GATE Syllabus
Agricultural Engineering

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SIMPLY EASY LEARNING

AGRICULTURAL ENGINEERING

Subject Code: AG

Course Structure

Sections/Units	Topics
Section A	**Engineering Mathematics**
1	Linear Algebra
2	Calculus
3	Vector Calculus
4	Differential Equations
5	Probability and Statistics
6	Numerical Methods
Section B	**Farm Machinery**
1	Machine Design
2	Farm Machinery
Section C	**Farm Power**
1	Sources of Power
2	Farm Power
3	Tractors and Powertillers
Section D	**Soil and Water Conservation Engineering**
1	Fluid Mechanics
2	Soil Mechanics
3	Hydrology
4	Surveying and Leveling

5	Soil and Water Erosion
6	Watershed Management
Section E	**Irrigation and Drainage Engineering**
1	Soil-Water-Plant Relationship
2	Irrigation Water Conveyance and Application Methods
3	Agricultural Drainage
4	Groundwater Hydrology
5	Wells and Pumps
Section F	**Agricultural Processing Engineering**
1	Drying
2	Size Reduction and Conveying
3	Processing and By-product Utilization
4	Storage System
Section G	**Dairy and Food Engineering**
1	Heat and Mass Transfer
2	Preservation of Food

Course Syllabus

Section A: Engineering Mathematics

Unit 1: Linear Algebra

- ➢ Matrices and determinants
- ➢ Systems of linear equations
- ➢ Eigen values and Eigen vectors

Unit 2: Calculus

- ➢ Limit, continuity and differentiability
- ➢ Partial derivatives

- ➢ Maxima and minima
- ➢ Sequences and series
- ➢ Tests for convergence
  - Fourier series
  - Taylor series

Unit 3: Vector Calculus

- ➢ Gradient; divergence and curl
- ➢ Line, surface and volume integrals
- ➢ Stokes, Gauss and Green's theorems

Unit 4: Differential Equations

- ➢ Linear and non-linear first order Ordinary Differential Equations (ODE)
- ➢ Higher order linear ODEs with constant coefficients
- ➢ Cauchy's and Euler's equations
- ➢ Laplace transforms
- ➢ Partial Differential Equations - Laplace, heat and wave equations

Unit 5: Probability and Statistics

- ➢ Mean, median, mode and standard deviation
- ➢ Random Variables
- ➢ Poisson, normal and binomial distributions
- ➢ Correlation and regression analysis
- ➢ Tests of significance
- ➢ Analysis of variance (ANOVA)

Unit 6: Numerical Methods

- ➢ Solutions of linear and non-linear algebraic equations
- ➢ Numerical integration - trapezoidal and Simpson's rule
- ➢ Numerical solutions of ODE

Section B: Farm Machinery

Unit 1: Machine Design

- ➢ Design and selection of machine elements:

- Gears
- Pulleys
- Chains and sprockets
- Belts
- Overload safety devices used in farm machinery
- Measurement of force, torque, speed, displacement and acceleration on machine elements

Unit 2: 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
  - 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 C: Farm Power

Unit 1: Sources of Power

- Sources of power on the farm:
  - Human
  - Animal
  - Mechanical

- Electrical
- Wind
- Solar
- Biomass
➢ Bio-fuels

Unit 2: 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
- 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

Unit 3: Tractors and Powertillers

➢ 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 D: Soil and Water Conservation Engineering

Unit 1: 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

Unit 2: 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

Unit 3: 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
    - Channel routing

Unit 4: 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

Unit 5: 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

Unit 6: Watershed Management

- ➢ Watershed characterization
- ➢ Land use capability classification
- ➢ Rainwater harvesting structures
- ➢ Check dams and farm ponds

Section E: Irrigation and Drainage Engineering

Unit 1: Soil-Water-Plant Relationship

- ➢ Water requirement of crops
- ➢ Consumptive use and evapotranspiration
- ➢ Measurement of infiltration:
  - • Soil moisture
  - • Irrigation water infiltration

Unit 2: 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

Unit 3: Agricultural Drainage

- ➢ Drainage coefficient:
  - • Planning
  - • Design and layout of surface
  - • Sub-surface drainage systems
- ➢ Leaching requirement and salinity control
- ➢ Irrigation and drainage water quality and reuse

Unit 4: Groundwater Hydrology

- ➢ Groundwater occurrence
- ➢ Darcy's Law, steady flow in confined and unconfined aquifers, evaluation of aquifer properties
- ➢ Groundwater recharge

Unit 5: Wells and Pumps

- ➢ Types of wells, steady flow through wells
- ➢ Classification of pumps
- ➢ Pump characteristics
- ➢ Pump selection and installation

Section F: Agricultural Processing Engineering

Unit 1: 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

Unit 2: 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

Unit 3: Processing and By-product Utilization

- Processing of:
  - Seeds
  - Spices
  - Fruits
  - Vegetables
- By-product utilization from processing industries

Unit 4: Storage Systems

- Controlled and modified atmosphere storage
- Perishable food storage, godowns, bins and grain silos

Section G: Dairy and Food Engineering

Unit 1: 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

Unit 2: 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