

## **9. AGRICULTURAL AND IRRIGATION ENGINEERING**

**Machine Design:** Design and selection of machine elements – gears, pulleys, chains and sprockets and belts; shafts and couplings, temporary and permanent joints, energy storing elements and engine components, bearings – measurement of force, torque, speed, displacement and acceleration on machine elements.

**Farm Machinery:** Soil tillage forces acting on a tillage tool; hitch systems and hitching of tillage implements; functional requirements, principles of working, construction and operation of manual, animal and power operated equipment for tillage, sowing, planting, fertilizer application, inter-cultivation, spraying, mowing, chaff cutting, harvesting, threshing and transport; calculation of performance parameters – field capacity, efficiency, application rate and losses; cost analysis of implements and tractors.

**Sources of Power:** Sources of power on the farm – human, animal mechanical, electrical, wind, solar and biomass; bio-fuels.

**Farm Power:** Thermodynamic principles of I.C. engines; I.C. engine cycles; engine components; fuels and combustion; lubricants and their properties; I.C. engine systems – fuel, cooling, lubrication, ignition, electrical, intake and exhaust.

**Tractors and Power Tillers:** Type, selection, maintenance, and repair of tractors and power tillers; tractor clutches and brakes; power transmission systems – gear trains, differential, final drives and power take-off; mechanics of tractor chassis; traction theory; three point hitches; mechanical steering and hydraulic control systems used in tractors.

**Fluid Mechanics:** Ideal and real fluids, properties of fluids; hydrostatic pressure and its measurement; hydrostatic forces on plane and curved surface; continuity equation; Bernoulli's theorem; laminar and turbulent flow in pipes, Darcy- Weisbach and Hazen Williams equations, Moody's diagram; flow through orifices and notches; flow in open channels.

**Soil Mechanics:** Engineering properties of soils; fundamental definitions and relationships; index properties of soils permeability and seepage analysis; shear strength, Mohr's circle of stress, active and passive earth pressures; stability of slopes.

**Hydrology:** Hydrological cycle and components; meteorological parameters, their measurement and analysis of precipitation data; runoff estimation; hydrograph analysis, unit hydrograph theory and application; stream flow measurement; flood routing.

**Surveying and Leveling:** Measurement of distance and area; instruments for surveying and leveling; chain surveying, methods of traversing; measurement of angles and bearings, plane table surveying; types of leveling; theodolite traversing; contouring; computation of areas and volume.

**Erosion Control:** Mechanics of soil erosion, soil erosion types, wind and water erosion, factors affecting erosion; soil loss estimation; biological and engineering measures to control erosion; terraces and bunds; vegetative waterways; gully control structures, drop, drop inlet and chute spillways; earthen dams; land use capability classification; rainwater harvesting structures, check dams and farm ponds.

**Soil-Water-Plant Relationship:** Water requirement of crops; consumptive use and evapotranspiration; measurement of infiltration, soil moisture and irrigation water infiltration.

**Irrigation Engineering:** Design of irrigation channels and underground pipelines; irrigation scheduling; surface, sprinkler and micro irrigation methods, design and evaluation of irrigation methods; irrigation efficiencies.

**Agricultural Drainage:** Drainage coefficient; planning, design and layout of surface and sub-surface drainage systems; leaching requirement and salinity control; irrigation and drainage water quality and reuse.

**Groundwater Hydrology:** Groundwater occurrence; Darcy's Law, steady flow in confined and unconfined aquifers, evaluation of aquifer properties; groundwater recharge.

**Wells and Pumps:** Types of wells, steady flow through wells; classification of pumps; pump characteristics; pump selection and installation.

**Drying:** Steady state heat transfer in conduction, convection and radiation; Psychrometry; concentration and drying of liquid foods- evaporators, tray, drum and spray dryers; hydrothermal treatment; drying and milling of cereals, pulses and oilseeds.

**Size Reduction and Conveying:** Mechanics and energy requirement in size reduction of granular solids, particle size analysis for comminuted solids; size separation by screening; pneumatic, bucket, screw and belt conveying; cleaning and grading; effectiveness of grain cleaners; centrifugal separation of solids, liquids and gases.

**Storage Systems:** Controlled and modified atmosphere storage; godowns, bins and grains silos.

**Preservation of Food:** Water activity, sorption and desorption isotherms; kinetics of microbial death – pasteurization and sterilization of milk and other liquid foods; preservation of food by cooling and freezing.

**Systems Analysis:** Linear programming, Irrigation water allocation – cropping pattern optimization; Dynamic Programming – Application to design and operation of reservoirs, Irrigation management; Simulation, application to irrigation scheduling; Decision support systems.

**IT in Agricultural Systems:** Precision farming; Crop production modeling; on-line measurement of plant growth in the greenhouse, models of plants production and expert systems in horticulture; e-governance, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions.

**Management of Water Resources:** IWRM framework, emerging issues in water management, watershed development, capacity building; participatory approach, Water Users Association, Farmers Association, CADP, water delivery systems, people's participation.