Semester	**:**	**I**			
Course No.	**:**	**GAE-111**	**Credit Hrs.**	**:**	**4 (3+1)**
Course Title	**:**	**Introduction to Agricultural Engineering**			

SYLLABUS

Objectives: To enable the students to have basic idea on different agricultural engineering applications of machinery for different farm operations, post-harvest, technologies on renewable energy, soil and water conservation, irrigation and farm structure and allied areas.

THEORY

FARM MACHINERY AND POWER ENGINEERING:

Importance of Agricultural Mechanization for today's Agriculture; Different sectors of Farm Machinery for employment for Agricultural Engineers; Scope of research and higher studies in Farm Machinery and Power in India and abroad; Farm mechanization needs and strategy, Classification of farm machinery on the basis of unit operations; Principles of selection of machinery for different sizes of land and matching power sources; Different types of equipment for tillage, sowing, planting and transplanting, fertilizer application, weed control, plant protection; Harvesting and threshing equipment for rice, wheat, maize, cotton, sugarcane, fruits, tuber crops and other locally important crops; Functions and capabilities of tractor and power tillers; Introduction to the IC engine systems, fuel and air supply systems, cooling and lubricating systems, and electrical systems in a tractor; Basic parts of a power tiller; Hitching system.

RENEWABLE ENERGY ENGINEERING:

Introduction to Renewable Energy Engineering for today's Agriculture; Different sectors of employment in Renewable Energy Engineering; Scope of research and higher studies in renewable energy Engineering in India and abroad. Types of Solar energy collectors; Application of Solar energy: Solar water heating system and Solar dryer; Solar photovoltaic system: components and applications; Wind energy: Working principle of WECS, Types and components of WECS; Biogas production and types of biogas plants.

SOIL AND WATER CONSERVATION ENGINEERING:

Importance of Soil and Water Conservation Engineering for today's Agriculture; Different sectors of employment in Soil and Water Conservation Engineering; Scope of research and higher studies in Soil and Water Conservation Engineering in India and abroad. Different agronomical measures for control of water erosion, mixed cropping, crop rotation, tillage practices, mulching; Different engineering measures, gully control measures; Use of topographical survey and contour maps; Different types of water harvesting structures.

IRRIGATION AND DRAINAGE ENGINEERING:

Importance of Irrigation and Drainage Engineering for today's Agriculture; Different sectors of employment in Irrigation and Drainage Engineering; Scope of research and higher studies in Irrigation and Drainage Engineering in India and abroad. Introduction to soil-plant-water relationship; Equipment for measurement of irrigation water viz., weirs, notches, orifices and mouth pieces; Introduction to different surface irrigation methods as border, furrow and check basin, sprinkler, drip irrigation and their different components; Underground water conveyance methods in pipes; Introduction to planning of drainage systems; Introduction to centrifugal pumps and different components.

FARM STRUCTURE ENGINEERING:

Importance of Farm Structural Engineering for today's Agriculture, Scope of research and higher studies in Farm Structural Engineering and Environment management in India and abroad. Different types of Agriculture structures, Introduction to planning layout of farmsteads, animal houses, poultry houses; Different types of grain storage structures; Greenhouse and its different parts, Low cost protected structures.

PROCESS AND FOOD ENGINEERING:

Importance of Process and Food Engineering for today's Agriculture; Different sectors of employment in Process and Food Engineering; Scope of research and higher studies Process and Food Engineering in India and abroad. Classification of different types of agricultural commodities as durables, perishables etc.; Moisture content and its importance in grain storage: common reasons of food spoilage, food preservation methods; Different primary operations and their necessity; Methods and equipments used for cleaning, washing, sorting, grading, peeling, size reduction; Different types of traditional and modern storage structures, Storage of perishables commodities; Different types of packaging materials and their suitability for various food products; Basic principles of value addition of food as drying and dehydration, evaporation, thermal processing, refrigerated and frozen storage, Chemical preservation and other novel methods.

PRACTICAL

Study of various implements (tillage, sowing, planting, weeding, fertilizer application); Study of farm implements (pesticide application, harvesting and threshing); Study of various components of tractor and matching implements; Study of various components of power tiller and matching implements. Study of biogas plants and operational parameters, Study of solar energy application systems. Visit to a watershed, Study on various components of sprinkler and drip irrigation. Study on various components centrifugal pump. Visit to a greenhouse with modern irrigation system. Study of various post-harvest operations, study of different food processing equipments, value addition of common crops. Visit to implement manufacturing unit, Visit to mechanized farm, Visit to food processing industry.

TEACHING SCHEDULE

THEORY [GAE-111]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
FARM MACHINERY AND POWER ENGINEERING			
1	Importance of Agricultural Mechanization	Importance of Agricultural Machinery for today's Agriculture; Different sectors of Farm Machinery for employment for Agricultural Engineers; Scope of research and higher studies in Farm Machinery and Power in India and abroad	5
2	Farm Mechanization	Farm mechanization advantages, strategy, Classification of farm machinery on the basis of unit operations; Selection of machinery for different sizes of land and matching power sources	
3	Tillage	Tillage: Types, Tillage machinery, Introduction to M.B. plough, disc plough, subsoiler, harrows, cultivators	5
4	Planting	Seed drill, planters, zero till drill, calibration, rice and vegetable transplanter	
5	Intercultural Equipments	Fertilizer applicators, types of weeders, uses, intercultural equipments	
6	Spraying Equipments	Sprayers: Manual and battery-operated knapsack sprayer, mist blowers, boom sprayer	5
7	Harvesting Equipments	Introduction to harvesting machines for rice, wheat, maize, cotton, sugarcane, fruit crop, tuber crop, sugarcane	
8	Threshing Equipments	Introduction to thresher for rice, wheat, maize; Combine harvester	
9	Engine	Introduction to the IC engine: C.I. and S.I. engines, their working principles, engine components their functions, valve operating mechanism, firing order in multi cylinder engine and trouble shooting	5
10	Engine System	Intake, exhaust system: types of air cleaner, their working, exhaust system Fuel supply system: in tractor, components their functions, carburetor, components, working principle, trouble shooting	

Continued…

11	Tractor systems	Cooling system: types, components and functions. Lubrication system: types, combination of splash and pressure system, components and function trouble shooting. Electrical system of tractor: Battery, electrolyte, charging, discharging system: components and functions	5
12	Tractor and Power tiller	Functions and capabilities of tractor and power tiller, Basic parts of a power tiller; Tractor hitching system	
		Sub-Total =	**25**
RENEWABLE ENERGY ENGINEERING			
13	Introduction to Renewable Energy Sources	Importance of renewable energy for today's agriculture; Different sectors of renewable energy for employment for Agricultural Engineers; Scope of research and higher studies in renewable energy in India and abroad. Definition, Classification, Types, Advantages/limitations and prospectus of renewable energy sources. Comparison between Conventional (Commercial) and Non-conventional energy (Renewable energy) sources.	5
14	Solar Energy Collector	Working principal and function of solar collector. Types and Application of solar collectors; Advantages and disadvantages of different solar collectors over each other.	
15	Application of Solar energy	Generalized classifications of solar energy applications; Solar Water Heating System: Working Principle, types, advantages and uses. Solar Drying System: Working principle, Types, advantages and uses.	
16	Solar Photovoltaics Systems	Definition and Principles of photovoltaic effect, Solar cell and semiconductor junction, Basic photovoltaics system for power generation; Applications, advantages and disadvantages of solar photovoltaic system	3
17	Wind Energy Systems	Basic components of wind energy conversion system, Types of wind energy machines; Applications, advantages and disadvantages of wind energy system	

Continued…

18	Biogas Production and Types	Working, Components, Classification and Types of Biogas plants Comparison of floating gas and fixed dome, Applications of biogas system, Factors affecting biogas generation	2
		Sub-Total =	**10**
SOIL AND WATER CONSERVATION ENGINEERING			
19	Importance of Soil and Water Conservation for today's Agriculture	Principles, Benefits, Problems by erosion, causes of erosion, Different sectors of employment in SWCE, Scope of research and higher studies in SWCE in India and Abroad	4
20	Agronomical Measures for Control of Water Erosion	Mixed cropping, crop rotation, tillage practices, mulching	
21	Different Engineering Measures; Temporary Gully Control Measures	Single row brusho wood dam, Double row brusho wood dam, Loose rock fill dam, log check dam, netting dam	3
22	Permanent Gully Control Structures	Drop inlet spillway, chute spillway and straight drop spillway (functional uses, adaptability, advantages, limitations of all)	3
23	Survey and Maps	Contour lines, Characteristics of contour lines, use of contour maps and topographical maps	2
24	Different Types of Water Harvesting Structures	Roof harvesting, Runoff harvesting (short term and long-term storage), flood water harvesting.	3
		Total =	**15**
IRRIGATION AND DRAINAGE ENGINEERING			
25	Importance and Scope	Importance of Irrigation and Drainage Engineering for today's Agriculture; Different sectors of employment in Irrigation and Drainage Engineering; Scope of research and higher studies in Irrigation and Drainage Engineering in India and abroad.	5
	Introduction to Soil-Plant-Water Relationship	Soil-Plant-Water Relationship: Relevant Terms/Definitions	
	Water Relations of Soil	Kinds of soil water, Movement of water into soils, Infiltration, Evaporation and Transpiration (Definitions only)	
26	Measurement of Irrigation Water	Units of measurement of water, Methods of water measurement, Weir and notches (Rectangular, Cipoletti weir, V-notch weir, Orifices, Parshall flume) Mouthpieces	

Continued…

27	Surface Irrigation Methods	Methods of irrigation- Border irrigation: Basic details only Check basin irrigation: Basic details only Furrow irrigation: Basic details only	5
28	Sprinkler, Drip irrigation and their Different Components	Sprinkler irrigation system: Basics, adaptability, limitations, Types of sprinkler systems: Components of sprinkler system (*List of components and their functions only*) Drip irrigation system: Basics, Advantages of drip system; Components of drip systems (*List of components and their functions only*)	
29	Underground Water Conveyance Methods in Pipes	Basics, Pipes for underground water distribution systems, Discharge capacity of pipelines	
30	Introduction to Planning of Drainage Systems	Basics of Drainage- Definitions, Water logging- Definition, Causes of water logging, Benefits of Drainage, Drainage coefficient and Subsurface drainage.	5
31	Introduction to Centrifugal Pumps and Different Components	Basics, Principle of operation of Centrifugal pumps, Centrifugal pump classification, components of centrifugal pump	
		Total =	**15**
FARM STRUCTURE ENGINEERING			
32	Importance	Importance of Farm Structural Engineering for today's Agriculture, Scope of research and higher studies in Farm Structural Engineering and Environment management in India and abroad	3
	Farmstead Planning	Introduction, location, size and arrangement, Defects in traditional houses, Rooms of improved farm house.	
33	Dairy barn and Poultry housing	Types of Dairy barns, Types of poultry houses with drawings	2.5
34	Grain Storage Structures	Grain storage methods, requirements of good storage structures, indigenous storage structures- Bukhari, Morai and Kothar structure, Grain bins- cylindrical, Rectangular and Pusa bin.	2
35	Protected Structures	Factors affecting plant growth, Greenhouse effect, Orientation of Greenhouse, Classification of Greenhouse based on shape. Greenhouse, Shade-net house and Low cost protected structures with drawings.	2.5
		Total =	**10**

Continued…

AGRICULTURAL PROCESS ENGINEERING			
36	Importance	Importance of Agricultural Processing, Different employment sectors for processing and Food Engineers, Scope of research and higher studies in processing and Food Engineering in India and abroad.	5
37	Agricultural Commodities	Its classification as durables, perishables, etc. Common reasons of spoilage and different preservation methods	
38	Unit Operations	Cleaning, sorting, grading	
39	Grain Processing Equipments	Air screen cleaner, Specific gravity separator, Indented cylinder and Disk separator, Spiral separator	5
40	Unit Operation of Fruit and Vegetable Processing	Methods of sorting, grading, washing, peeling of fruits and vegetables	
41	Size Reduction	Method and Equipment	5
42	Moisture content and its Representation	Wet and dry basis moisture content; Numerical only on conversion of wet and dry basis	
43-44	Drying and Dehydration	Principles of drying, importance and advantages of drying, different methods of drying	5
45	Thermal Processing	Sterilization, pasteurization, blanching and evaporation	5
46	Storage	Storage of perishables, air tight storage	
47	Packaging	Different types of packaging materials	
48	Novel Processing	Different novel processing techniques (in brief)	
		Sub-Total =	**25**
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [GAE 111]

Exercise No.	Exercise Title
FARM MACHINERY AND POWER ENGINEERING	
1	Study of tillage, sowing and planting equipments
2	Study of weeding, fertilizer application, pesticide application equipments
3	Study of harvesting and threshing equipments
4	Study of matching implements of tractor and power tiller
5	Study of various components of tractor and power tiller
6	Study of intake exhaust, lubrication and cooling systems
7	Study of fuel, ignition system and electrical system of tractor
RENEWABLE ENERGY ENGINEERING	
8	Study of various types of biogas plants and operating parameters.
9	Study of various applications of solar energy systems.
SOIL AND WATER CONSERVATION ENGINEERING	
10	Study of various Soil and Water Conservation measures
IRRIGATION AND DRAINAGE ENGINEERING	
11	Study on various components of sprinkler and drip irrigation
12	Study on various components centrifugal pump
PROCESSING AND FOOD ENGINEERING	
13	Determination of moisture content of agricultural produce
14	Value addition of horticultural crops
15	Value addition of food grains
Common for all above Departments*	
16	Visit to implement manufacturing unit, mechanised farm, Visit to watershed, Visit to a greenhouse with modern irrigation system, Visit to a food processing industry.

Suggested Readings [GAE 111]:

FARM MACHINERY AND POWER ENGINEERING

1. Jain S C and Philip G 2009. Farm Machinery: An Approach. Second Ed. Standard Publisher and distributor, New Delhi
2. Michel A.M. and Ojha T.P. 2003. Principles of Agricultural Engineering-I, Jain Brothers, New Delhi
3. Nakra C.P 1980. 1980. Farm Machines and Equipments, Dhanpat Rai Publishing Company Pvt Ltd. New Delhi.

RENEWABLE ENERGY ENGINEERING

1. Rai G.D.2017. Non-Conventional Energy Sources, Khanna Publishers, New Delhi.
2. Rai G.D.2014. Solar Energy Utilization, Khanna Publishers, New Delhi.
3. Rathore N. S., Panwar N.L. & Kurchaniya A. K. 2008. Renewable Energy-Theory and Practices, Himanshu Publications, Udaipur.
4. Kalbande S. R., Bhale V. M. & Sedani S.R. 2022. Renewable Energy Technologies, Narendra Publications, New Delhi.

SOIL AND WATER CONSERVATION ENGINEERING

1. Michael, A.M. and T.P. Ojha 2020. Principles of Agricultural Engineering. Volume II. 5th Edition, Jain Brothers, New Delhi.
2. Suresh, R. 2020. Soil and Water Conservation Engineering. Standard Publ. Distributors, New Delhi.
3. Suresh, R. 2009. Soil and Water Conservation Engineering. Standard Publ. Distributors, New Delhi.

IRRIGATION AND DRAINAGE ENGINEERING

1. Irrigation: Theory and Practice (2nd Edition) by A.M. Michael,Vikas Publishing House, New Delhi.
2. Principles of Agricultural Engineering- Vol.-II (3rd Edition), A.M. Michael and T.P. Ojha published by Jain Brothers, New Delhi.
3. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Publication New Delhi.

FARM STRUCTURE ENGINEERING

1. Principles of Agricultural Engineering, Volume-I by T.P. Ojha and A.M. Michael, Jain Brothers, New Delhi -110 005 (Fourth Edition, 2003).
2. Greenhouse Technology and Applications by Vilas M. Salokhe and Ajay K. Sharma. Agrotech Publishing Academy, Udaipur (Raj.), First Edition (2006).

PROCESS AND FOOD ENGINEERING

1. Chakraverty, A. Post Harvest Technology of Cereals, Pulses and Oilseeds Oxford & IBH Publishing Pvt Ltd 66, Janpath, New Delhi 110001.
2. Sahay K.M .and K.K. Singh, Unit operations of Agricultural Processing-2022 Vikas Publishing house, Pvt. Ltd.576, Masjid Road, Jangpura, New Delhi 110014.
3. Girdharilal, G.S. Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables Indian Council of Agricultural Research, New Delhi.
4. Akash Pare and B L. Mandhyan, Food Process Engineering and Technology Nipa GenX Electronic Resources and Solutions Pvt Ltd, Pritam Pura New Delhi.
5. I.S. Singh, Post-Harvest Handling and Processing of Fruits and Vegetables, Westville Publishing houses, New Delhi.