	Dairy and Food Engineering	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
AE371	Bio-energy Systems: Design and Applications	2	0	2	10	10	**20**	5	5	**10**	**20**	**50**	50	**100**	2:0:1	3(2+1)
Total																**22 (12+10)**
Skill Development Training-II in Summer break June-July after 6th Semester (Student READY)																

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Computer Programming and Data Structures
Paper Code: CA342
w.e.f. Session 2020-21

3(1+2)

Theory

Unit.1

Theory Introduction to high level languages, Primary data types and user defined data types, Variables, typecasting.

Unit.2

Operators, Building and evaluating expressions, Standard library functions, managing input and output, Decision making, Branching, Looping, Arrays.

Unit.3

User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable.

Unit.4

String functions, Structures and union, Pointers, Stacks, Push/Pop operations.

Unit.5

Queues, Insertion and deletion operations, Linked lists.

Practical

Practical Familiarizing with Turbo C IDE; Building an executable version of C program; Debugging a C program; Developing and executing simple programs; Creating programs using decision making statements such as if, go to & switch; Developing program using loop statements while, do & for; Using nested control structures; Familiarizing with one and two dimensional arrays; Using string functions; Developing structures and union; Creating user defined functions; Using local, global & external variables; Using pointers; Implementing Stacks; Implementing push/pop functions; Creating queues; Developing linked lists in C language; Insertion/Deletion in data structures.

Suggested Readings:

- Rajaraman V. 1985. Computer Oriented Numerical Methods. Prentice Hall of India. Pvt. Ltd., New Delhi.
- Balagurusamy E. 1990. Programming in ‘C’. Tata McGraw Hill Publishing Co. Ltd., 12/4 Asaf Ali Road, New Delhi.
- Rajaraman V. 1995. Computer Programming in ‘C’. Prentice Hall of India Pvt.Ltd., New Delhi.
- Bronson G and Menconi S. 1995. A First Book of ‘C’ Fundamentals of ‘C’ Programming. Jaico Publishing House, New Delhi
- Sahni S.. Data Structures, Algorithms and Applications in C++. University press (India) Pvt Ltd / Orient Longman Pvt. Ltd.
- Michael T. Goodrich, R. Tamassia and D Mount. Data structures and Algorithms in C++. Wiley Student Edition, John Wiley and Sons.
- Mark Allen Weiss. Data Structures and Algorithm Analysis in C++. Pearson Education.
- Augenstein, Langsam and Tanenbaum. Data structures using C and C++. PHI/Pearson Education.
- Drozdek Adam. Data Structures and Algorithms in C++. Vikas Publishing House / Thomson International Student Edition.
- Agarwal, Ajay. The Complete Reference Guide: Data Structure through C. ISBN: 8178840448; Publisher: Cyber Tech Publications.

COURSE OBJECTIVES:

1. To learn about the introduction to high level languages, Primary data types and user defined data types, Variables, typecasting, Operators,.
2. To learn basics of building and evaluating expressions, Standard library functions, Managing input and output.
3. To learn fundamentals of decision making, Branching, Looping, Arrays, User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable.
4. To learn about the String functions, Structures and union, Pointers, Stacks, Push/Pop operations, Queues, Insertion and deletion operations, Linked lists.

COURSE OUTCOMES (CO):

CO	DESCRIPTION
CO1	Able to know about the introduction to high level languages, Primary data types and user defined data types, Variables, typecasting, Operators
CO2	Ability to know about building and evaluating expressions, Standard library functions, Managing input and output.
CO3	Students able to know about the decision making, Branching, Looping, Arrays, User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable.
CO4	Able to know String functions, Structures and union, Pointers, Stacks, Push/Pop operations, Queues, Insertion and deletion operations, Linked lists

CO-PO MAPPING:

	CO	**PO1** Knowledge of Applied Science in Agricultural Engineering	**PO2** Knowledge of Basic Engineering	**PO3** Problem Solving	**PO4** Field Experimentations	**PO5** Knowledge of Soil and Water Conservation Engineering	**PO6** Knowledge of Irrigation and Drainage Engineering	**PO7** Knowledge of Farm Machinery, equipments and techniques	**PO8** Knowledge of Process and Food Engineering equipments and techniques	**PO9** Knowledge of Renewable Energy Engineering	**PO10** Environment and sustainability	**PO11** Ethics	**PO12** Individual and team work	**PO13** Communication and skill development	**PO14** Lifelong learning
CO1	Able to know about the introduction to high level languages, Primary data types and user defined data types, Variables, typecasting, Operators	2	2	3	0	0	0	0	0	0	0	2	1	1	1
CO2	Ability to know about building and evaluating expressions, Standard library functions, Managing input and output.	2	3	3	2	0	0	0	0	0	0	2	2	2	1
CO3	Students able to know about the decision making, Branching, Looping, Arrays, User defined functions, passing arguments and returning values, recursion, scope and visibility of a variable	2	3	3	0	0	0	0	0	0	0	1	2	1	2
CO4	Able to know String functions, Structures and union, Pointers, Stacks, Push/Pop operations, Queues, Insertion and deletion operations, Linked lists	2	3	3	0	0	0	0	0	0	0	2	2	2	2

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Farm Machinery and Equipment-II
Paper Code: AE365
w.e.f. Session 2020-21

3(2+1)

Theory

Unit.1

Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. Calculations for calibration of sprayers and chemical application rates. Introduction to interculture equipment. Use of weeders – manual and powered. Study of functional requirements of weeders and main components.

Unit.2

Familiarization of fertilizer application equipment. Study of harvesting operation – harvesting methods, harvesting terminology. Study of mowers – types, constructional details, working and adjustments. Study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern.

Unit.3

Study of reapers, binders and windrowers – principle of operation and constructional details. Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay. Introduction to threshing systems – manual and mechanical systems. Types of threshing drums and their applications.

Unit.4

Types of threshers- tangential and axial, their constructional details and cleaning systems. Study of factors affecting thresher performance. Study of grain combines, combine terminology, classification of grain combines, study of material flow in combines. Computation of combine losses, study of combine troubles and troubleshooting. Study of chaff cutters and capacity calculations.

Unit.5

Study of straw combines – working principle and constructional details. Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of potato and groundnut diggers. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools.

Practical

Familiarization with plant protection and interculture equipment. Study of sprayers, types, functional components. Study of dusters, types and functional components. Calculations for chemical application rates. Study of nozzle types and spread pattern using patternator. Familiarization with manual and powered weeding equipment and identification of functional components. Study of fertilizer application equipment including manure spreaders and fertilizer broadcasters. Study of various types of mowers, reaper, reaper binder. Study of functional components of mowers and reapers. Familiarization with threshing systems, cleaning systems in threshers. Calculations of losses in threshers. Familiarization with functional units of Grain combines and their types. Calculations for grain losses in a combine. Study of root crop diggers and familiarization with the functional units and attachments. Familiarization with the working of cotton and maize harvesters. Familiarization with vegetable and fruit harvesters.

Suggested Readings

- Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery.
- Smith HP and LH Wilkey. Farm Machinery and Equipment.
- Culpin Claude. Farm Machinery.
- Srivastava AC. Elements of Farm Machinery.
- Lal Radhey and AC Datta. Agricultural Engineering Principles of Farm Machinery.

Course Objective:

1. To impart knowledge on various cutting principle of Agricultural machinery.
2. To gain basic knowledge of operation of crop harvesting machinery and root crop harvesting equipment.
3. To know the working principles of mower, reaper, potato digger, sugarcane harvester, thresher etc.
4. To gain the basic knowledge on testing of farm machinery.
5. To impart the basic knowledge about selection and management of farm machines for optimum performance.

Course Outcome:

At the completion of the course the student will:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Have knowledge on various cutting principle of Agricultural machinery.
CO2	Be able to know the operation of crop harvesting machinery and root crop harvesting equipment.
CO3	Be able to know the working principles of mower, reaper, potato digger, sugarcane harvester, thresher etc.
CO4	Have the basic knowledge of on testing of farm machinery
CO5	Have the basic knowledge about selection and management of farm machines for optimum performance.

CO-PO MAPPING:

	CO	**PO1.** Knowledge of Applied Science in Agricultural Engineering.	**PO2.** Knowledge of Basic Engineering.	**PO3.** Problem Solving.	**PO4.** Field Experimentations.	**PO5.** Knowledge of Soil and Water Conservation Engineering.	**PO6.** Knowledge of Irrigation and Drainage Engineering.	**PO7.** Knowledge of Farm Machinery, equipment and techniques.	**PO8.** Knowledge of Process and Food Engineering equipment and techniques.	**PO9.** Knowledge of Renewable Energy Engineering.	**PO10.** Environment and sustainability.	**PO11.** Ethics.	**PO12.** Individual and team work	**PO13.** Communication and skill development.	**PO14.** Lifelong learning.
CO1	have knowledge on various cutting principle of Agricultural machinery.	3	2	3	2	-	-	3					1		3
CO2	be able to know the operation of crop harvesting machinery and root crop harvesting equipment.	3	3	2	3	-	-	3					3		2
CO3	be able to know the working principles of mower, reaper, potato digger, sugarcane harvester, thresher etc.	3	2	2	3	-	-	3					3		2
CO4	have the basic knowledge of on testing of farm machinery	2	3	3	3	-	-	3					2		3
CO5	have the basic knowledge about selection and management of farm machines for optimum performance.	2	3	2	2	-	-	3					1		2

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Post Harvest Engineering of Horticultural Crops
Paper Code: AE366
w.e.f. Session 2020-21

2(1+1)

Theory

Unit.1

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.2

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.

Unit.3

Equipment for chilling and freezing (mechanical & cryogenic), Effect on food during chilling and freezing, Cold storage heat load calculations and cold storage design, refrigerated vehicle and cold chain system, Dryers for fruits and vegetables, Osmo-dehydration, Packaging of horticultural commodities, Packaging requirements (in terms of light transmittance, heat, moisture and gas proof, micro organisms, mechanical strength)

Unit.4

Different types of packaging materials commonly used for raw and processed fruits and vegetables products, bulk and retail packages and packaging machines, handling and transportation of fruits and vegetables, Pack house technology, Minimal processing, Common methods of storage, Low temperature storage, evaporative cooled storage, Controlled atmospheric storage, Modified atmospheric packaging, Preservation Technology.

Unit.5

General methods of preservation of fruits and vegetables, Brief description and advantages and disadvantages of different physical/ chemical and other methods of preservation, Flowcharts for preparation of different finished products, Important parameters and equipment used for different unit operations, Post harvest management and equipment for spices and flowers, Quality control in fruit and vegetable processing industry. Food supply chain

Practical

Performance evaluation of peeler and slicer, Performance evaluation of juicer and pulper, Performance evaluation of blanching equipment, Testing adequacy of blanching, Study of cold storage and its design, Study of CAP and MAP storage, Minimal processing of vegetables, Preparation of value added products, Visit to fruit and vegetable processing industry, Visit to spice processing plant.

Suggested Readings

- Arthey, D. and Ashurst, P. R. 1966. Fruit Processing. Chapman and Hall, New York.
- Pantastico, E.C.B. 1975. Postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables AVI Pub. Co., New Delhi.
- Pandey, R.H. 1997. Postharvest Technology of fruits and vegetables (Principles and practices).Saroj Prakashan, Allahabad.
- Sudheer, K P. and Indira, V. 2007. Post Harvest Engineering of horticultural crops. New India Publishing House.

Course Objective

1. To understand the Importance of processing of fruits and vegetables and characteristics of engineering properties of horticultural crops.
2. To get knowledge about blanching, peeling, freezing and chilling for processing of horticultural crops.
3. To learn about the drying and its application, theory, methods and equipment's for drying of horticultural crops.
4. To know about the packaging, its application and materials for packaging of horticultural crops.
5. To understand about the concept of preservation and post-harvest management of horticultural crops.

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To Study of the Importance of processing of fruits and vegetables and characteristics of engineering properties of horticultural crops
CO2	Understand about the concept about blanching, peeling, freezing and chilling for processing of horticultural crops
CO3	Study about the drying and its application, theory, methods and equipment's for drying of horticultural crops
CO4	Understand about the packaging, its application and materials for packaging of horticultural crops
CO5	Understand about the concept of preservation and post-harvest management of horticultural crops.

CO-PO MAPPING:

	CO	**PO1** Knowledge of Applied Science in Agricultural Engineering	**PO2** Knowledge of Basic Engineering	**PO3** Problem Solving	**PO4** Field Experimentations	**PO5** Knowledge of Soil and Water Conservation Engineering	**PO6** Knowledge of Irrigation and Drainage Engineering	**PO7** Knowledge of Farm Machinery, equipments and techniques	**PO8** Knowledge of Process and Food Engineering equipments and techniques	**PO9** Knowledge of Renewable Energy Engineering	**PO10** Environment and sustainability	**PO11** Ethics	**PO12** Individual and team work	**PO13** Communication and skill development	**PO14** Lifelong learning
CO1	To Study of the Importance of processing of fruits and vegetables and characteristics of engineering properties of horticultural crops	3	3	3	-	-	-	-	3	-	1	3	2	-	2
CO2	Understand about the concept about blanching, peeling, freezing and chilling for processing of horticultural crops	3	3	3	-	-	-	-	3	-	1	2	3	-	3
CO3	Study about the drying and its application, theory, methods and equipment's for drying of horticultural crops	3	3	2	-	-	-	-	3	-	1	2	3	-	3
CO4	Understand about Food grades and standards BIS, AGMARK, PFA, FPO, CAC	3	3	3	-	-	-	-	3	-	2	2	3	-	3
CO5	Understand about the concept of preservation and post-harvest management of horticultural crops.	3	3	2	-	-	-	-	3	-	1	2	3	-	3

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Water Harvesting and Soil Conservation Structures
Paper Code: AE367
w.e.f. Session 2020-21

3(2+1)

Theory

Unit.1

Water harvesting -principles, importance and issues. Water harvesting techniques - classification based on source, storage and use. Runoff harvesting – short-term and long-term techniques. Short-term harvesting techniques - terracing and bunding, rock and ground catchments. Longterm harvesting techniques - purpose and design criteria.

Unit.2

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. Percolation pond - site selection, design and construction details. Design considerations of nala bunds.

Unit.3

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. Hydraulic jump and its application.

Unit.4

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. Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.

Unit.5

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.

Practical

Study of different types of farm ponds. Computation of storage capacity of embankment type of farm ponds. Design of dugout farm ponds. Design of percolation pond and nala bunds. Runoff measurement using H-flume. Exercise on hydraulic jump. Exercise on energy dissipation in water flow. Hydrologic, hydraulic and structural design of drop spillway and stability analysis. Design of SAF stilling basins in chute spillway. Hydrologic, hydraulic and structural design of drop inlet spillway. Design of small earthen embankment structures. Practice on softwares for design of soil and water conservation structures. Field visit to watershed project areas treated with soil and water conservation measures / structures.

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.
- 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.
- 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.
- Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1993. Soil and Water Conservation Engineering.4th Edition, John Wiley and Sons Inc. New York.

- Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
- Samra, J.S., V.N. Sharda and A.K. Sikka. 2002. Water Harvesting and Recycling: Indian Experiences. CSWCR&TI, Dehradun, Allied Printers, Dehradun.
- Theib Y. Oweis, Dieter Prinz and Ahmed Y. Hachum. 2012. Rainwater Harvesting for Agriculture in the Dry Areas. CRC Press, Taylor and Francis Group, London.
- Studer Rima Mekdaschi and Hanspeter Liniger. 2013. Water Harvesting - Guidelines to Good Practice. Centre for Development and Environment, University of Bern, Switzerland.

Course Objective

1. To impart knowledge about water harvesting and techniques
2. To understand about the design of farm pond and its types
3. To learn regarding the soil erosion and its control structures
4. To understand the concept of hydraulic and structural design and stability analysis
5. To get knowledge about the different types of spillway and its application

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Understand the basic about water harvesting and techniques
CO2	Understand about the design of farm pond and its types
CO3	Acquaint with the soil erosion and its control structures
CO4	Understand the concept of hydraulic and structural design and stability analysis
CO5	Acquaint with about the different types of spillway and its application

CO-PO MAPPING:

	CO	**PO1** Knowledge of Applied Science in Agricultural Engineering	**PO2** Knowledge of Basic Engineering	**PO3** Problem Solving	**PO4** Field Experimentations	**PO5** Knowledge of Soil and Water Conservation Engineering	**PO6** Knowledge of Irrigation and Drainage Engineering	**PO7** Knowledge of Farm Machinery, equipments and techniques	**PO8** Knowledge of Process and Food Engineering equipments and techniques	**PO9** Knowledge of Renewable Energy Engineering	**PO10** Environment and sustainability	**PO11** Ethics	**PO12** Individual and team work	**PO13** Communication and skill development	**PO14** Lifelong learning
CO1	To impart knowledge about water harvesting and techniques	3	3	3	2	3	3	-	-	-	3	2	2	1	-
CO2	To understand about the design of farm pond and its types	3	3	3	2	3	3	-	-	-	2	2	3	2	-
CO3	To learn regarding the soil erosion and its control structures	3	3	2	2	3	3	-	-	-	3	2	3	1	-
CO4	Understand the concept of hydraulic and structural design and stability analysis	3	3	3	2	3	2	-	-	-	2	2	3	1	-
CO5	To get knowledge about the different types of spillway and its application	3	3	2	2	3	3	-	-	-	3	2	3	1	-

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Groundwater, Wells and Pumps
Paper Code: AE368
w.e.f. Session 2020-21

3(2+1)

Theory

Unit.1

Occurrence and movement of ground water; aquifer and its types; classification of wells, fully penetrating tubewells and open wells, familiarization of various types of bore wells; design of open wells.

Unit.2

groundwater exploration techniques; methods of drilling of wells: percussion, rotary, reverse rotary; design of tubewell and gravel pack.Installation of well screen, completion and development of well; groundwater hydraulics.

Unit.3

Determination of aquifer parameters by different method such as Theis, Jacob and Chow's, Theis recovery method; well interference, multiple well systems, estimation of ground water potential, quality of ground water.

Unit.4

Artificial groundwater recharge techniques; pumping systems: water lifting devices; different types of pumps, classification of pumps, component parts of centrifugal pumps, priming, pump selection, installation and trouble shooting.

Unit.5

Pump performance curves, effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; deep well turbine pump and submersible pump.

Practical

Verification of Darcy's Law; study of different drilling equipments; sieve analysis for gravel and well screens design; estimation of specific yield and specific retention; testing of well screen; estimation of aquifer parameters by Theis method, Coopers-Jacob method, Chow method; Theis Recovery method; well design under confined and unconfined conditions; well losses and well efficiency; estimating ground water balance; study of artificial ground water recharge structures; study of radial flow and mixed flow centrifugal pumps, multistage centrifugal pumps, turbine, propeller and other pumps; installation of centrifugal pump; testing of centrifugal pump and study of cavitations; study of hydraulic ram; study and testing of submersible pump.

Suggested Readings

- Michael AM, Khepar SD. and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill.
- Todd David Keith and Larry W. Mays. 2004. Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).
- Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers Publication, New Delhi.

Course Objective

1. To impart knowledge about Occurrence and movement of ground water, aquifer and its types
2. To understand the Design of open well, groundwater exploration techniques, methods of drilling of wells

3. To learn Artificial groundwater recharge planning, modeling, ground water project formulation
4. To understand the concept Effect of change of impeller dimensions on performance characteristics
5. To get knowledge about the application of the Verification of Darcy's Law

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Understand the basic concepts of Occurrence and movement of ground water and wells
CO2	Understand the mechanism of groundwater hydraulics-determination of aquifer parameters
CO3	Acquaint with the Design of open well, groundwater exploration techniques
CO4	Understand the concept of Estimating ground water balance; Study of artificial ground water
CO5	Acquaint with propeller pumps, mixed flow pumps and their performance characteristics

CO-PO MAPPING:

	CO	PO1 Knowledge of Applied Science in Agricultural Engineering	PO2 Knowledge of Basic Engineering	PO3 Problem Solving	PO4 Field Experimentations	PO5 Knowledge of Soil and Water Conservation Engineering	PO6 Knowledge of Irrigation and Drainage Engineering	PO7 Knowledge of Farm Machinery, equipments and techniques	PO8 Knowledge of Process and Food Engineering equipments and techniques	PO9 Knowledge of Renewable Energy Engineering	PO10 Environment and sustainability	PO11 Ethics	PO12 Individual and team work	PO13 Communication and skill development	PO14 Lifelong learning
CO1	Understand the basic concepts of Occurrence and movement of ground water and wells	3	3	3	-	3	3	-	-	-	3	2	2	1	-
CO2	Understand the mechanism of groundwater hydraulics-determination of aquifer parameters	3	3	3	-	2	2	-	-	-	2	2	3	2	-
CO3	Acquaint with the Design of open well, groundwater exploration techniques	3	3	2	-	3	3	-	-	-	3	2	3	1	-
CO4	Understand the concept of Estimating ground water balance; Study of artificial ground water	3	3	3	-	3	2	-	-	-	2	2	3	1	-
CO5	Acquaint with propeller pumps, mixed flow pumps and their performance characteristics	3	3	2	-	3	3	-	-	-	3	2	3	1	-

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Tractor and Farm Machinery Operation and Maintenance
Paper Code: AE369
w.e.f. Session 2020-21

2(0+2)

Practical

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. 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. 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. 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 offseason. Repair and maintenance of implements – adjustment of functional parameters in tillage implements. Replacement of broken components in tillage implements. Replacement of furrow openers and change of blades of rotavators. Maintenance of cutter bar in a reaper. Adjustments in a thresher for different crops. Replacement of V-belts on implements. Setting of agricultural machinery workshop.

Suggested Readings

- Ghosh RK and S Swan. Practical Agricultural Engineering.
- Black PO and WE Scahill. Diesel Engine Manual.
- Southorn N. Tractor operation and maintenance.
- Jain SC and CR Rai. Farm Tractor Maintenance and Repair.
- Operators manuals of tractors. y Service manuals provided by manufacturers.

Course Objective:

1. To expose the student with the Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10, 50, 100, 250, 500 and 1000 hrs of operation. Safety hints. Top end overhauling. Overhauling of fuel tank, mechanical fuel Pump, electrical pump, fuel filters, carburetors Testing of fuel pumps for proper functioning.
2. To educate the students about Introduction of fuel saving by idle away, air conditioning, use overdrive, observe the speed limit, tire pressure, reduce weight, regular care and constant speed, preparing the tractor for storage
3. To impart the knowledge about Care and maintenance procedure of agricultural machinery during operation and off-season. Maintenance, Servicing of different types of air cleaner, turbocharger, intercooler, throttle body, intake manifold, exhaust systems, exhaust manifold, catalytic converter, resonator and muffler.
4. To impart the knowledge of Maintenance, diagnosis and servicing of basic petrol fuel system components, conventional diesel fuel system and its components, lubrication system

5. To provide knowledge about cooling system and servicing battery maintenance and servicing of starting system, charging system. and conventional ignition system. Repair and maintenance of workshop requirements

Course Outcome:

CO	DESCRIPTION
CO1	Student able to know with the Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10, 50, 100, 250, 500 and 1000 hrs of operation. Safety hints. Top end overhauling. Overhauling of fuel tank, mechanical fuel Pump, electrical pump, fuel filters, carburetors Testing of fuel pumps for proper functioning
CO2	Have educate the students about Introduction of fuel saving by idle away, air conditioning, use overdrive, observe the speed limit, tire pressure, reduce weight, regular care and constant speed, preparing the tractor for storage
CO3	Have the knowledge about Care and maintenance procedure of agricultural machinery during operation and off-season. Maintenance, Servicing of different types of air cleaner, turbocharger, intercooler, throttle body, intake manifold, exhaust systems, exhaust manifold, catalytic converter, resonator and muffler.
CO4	Have the knowledge of Maintenance, diagnosis and servicing of basic petrol fuel system components, conventional diesel fuel system and its components, lubrication system
CO5	Be able to know about To provide knowledge about cooling system and servicing battery maintenance and servicing of starting system, charging system. and conventional ignition system. Repair and maintenance of workshop requirements

CO-PO MAPPING:

	CO	**PO1.** Knowledge of Applied Science in Agricultural Engineering.	**PO2.** Knowledge of Basic Engineering.	**PO3.** Problem Solving.	**PO4.** Field Experimentations.	**PO5.** Knowledge of Soil and Water Conservation Engineering.	**PO6.** Knowledge of Irrigation and Drainage Engineering.	**PO7.** Knowledge of Farm Machinery, equipment and techniques.	**PO8.** Knowledge of Process and Food Engineering equipment and techniques.	**PO9.** Knowledge of Renewable Energy Engineering.	**PO10.** Environment and sustainability.	**PO11.** Ethics.	**PO12.** Individual and team work	**PO13.** Communication and skill development.	**PO14.** Lifelong learning.
CO1	Student able to know with the Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10, 50, 100, 250, 500 and 1000 hrs of operation. Safety hints. Top end overhauling. Overhauling of fuel tank, mechanical fuel Pump, electrical pump, fuel filters, carburetors Testing of fuel pumps for proper functioning	2	1	3	2	-	-	3					1		3
CO2	Have educate the students about Introduction of fuel saving by idle away, air conditioning, use overdrive, observe the speed limit, tire pressure, reduce weight, regular care and constant speed, preparing the tractor for storage	3	3	2	3	-	-	3					3		2

CO3	Have the knowledge about Care and maintenance procedure of agricultural machinery during operation and off-season. Maintenance, Servicing of different types of air cleaner, turbocharger, intercooler, throttle body, intake manifold, exhaust systems, exhaust manifold, catalytic converter, resonator and muffler.	3	3	2	3	-	-	3					3		3
CO4	Have the knowledge of Maintenance, diagnosis and servicing of basic petrol fuel system components, conventional diesel fuel system and its components, lubrication system	3	3	3	3	-	-	3					2		3
CO5	Be able to know about To provide knowledge about cooling system and servicing battery maintenance and servicing of starting system, charging system. and conventional ignition system. Repair and maintenance of workshop requirements	3	3	2	2	-	-	3					2		2
3: Strong contribution, 2: average contribution, 1: Low contribution															

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Dairy and Food Engineering
Paper Code: AE370
w.e.f. Session 2020-21

3(2+1)

Theory

Unit.1

Deterioration in food products and their controls, Physical, chemical and biological methods of food preservation. Nanotechnology: History, fundamental concepts, tools and techniques nanomaterials, applications in food packaging and products, implications.

Unit.2

Environmental impact of nanomaterials and their potential effects on global economics, regulation of nanotechnology. Dairy development in India, Engineering, thermal and chemical properties of milk and milk products, Process flow charts for product manufacture, Unit operation of various dairy and food processing systems.

Unit.3

Principles and equipment related to receiving of milk, pasteurization, sterilization, homogenization, centrifugation and cream separation. Preparation methods and equipment for manufacture of cheese, paneer, butter and ice cream, Filling and packaging of milk and milk products; Dairy plant design and layout, Plant utilities.

Unit.4

Principles of operation and equipment for thermal processing, Canning, Aseptic processing, Evaporation of food products: principle, types of evaporators, steam economy, multiple effect evaporation, vapour recompression, Drying of liquid and perishable foods: principles of drying, spray drying, drum drying, freeze drying.

Unit.5

Filtration: principle, types of filters; Membrane separation, RO, Nano-filtration, Ultra filtration and Macro-filtration, equipment and applications, Non-thermal and other alternate thermal processing in Food processing.

Practical

Study of pasteurizers, Study of sterilizers, Study of homogenizers, Study of separators, Study of butter churns, Study of evaporators, Study of milk dryers, Study of freezers, Study of filtration, Design of food processing plants & preparation of layout, Visit to multi-product dairy plant, Estimation of steam requirements, Estimation of refrigeration requirements in dairy & food plant, Visit to Food industry.

Suggested Readings

- Ahmed, T. 1997. Dairy Plant Engineering and Management. 4th Ed. Kitab Mahal.
- McCabe, W.L. and Smith, J. C. 1999. Unit Operations of Chemical Engineering. McGraw Hill.
- Rao, D.G. Fundamentals of Food Engineering. PHI learning Pvt. Ltd. New Delhi.
- Singh, R.P. & Heldman, D.R. 1993. Introduction to Food Engineering. Academic Press.
- Toledo, R. T. 1997. Fundamentals of Food Process Engineering. CBS Publisher.

Course objective:

1. To give knowledge about importance and scope of dairy technology, planning dairy development in India and engineering, thermal and chemical properties of milk and milk products.

2. To provide the knowledge about Unit operation of various dairy and food processing systems, process flow charts for product manufacture.
3. To educate the students about working principles of equipment for receiving, pasteurization sterilization, homogenisation, filling & packaging, butter manufacture.
4. To aware the students about the dairy plant design and layout, composition and proximate analysis of food products.
5. To provide Knowledge regarding the evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement.

Course Outcome

After completion of course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students able to understand the conceptual knowledge about importance and scope of dairy technology, planning dairy development in India and engineering, thermal and chemical properties of milk and milk products.
CO2	Able to know about Unit operation of various dairy and food processing systems, process flow charts for product manufacture.
CO3	Student able to understand about working principles of equipment for receiving, pasteurization sterilization, homogenisation, filling & packaging, butter manufacture.
CO4	Able to know about about the dairy plant design and layout, composition and proximate analysis of food products.
CO5	Students able to understand the basic Knowledge regarding the evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement.

CO-PO MAPPING:

	CO	**PO1** Knowledge of Applied Science in Agricultural Engineering	**PO2** Knowledge of Basic Engineering	**PO3** Problem Solving	**PO4** Field Experimentations	**PO5** Knowledge of Soil and Water Conservation Engineering	**PO6** Knowledge of Irrigation and Drainage Engineering	**PO7** Knowledge of Farm Machinery, equipments and techniques	**PO8** Knowledge of Process and Food Engineering equipments and techniques	**PO9** Knowledge of Renewable Energy Engineering	**PO10** Environment and sustainability	**PO11** Ethics	**PO12** Individual and team work	**PO13** Communication and skill development	**PO14** Lifelong learning
CO1	Students able to understand the conceptual knowledge about importance and scope of dairy technology, planning dairy development in India and engineering, thermal and chemical properties of milk and milk products.	3	3	3	2	-	-	-	3	-	3	3	2	3	2
CO2	Able to know about Unit operation of various dairy and food processing systems, process flow charts for product manufacture.	3	3	3	2	-	-	-	3	-	2	2	3	2	3
CO3	Student able to understand about working principles of equipment for receiving, pasteurization sterilization, homogenisation, filling & packaging, butter manufacture.	3	3	2	2	-	-	-	3	-	3	2	3	2	3
CO4	Able to know about about the dairy plant design and layout, composition and proximate analysis of food products.	3	3	3	1	-	-	-	3	-	3	2	3	2	3
CO5	Students able to understand the basic Knowledge regarding the evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement.	3	3	2	3	-	-	-	3	-	3	2	3	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

B. Tech. (Agricultural Engineering)
SEMESTER-VI
Syllabus: Bio-energy Systems: Design and Applications
Paper Code: AE371
w.e.f. Session 2020-21

3(2+1)

Theory

Unit.1

Fermentation processes and its general requirements, An overview of aerobic and anaerobic fermentation processes and their industrial application.

Unit.2

Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential. Biomass Production: Wastelands, classification and their use through energy plantation, selection of species, methods of field preparation and transplanting.

Unit.3

Harvesting of biomass and coppicing characteristics. Biomass preparation techniques for harnessing (size reduction, densification and drying). Thermochemical degradation.

Unit.4

History of small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics.

Unit.5

Transesterification for biodiesel production. A range of bio-hydrogen production routes. Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

Practical:

Study of anaerobic fermentation system for industrial application, Study of gasification for industrial process heat, Study of biodiesel production unit, Study of biomass densification technique (briquetting, pelletization, and cubing), Integral bio energy system for industrial application, Study of bio energy efficiency in industry and commercial buildings, Study and demonstration of energy efficiency in building, Measuring efficiency of different insulation technique, Study of Brayton, Striling and Rankine cycles, Study of modern greenhouse technologies.

Suggested Readings

- British BioGen. 1997, Anaerobic digestion of farm and food processing practices- Good practice guidelines, London, available on www.britishbiogen.co.UK.
- Butler, S. 2005. Renewable Energy Academy: Training wood energy professionals.
- Centre for biomass energy. 1998. Straw for energy production; Technology- EnvironmentEcology. Available: www.ens.dk

Course Objective

1. To understand the Fermentation processes and its general requirements .
2. To get knowledge about Heat transfer processes in anaerobic digestion systems, land fill gas technology and potential. Biomass Production: Wastelands, classification and their use through energy plantation.

3. To learn about the Harvesting of biomass and coppicing characteristics. Biomass preparation techniques.
4. To know about small gas producer engine system. Chemistry of gasification. Gas producer – type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas.
5. To know about the for biodiesel production. A range of bio-hydrogen production routes.

Course Outcome:

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	**DESCRIPTION**
CO1	To Study of Importance of aerobic and anaerobic fermentation processes and their industrial application
CO2	Understand the knowledge about land fill gas technology and potential. Biomass Production: Wastelands. .
CO3	To study about the Thermochemical degradation
CO4	Understand about shaft power generation, thermal application and economics.
CO5	To learn about the about the biodiesel production. A range of bio-hydrogen production routes

CO-PO MAPPING:

	CO	**PO1** Knowledge of Applied Science in Agricultural Engineering	**PO2** Knowledge of Basic Engineering	**PO3** Problem Solving	**PO4** Field Experimentations	**PO5** Knowledge of Soil and Water Conservation Engineering	**PO6** Knowledge of Irrigation and Drainage Engineering	**PO7** Knowledge of Farm Machinery, equipments and techniques	**PO8** Knowledge of Process and Food Engineering equipmentsand techniques	**PO9**Knowledge of Renewable Energy Engineering	**PO10**Environment and sustainability	**PO11** Ethics	**PO12** Individual and team work	**PO13**Communication and skill development	**PO14**Lifelong learning
CO1	To Study of Importance of aerobic and anaerobic fermentation processes and their industrial application	3	3	3	-	-	-	-	3	-	1	3	2	-	2
CO2	Understand the knowledge about land fill gas technology and potential. Biomass Production: Wastelands .	3	3	3	-	-	-	-	3	-	1	2	3	-	3
CO3	To study about the Thermochemical degradation	3	3	2	-	-	-	-	3	-	1	2	3	-	3
CO4	Understand about shaft power generation, thermal application and economics	3	3	3	-	-	-	-	3	-	2	2	3	-	3
CO5	To learn about the about the biodiesel production. A range of bio-hydrogen production routes	3	3	2	-	-	-	-	3	-	1	2	3	-	3

3: Strong contribution, 2: average contribution, 1: Low contribution