



GATE EXAM

2025

SYLLABUS

**AGRICULTURAL
ENGINEERING
(AG)**

GATE 2025

AG | Agricultural Engineering

Section 1: Engineering Mathematics

Linear Algebra: Matrices and determinants, linear and orthogonal transformations, Cayley Hamilton theorem; Eigen values and Eigen vectors, solutions of linear equations.

Calculus: Limit, continuity and differentiability; partial derivatives; homogeneous function – Euler's theorem on homogeneous functions, total differentiation; maxima and minima of function with several independent variables; sequences and series – infinite series, tests for convergence; Fourier, Taylor and Mac Laurin series.

Vector Calculus: Vector differentiation, scalar and vector point functions, vector differential operators – del, gradient; divergence and curl; physical interpretations-line, surface and volume integrals; Stokes, Gauss and Green's theorems.

Differential Equations: Linear and non-linear first order Ordinary Differential Equations (ODE); homogeneous differential equations, higher order linear ODEs with constant coefficients; Laplace transforms and their inverse; Partial Differential Equations - 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; numerical integration - trapezoidal and Simpson's rule; numerical solutions of ODEs.

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, stress, torque, speed, displacement and acceleration on machine elements - shafts, couplings, keys, bearings and knuckle joints.

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, intercultivation, spraying, mowing, chaff cutting, harvesting and threshing 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; performance index, cost analysis of implements and tractors.

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 - free link and restrained link operations; steering and hydraulic control systems used in tractors; tractor tests and performance; human engineering and safety considerations 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; continuity equation, kinematics and dynamics of flow; Bernoulli's theorem; laminar and turbulent flow in pipes, Darcy- Weisbach and Hazen-Williams equations, Moody's diagram; flow through orifices, weirs and notches; flow in open channels, dimensional analysis – concepts of geometric dimensionless numbers.

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, Terzaghi's one dimensional soil consolidation theory.

Hydrology: Hydrological cycle and measurement of its components; meteorological parameters and their measurement; analysis of precipitation data; runoff estimation; hydrograph analysis, unit hydrograph theory and application; stream flow measurement; flood routing, hydrological reservoir and channel routing, Infiltration – indices and equations, drought and its classification.

Surveying and Leveling: Measurement of distance and area; instruments for surveying and levelling; chain surveying, methods of traversing; measurement of angles and bearings, plane table surveying; types of levelling; the odolite traversing; contouring; total station, introduction to GPS survey, computation of areas and volume.

Soil and Water Erosion: Mechanics of soil erosion - wind and water erosion: soil erosion types, 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 and land use capability classification; water budgeting in watershed, rainwater harvesting, check dams and farm ponds.

Section 5: Irrigation and Drainage Engineering

Soil-Water-Plant Relationship: Water requirement of crops; consumptive use and evapotranspiration; 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 subsurface drainage systems; leaching requirement and salinity control; irrigation and drainage water quality and reuse; non-conventional drainage system.

Groundwater Hydrology: Groundwater occurrence; Darcy's Law, steady and unsteady flow in confined and unconfined aquifers, groundwater exploration techniques; overview of groundwater recharge estimation and artificial recharge techniques.

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

Section 6: Agricultural Process Engineering

Engineering properties of agriculture produce: Physical, thermal, frictional, rheological and electrical properties.

Evaporation and Drying: Concentration and drying of liquid foods – evaporators, tray, drum and spray dryers; hydrothermal treatments; drying and milling of cereals, pulses and oilseeds; drying kinetics; psychrometry – properties of air-water vapor mixture.

Size Reduction and Material Handling: Mechanics and energy requirement in size reduction of agriculture produce; 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 separation; centrifugal separation of solids, liquids and gases; homogenization; filtration and membrane separation. UNLIMITED LEARNING...

Processing of Agriculture Produce: Processing of seeds, spices, fruits and vegetables; value addition of agriculture produce.

Storage Systems: Controlled and modified atmosphere storage; perishable food storage, godowns, bins and grain silos, packaging material and machines.

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.