

## Syllabus for A. A .E. Recruitment Examination

Paper-I		Full Marks: 100
(A) General Engineering (B) Farm Machinery and Power		
<b>A. General Engineering (30 Marks)</b>		
<b>Computer Programming and Data Structures</b>	(a)	Data types, variables, operators, building and evaluating expressions, standard library functions.
	(b)	Managing input and output, decision making
	(c)	Branching, looping, arrays, string functions
	(d)	Structures and union, queues, insertion and deletion operations
<b>Workshop practice and Workshop technology</b>	(a)	Measuring tools
	(b)	Welding, lathe, shaper, drilling, milling machines- their types, components, specification, tools and functions
<b>Applied Electronics and Instrumentation</b>	(a)	Diode, transistors, logic circuits
	(b)	Generalized instrumentation
	(c)	Measurement of displacement, temperature, velocity, pressure and force
	(d)	Transducer types and applications, strain gauge
<b>Common Statistical data on agriculture</b>	(a)	Statistics on Agriculture (Odisha & India)
	(b)	Land distribution pattern, land use, land holding sizes, major crops, their production and productivity
	(c)	Farm power availability, agriculture workers and draft animals, sale and population of tractors, power tillers, pump sets and implements
	(d)	Water resource availability, irrigation potential
<b>Units and dimensions</b>	(a)	Units and measurement, Fundamental and derived units. Relation between different units of measurement
	(b)	Dimensional analysis
<b>Surveying and levelling</b>	(a)	Linear measurements
	(b)	Types of survey and their applications, estimation of errors in measurements
	(c)	Levelling and contouring
<b>Building construction and cost estimation</b>	(a)	Building materials, building design and construction, agricultural structures, lead and material statement, Building codes
	(b)	Estimates of buildings and agricultural structures
<b>Design and maintenance of Greenhouse</b>	(a)	Types of greenhouse, its components, site selection, design criteria and construction, applications, repair and maintenance
<b>B. Farm Machinery and Power (70 Marks)</b>		
<b>Farm Machinery</b>	(a)	Need of farm mechanization, classification of farm implementations and their suitability
	(b)	Seed bed preparation machineries- MB plough, disc plough, sub-soilers, cultivators, rotavator, harrows, puddlers: their types, components, function & adjustments. Forces acting on tillage tools, hitching systems and controls, draft measurement

	(c) Seeding and planting equipment-their types, parts, function and adjustment. Metering mechanisms for small and bold seeds, calibration. Rice transplanters-types, component, functions and seedling raising techniques
	(d) Fertilizer application equipment, weeders, plant protection equipment- sprayers and dusters, their calibration, components and adjustments
	(e) Principles & types of cutting mechanisms, crop harvesting machinery- reapers, reaper binders and combine harvesters, mowers and chaff cutters
	(f) Threshers- types, components, functions and principles of threshing. Cotton pickers, sugarcane harvester, potato digger, groundnut digger cum shaker, fruit harvesting tools and machines
	(g) Testing of farm machines, test codes & procedure
<b>Farm power</b>	(a) Sources of farm power. Classification of tractors and IC engines. Engine components and their construction, functions and adjustment.
	(b) Engine systems- valves, fuel & air supply, governing, ignition, cooling, lubrication and electrical systems.
	(c) IC engine fuels and lubricants- their properties. Detonation and knocking
<b>Tractor systems and controls</b>	(a) Transmission systems- clutch, gearbox, differential and final drive. Brake, steering and hydraulic system, P.T.O. shaft, belt pulley and drawbar
	(b) Mechanics of tractor chassis, determination of C.G. of tractor, overturning of tractor, weight transfer
	(c) Tractor maintenance and trouble shooting
<b>Farm power and machinery management</b>	(a) Role of farm mechanization in increasing production and productivity and reducing drudgery. Index of farm mechanization.
	(b) Performance analysis- machine performance, capacity, field pattern, time efficiency, field efficiency. Power analysis
	(c) Cost analysis of farm machines. Break-even analysis- method of finding break-even hour and area of machines. Reliability analysis
<b>Human engineering and safety</b>	(a) Importance of the human engineering in design of farm machinery and workspace
	(b) Ergonomic parameters for evaluation of workers. Anthropometry and its use in machine design. Effect of noise, heat and vibration on operator's efficiency
	(c) Safety aspects of tractors and farm machinery. Safety measures and preventions of accidents.
<b>Precision agriculture</b>	(a) Concepts of precision agriculture- requirements and applications in agricultural production system. Farm implements for precision agriculture

<b>Renewable energy engineering</b>	(a) Biomass conversion technology-types of biogas plants, design & construction and their defects, gasifier technology. Technology and production process of bio-diesel and bio-ethanol
	(b) Solar Energy-fundamentals of solar energy, solar photo Voltaic (PV) system, solar thermal system and their applications in agricultural system
	(c) Wind energy conversion system, its applications and limitations
<b>Systems Engineering</b>	(a) System concepts, Linear programming- formulation and applications, Simplex method, Big M method
	(b) Transportation problems. Assignment problems
	(c) Project management by PERT/CPM
	(d) Waiting line theory.

**Paper-II**

**Full Marks: 100**

**(A) Agricultural Processing and Food Engineering**

**(B) Soil and Water Conservation Engineering**

**A. Agricultural Processing and Food Engineering (35 Marks)**

**Engineering properties of Food materials**

- (a) Importance of engineering properties of biological materials
- (b) Physical, thermal, frictional and aerodynamic characteristics of grains, fruits and vegetables.

**Grain Processing**

- (a) Cleaning and grading of food grains: Aspiration, scalping, size separators, screens, sieve analysis, capacity and effectiveness of screens, various types of separators, shape graders
- (b) Size reduction: Principle, Different laws governing size reduction, size reduction machineries
- (c) Milling of rice: Conditioning and parboiling, advantages and disadvantages, traditional methods, CFTRI and Jadavpur methods of parboiling, pressure parboiling method, types of rice milling (traditional and modern rice milling), different unit operations and equipment
- (d) Milling of wheat and corn: Unit operations and equipment for wheat milling ; Milling of corn and its products: Dry and wet milling
- (e) Milling of pulses: Traditional milling methods, commercial methods, dry milling and wet milling methods, pulse milling machines
- (f) Milling of oilseeds: Preconditioning of oilseeds; Mechanical expression, solvent extraction methods, refining of oil, stabilization of rice bran; By-products utilization (Paddy)
- (g) Material handling equipment: Types of conveyers (belt, roller, chain and screw), elevators, trucks (refrigerated/ unrefrigerated), pneumatic conveying.

**Drying and Storage of crops**

- (a) Drying: Moisture content and water activity, isotherm, hysteresis effect, EMC determination, psychrometric chart and its use in drying, drying principles and theory, thin layer and deep bed drying analysis, falling rate and constant rate drying periods, drying equations and factors affecting drying, mass and energy balance, Shedd's equation, different methods of drying, tempering during drying, different types of grain dryers, dryer performance.

	<p>(b) Storage of food grains: Basics of Storage, functional requirement of storage, Types and causes (factors) of spoilage respiration of grains, moisture and temperature changes. Control measures of storage environment; Ventilation/Aeration; symptoms, damages, control measures of destructive agents like rodents, birds, insects and microbes. Bag and bulk storage; traditional storage structures; Bag storage design. Improved and modern storage systems. Shallow and Deep bin/silo, Rankine, Janssen and Airy's equation. Storage of seeds, hermetically sealed and CAP storage. Godown and Ware house design.</p>
<p><b>Horticultural Produce Processing</b></p>	<p>(a) Fruits and Vegetables processing: Cleaning, sorting, grading; Juice extractors; Mechanical filtration-plate and frame filter press, shell and leaf filter, bag filter, Different types of dryers for fruits and vegetables</p>
	<p>(b) Storage of fruits and vegetables: Evaporatively cooled storage structures; Refrigerated storage; Calculation of refrigeration load; sizing and economics of cold storage. Modified and Controlled atmospheric storage. Advantages of CAS/MAP, active and passive MAP, different types of active agents for controlling oxygen, CO<sub>2</sub> and ethylene in packages; Shrink and Cling packaging, Vacuum and gas packaging; antimicrobial food packaging; Smart packaging.</p>
	<p>(c) Thermal processing: Thermal death time, D and Z value, Process time, thermal processing equipment</p>
	<p>(d) Evaporation: Objectives of evaporation, basic components of evaporators, different types of evaporators. Multiple effect evaporation, mass and energy balance in evaporation</p>
	<p>(e) Freezing: Freezing time, freezing curve, different types of freezing equipment</p>
	<p>(f) Food laws: Food Laws and Regulations in India (FSSAI); Food Standards (BIS Standards and specifications, Codex Alimentarius Standards, International Standards Organisation (ISO).</p>
	<p><b>B. Soil and Water Conservation Engineering (65 Marks)</b></p>
<p><b>Fluid Mechanics</b></p>	<p>(a) Properties of fluids: Ideal and real fluid</p>
	<p>(b) Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, centre of pressure, buoyancy, metacentre and metacentric height</p>
	<p>(c) Kinematics of fluid flow</p>
	<p>(d) Dynamics of fluid flow, flow in pipes, power transmission through pipe</p>
	<p>(e) Dimensional analysis, types of similarities, dimensionless numbers</p>

<p><b>Irrigation Engineering</b></p>	<p>(a) Major, medium and minor irrigation projects</p> <p>(b) Sources of irrigation water, Measurement of irrigation water, water conveyance, design of irrigation field channels, underground pipe conveyance system, irrigation structures, channel lining.</p> <p>(c) Land grading, different design methods and estimation of earth work and cost</p> <p>(d) Soil water plant relationship, infiltration, evapotranspiration, soil moisture constants, depth of irrigation, frequency of irrigation, irrigation efficiencies</p> <p>(e) Surface irrigation methods of water application</p> <p>(f) Basic concepts of command area- definition, need, scope and development approaches: command area development authorities. Planning and execution of on farm development activities within the scope of command area development, design of field channels; cross drainage works, Participatory irrigation management</p> <p>(g) Types and Components of micro-irrigation system, Micro-irrigation system; Sprinkler and Drip irrigation- design, installation and maintenance.</p>
<p><b>Drainage Engineering</b></p>	<p>(a) Drainage, objectives of drainage. Surface drainage, drainage coefficient, types of surface drainage.</p> <p>(b) Sub-surface drainage purpose and benefits, investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc., types and use of subsurface drainage system.</p> <p>(c) Design of sub-surface drains, interceptor and relief drains. Derivation of ellipse (Hooghoudt's) and Ernst's drain spacing equations</p> <p>(d) Design of surface drainage system. Drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains, Drainage structures.</p> <p>(e) Salt balance, reclamation of saline and alkaline soils. Leaching requirements</p>
<p><b>Groundwater, Wells and Pumps</b></p>	<p>(a) Occurrence and movement of ground water, aquifer and its types, classification of wells.</p> <p>(b) Well Hydraulics, Well interference, multiple well systems, Design of open well.</p> <p>(c) Tube well design, design of gravel pack, well screen, sanitary protection. Methods of drilling of wells; and development of well</p> <p>(d) Quality of ground water, Conjunctive use, artificial groundwater recharge planning</p> <p>(e) Pumping Systems: Water lifting devices; classification of pumps, component; parts of centrifugal pumps: pump selection, installation and troubleshooting; performance curves, hydraulic ram.</p>

<p><b>Hydrology</b></p>	<p>(a) Introduction; hydrologic cycle; precipitation-forms, rainfall measurement, mean rainfall, depth and frequency analysis of point rainfall</p>
	<p>(b) Geomorphology of watersheds</p>
	<p>(c) Runoff- factors affecting, measurement; stage and velocity, rational method, Curve number method; hydrograph</p>
	<p>(d) Head water flood control- methods, retards and their location</p>
	<p>(e) Flood routing- graphical methods of reservoir flood routing.</p>
<p><b>Soil, Water Conservation Engineering and Watershed Management</b></p>	<p>(a) Soil erosion- causes, types and agents of soil erosion; gullies and their classification, stages of gully development, Universal soil loss equation</p>
	<p>(b) Erosion control measures- agronomical measures; engineering measures- terraces- types, their design, layout procedure and planning, bunds and their design; temporary gully control structures, Permanent gully control structures- drop, chute and pipe inlet spillway and their design.</p>
	<p>(c) Wind erosion- types and control measures</p>
	<p>(d) Sedimentation in reservoirs and streams; estimation, measurement and control measures, Introduction to stream water quality and pollution.</p>
	<p>(e) Land use capability classification</p>
	<p>(f) Grassed waterways and their design</p>
	<p>(g) Introduction to water harvesting techniques</p>
	<p>(h) Small earth embankments- their types and design principles, farm ponds and reservoirs, cost estimation of structures</p>
	<p>(i) Watershed management- problems and prospects; Watershed based land use planning, watershed characteristics- physical and geomorphologic parameters, factors affecting watershed management, planning and formulation of project proposal.</p>