

SYLLABUS FOR AGRICULTURAL ENGINEERING FOR CONDUCTING WRITTEN EXAMINATION FOR DIRECT RECRUITMENT OF TEACHING POSTS IN THE CADRE OF ASSISTANT PROFESSORS AT UASM

1. Farm Machinery and Power Engineering

Farm Mechanization and Equipment

Status of farm mechanization in India; power availability on farms; hand tools used for different kinds of farm operations and materials for construction. Functional requirement, principle of working, constructional features and operation of animal and power operated equipment for land development, tillage, sowing, planting, transplanting, fertilizer application, inter cultivation, plant protection, harvesting, threshing, mowing, chaff cutting and baling; special equipment for crops such as sugarcane, cotton, groundnut, potato and plantation crops like coconut, areca nut, cashew nut etc.

Farm Machinery Design

Design and selection of machinery elements viz. gears, pulleys, chains and sprockets, belts, bearings, couplings and springs and fasteners. farm machine system characteristics and evaluation, dynamic balancing and stability of farm machines, force analysis on agricultural tools and implements, pull, draft, unit draft and power of farm equipment, design of soil working tools for sowing and planting; design of fertilizer applicators, intercultivation equipment, harvesters and threshers; pneumatic and hydraulic controls.

Farm Machinery Testing, Evaluation and Management

Calibration of seed drills, planters, plant protection equipment; methods of testing and performance evaluation of tillage equipment, seed drills and planters, fertilizer applicators, sprayers and dusters, harvesting and threshing equipment, grain and straw combines, and special equipment such as sugarcane, cotton, rice and potato planter; calculations of field capacity, efficiency and rates of seed fertilizer and chemical applicators; calculation of capacity, efficiency and losses in threshers, harvesters and chaff cutters. Farm machinery selection and management for different soils, crops and operations; cost analysis of animal and tractor operated implements and tractors; matching power-implement system, estimation of energy and power requirements, reliability of farm machinery.

Engines and Tractor Systems

Engineering thermodynamics, power cycles, fuels; various systems of IC engines; operations, adjustment and trouble shooting of different systems; calculations of power, torque, speed, firing arrangement and intervals, heat load and power transmission from piston to the flywheel; tractor power transmission, differential, final drives; power outlets such as P.T.O. and drawbar; recent trends in tractor design; emissions and control of pollutants; mechanical and power steering; tractor chassis mechanics, hitching systems, hydraulic controls for tractors, automatic position and draft control; tractor performance tests, operation and maintenance tractors and power tillers.

Soil Dynamics in Tillage and Traction

Dynamic properties of soil and their measurements; stress-strain relationships; theories of soil failure, mechanics of tillage tools; design parameters and performance of tillage tools. Introduction to traction devices, tyre function and size, their selection, mechanics of traction devices, traction theories, slippage and sinkage of wheels, evaluation and prediction of traction performance; soil compaction - causes and methods for alleviating the effect on soil and crop responses.

Energy in Agriculture

Conventional and renewable energy sources in agriculture; solar radiation and its measurement; characteristics of solar spectrum; solar energy collection, storage and applications; solar photovoltaic conversion and SPV powered systems. Types of wind mills and their applications; thermo-chemical conversion of biomass, direct combustion, Pyrolysis and gasification, chemical conversion processes, carbonization, briquetting, pelletization and densification of biomass; bioconversion into alcohols, methyl and ethyl esters, organic acids, solvents of amino acids; types of biogas plants, biogas properties, uses and distribution, alternate fuels for IC engines. Energy requirement in agricultural production systems, energy ratio and specific energy value, inflow and outflow of energy in unit agricultural operation, energy audit, accounting and analysis.

Manufacturing Technology

Specification of materials, surface roughness, production drawing, Introduction to various carpentry tools, materials, types of wood and their characteristics and Processes or operations in wood working, Smithy tools and operations, Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes, Main operations and tools used on center lathes, Types of shapers, Constructional details of standard shaper, Types of drilling machines. Constructional details of pillar types and radial drilling machines, Types and classification. Constructional details and principles of operation of column and knee on milling machine. Type universal milling machines. Plain milling cutter. Main operations on milling machine, heat treatment.

Instrumentation and Measurement Techniques

Mechanical measurements, sensors and transducers, application of electrical strain gauges, signal transmission and processing, dynamic measurements; measurement of temperature, pressure, strain, force, torque, power vibrations etc.; determination of calorific value, fluid flow rates etc; signal conditioning and monitoring, data acquisition and storage.

2. Soil and Water Conservation Engineering

Soil and Water Conservation

Soil erosion and types of erosion. Quantitative soil loss estimation, universal soil loss equation and its subsequent modifications. In-situ measurement of soil loss. Field practices in controlling erosion by water and wind. Soil and Water conservation structures and their design. Gully control: vegetative measures, temporary, semi-permanent and permanent structures for gully control and reclamation and their design. Design and construction of farm pond and reservoir. Seepage theory. Design of earthen dams and retaining walls, stability analysis on slopes.

Fluid Mechanics and Open Channel Hydraulics

Fundamental Concepts of Fluid Flow: Fundamental definitions, Flow characteristics, Classification of fluids, Fluid properties, Foundations of flow analysis. Fluid Statics: Fluid pressure, Forces on solid surfaces, Buoyant forces. Kinematics of Fluid Flow: Equations for acceleration, Continuity equation, Irrotational and rotational flow, Potential and stream functions Dynamics of Fluid Flow: Finite control volume analysis, Euler and Bernoulli's theorems. Laminar and Turbulent Flows: Types of flow, Reynolds experiment, Laminar flow between parallel plates Laminar flow in pipes, Turbulent flow in pipes. Pipe Flow Systems: Darcy-Weisbach equation, Energy losses in pipelines, Minor losses, Multiple pipe systems. Dimensional

Analysis: Model similitude, Model scales, Theory and applications. Hydraulics of open channel flow, energy and momentum principles, specific energy, Hydraulic jump, classification and its use as energy dissipater. Discharge over orifice meter and venturimeter. Discharge over notches and weirs, Rectangular, Triangular and trapezoidal notches and weirs.

Soil, Plant, Water and Atmosphere Relationship

Soil physical characteristics influencing irrigation. Soil moisture characteristics, field capacity, permanent wilting point, plant available water and extractable water. Soil irrigability classifications, factors affecting water storage profile. Determination of soil water content, computation of soil water depletion, soil water potential and its components, hydraulic head. Field water budget: water gains and water losses from soil, deep percolation beyond root zone, capillary rise. Evapotranspiration (ET) and irrigation requirement, critical stages of crop growth in relation to irrigation. Irrigation scheduling. Plant water relations, concept of plant water potential. Water movement through soil plant atmosphere system. Uptake and transport of water by roots. Management strategies to improve crop productivity under limited water supplies. Contingent crop plans and other strategies for aberrant weather conditions. Cropping patterns, alternate land use and crop diversification in rainfed regions.

Watershed Hydrology

Hydrologic cycle, precipitation, infiltration and surface runoff. Measurement and analysis of hydrologic data. Rainfall and runoff relationships, stream gauging and runoff measurement. Different methods of surface runoff Estimation. Hydrographs, S-hydrograph, IUH, Synthetic hydrograph, unit hydrograph theory and its application. Concept of hydrologic flood routing: channel and reservoir routing.

Groundwater Development, Wells and Pumps

Water resources of India. Present status of development and utilization of water resources of India and scope for additional use. Irrigation potential and contribution of groundwater, scope of groundwater development. Application of groundwater models for groundwater development and management. Aquifer types and parameters. Principles of groundwater flow, interaction between surface and groundwater, natural and artificial groundwater recharge. Salt water intrusion in inland and coastal aquifers. Groundwater exploration techniques. Hydraulics of fully and partially penetrating wells. Design, construction and development of irrigation wells. Water lifts, pumps and prime movers, well and pumps characteristics, performance evaluation and selection of pumps. Energy requirement in groundwater pumping. Design of centrifugal pumps. Groundwater pollution. Conjunctive use of surface and groundwater.

3. Processing and Food Engineering

Engineering Properties and Quality of Biomaterials

Engineering Properties and Quality of Biomaterials Uniqueness of bio-materials, Importance of engineering properties of biological materials, Physical characteristics viz. shape, size, volume, density, porosity, surface areas, Frictional characteristics viz., rolling resistance, angle of repose. Properties of bulk particulate solids viz. specific surface area, mean diameter, flow rate, Aerodynamics characteristics viz. drag coefficient and terminal velocity. Pressure drop through packed beds, Thermal properties viz. specific heat, thermal conductivity, thermal diffusivity, Dielectric properties viz. dielectric and microwave radiation, dielectric constant, energy absorption, heating, Optical properties and transmittance and reflectance, Rheological properties and stress-strain-time relationship, rheological models, visco-elasticity, Hertz's theory of contact stresses.

Heat and Mass Transfer

Basic laws of thermodynamics, thermodynamic properties and processes, energy equations, heat, work, heat engine, heat pump, refrigeration and steam tables. EMC, sorption and desorption isotherms, water activity and psychrometry. Modes of heat transfer, heat exchanger.

Post Harvest Unit Operations

Grading, cleaning, washing, sorting, shelling, dehushing, decortication, milling, polishing, pearling, drying (evaporative, osmotic and freeze drying), pasteurization and sterilization of liquid foods, kinetics of microbial death, size reduction, cryogenic grinding, granulation, crystallization, membrane separation processes viz. micro filtration, ultra-filtration, nano- filtration, reverse osmosis.

Material Handling, Packaging and Transport

Bulk conveying equipments, viz. belt conveyors, screw/auger conveyors, bucket elevators and drag/chain conveyors. Estimation of energy requirement and capacity, damage to products during mechanical handling. Operation and maintenance of conveying equipment. Packaging material characteristics and selection. Packaging techniques and equipment for liquid, powder and granular materials, and horticultural produce. Transportation of agro-produce by bullock- carts, trailers, trucks, rail wagons and containers.

Storage Engineering

Storage environment and its interaction with stored product, factors/parameters influencing the shelf life of the stored product and deterioration index. Prediction of storage life, quality deterioration mechanisms and their control. Storage practices (including fumigation) for food grains. Design of bulk storage and aeration system. Analysis of heat, moisture and gas transfer in bulk storage structures. Bag storage structures, their design and management. Storage of perishables in ventilated, refrigerated, controlled and modified atmosphere storage systems and their design, smart storage system. Quality analysis of stored produce.

4. Renewable Energy Engineering

Biochemical Conversion Technology

Anaerobic digestion, biogas plants, design, operation, utilization, Bioethanol – feedstock – process – utilization - composting - methods – machinery.

Thermo chemical conversion Technology

Biomass gasification – chemistry of gasification – gasifiers design - gas turbine systems - applications - shaft power generation - Gas cleaning & conditioning - thermal application - performance evaluation – economics.

Liquid Biofuels

Biofuel – biofuel crops – production – processes – properties and characteristics. Biodiesel – chemistry – raw materials – availability – preparation - production – trans-esterification methods-storage methods – blending options - by-product utilization. Bioethanol production from different biomass substrates.

Solar Energy Engineering

Solar radiation availability - radiation measurement – transmittance-absorptance - flat plate collectors and concentrating collectors - collector efficiency - heat balance – absorber plate – types - selective surfaces. Design and types of solar driers – heat and mass transfer – performance. - solar thermal power stations – principle and applications. Solar stills and ponds - types - design and performance. Photovoltaics - types – characteristics – load estimation - batteries – invertors –operation - system controls. PV system installations – standalone systems – PV powered water pumping - hybrid system – lifecycle costing - solar technologies in green buildings

Wind Energy Engineering

Nature of wind – wind structure and measurement - wind power laws - velocity and power duration curves - aero foil - tip speed ratio - dimensionless coefficients -torque and power characteristics - power coefficients - Betz coefficient. Wind tunnel testing - axial momentum theory - momentum theory – blade element theory - strip theory - tip loss factor of HAWT rotors- taxonomy. Wind mill – types – design – materials – loads – subsystems – power curve.