

GATE Agricultural Engineering Syllabus

Section 1: Engineering Mathematics

Linear Algebra:

Matrices and Determinants, Systems of linear equations, Eigen values and eigen vectors.

Calculus:

Limit, continuity and differentiability; Partial Derivatives; Maxima and minima; Sequences and series; Test for convergence; Fourier series.

Vector Calculus:

Gradient; Divergence and Curl; Line; surface and volume integrals; Stokes, Gauss and Green's theorems.

Differential Equations:

Linear and non-linear first order ODEs; Higher order linear ODEs with constant coefficients; Cauchy's and Euler's equations; Laplace transforms; PDEs - Laplace, heat and wave equations.

Probability and Statistics:

Mean, median, mode and standard deviation; Random variables; Poisson, normal and binomial distributions; Correlation and regression analysis.

Numerical Methods:

Solutions of linear and non-linear algebraic equations; integration of trapezoidal and Simpson's rule; single and multi-step methods for differential equations.

Section 2: Farm Machinery

Machine Design:

Design and selection of machine elements – gears, pulleys, chains and sprockets and belts; overload safety devices used in farm machinery; 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; testing of agricultural machinery and equipment; calculation of performance parameters - field capacity, efficiency, application rate and losses; cost analysis of implements and tractors.

Section 3: Farm Power

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; selection, operation, maintenance and repair of I.C. engines; power efficiencies and measurement; calculation of power, torque, fuel consumption, heat load and power losses.

Tractors and Power tillers:

Type, selection, maintenance and repair of tractors and powertillers; 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- free link and restrained link operations; mechanical steering and hydraulic control systems used in tractors; tractor tests and performance.

Human engineering and safety in design of tractor and agricultural implements.

Section 4: Soil and Water Conservation Engineering

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, hydrological reservoir and channel 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.

Soil and Water Erosion:

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.

Watershed Management:

Watershed characterization; land use capability classification; rainwater harvesting structures, check dams and farm ponds.

Section 5: Irrigation and Drainage Engineering

Soil-Water-Plant Relationship:

Water requirement of crops; consumptive use and evapo-transpiration; measurement of infiltration, soil moisture and irrigation water infiltration.

Irrigation Water Conveyance and Application Methods:

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.

Section 6: Agricultural Processing Engineering

Drying:

Psychrometry – properties of air-vapors mixture; 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; fluidization of granular solids-pneumatic, bucket, screw and belt conveying; cleaning and grading; effectiveness of grain cleaners; centrifugal separation of solids, liquids and gases.

Processing and By-product Utilization:

Processing of seeds, spices, fruits and vegetables; By-product utilization from processing industries.

Storage Systems:

Controlled and modified atmosphere storage; perishable food storage, godowns, bins and grain silos.

Section 7: Dairy and Food Engineering

Heat and Mass Transfer:

Steady state heat transfer in conduction, convection and radiation; transient heat transfer in simple geometry; working principles of heat exchangers; diffusive and convective mass transfer; simultaneous heat and mass transfer in agricultural processing operations; material and energy balances in food processing systems; water activity, sorption and desorption isotherms.

Preservation of Food:

Kinetics of microbial death – pasteurization and sterilization of milk and other liquid foods; preservation of food by cooling and freezing; refrigeration and cold storage basics and applications.