Syllabus for Agricultural Engineering

Unit - I Soil and Water Conservation Engineering

- Soil erosion:- Introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion.
- Water erosion:- Mechanics and forms - splash, sheet, rill, gully, ravine and stream bank erosion. Gullies - Classification, stages of development.
- Soil loss estimation:- Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity - estimation by KE>25 and EI_{30} methods. Soil erodibility - topography, crop management and conservation practice factors.
- Measurement of soil erosion-Runoff plots, soil samplers. Water erosion control measures - agronomical measures - contour farming, strip cropping, conservation tillage and mulching.
- Engineering measures- Bunds and terraces. Bunds - contour and graded bunds - design and surplussing arrangements.
- Terraces - level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stonewall and trenching.
- Gully and ravine reclamation - principles of gully control - vegetative measures, temporary structures and diversion drains.
- Grassed waterways and design.
- Wind erosion- Factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes.
- Land capability classification. Rate of sedimentation, silt monitoring and storage loss in tanks.

Unit -II Water Harvesting and Soil Conservation Structures

- Water harvesting techniques - classification based on source, storage and use. Runoff harvesting - short-term and long-term techniques. Short- term harvesting techniques -
- Structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes.
- Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction.
- Percolation pond - site selection, design and construction details. Design considerations of *nala* bunds.
- Soil erosion control structures - introduction, classification and functional requirements. Permanent structures for soil conservation and gully control - check dams.
- Drop, chute and drop inlet spillways – design requirements, planning for design, design procedures hydrologic, hydraulic and structural design and stability analysis.
- Hydraulic jump and its application.

- Drop spillway applicability, types - straight drop, box-type inlet spillways - description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components and functions.
- Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations.
- Drop inlet spillway-description, functional use and design criteria.

Unit III Watershed Planning and Management

- Watershed - introduction and characteristics. Watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio- economic factors.
- Watershed management – concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning.
- Watershed codification, delineation and prioritization of watersheds -sediment yield index.
- Water budgeting in a watershed. Management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage, water harvesting and recycling.
- Dry farming techniques, inter-terrace and inter-bund land management.
- Integrated watershed management - concept, components, arable lands -agriculture and horticulture, non-arable lands - forestry, fishery and animal husbandry.
- Effect of cropping systems, land management and cultural practices on watershed hydrology.
- Watershed programme - execution, follow-up practices, maintenance, monitoring and evaluation.
- Participatory watershed management - role of watershed associations, user groups and self-help groups.
- Planning and formulation of project proposal for watershed management programme including cost-benefit analysis.

Unit-IV Irrigation and Drainage Engineering

- Measurement of irrigation water: - Weir, flumes and orifices and other methods: open channel water conveyance system: design and lining of irrigation field channels, on farm structures for water conveyance, control & distribution.
- Underground pipe conveyance system: components and design: land grading: criteria for land leveling, land leveling design methods, estimation of earth work.
- Soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants.
- Measurement of soil moisture, moisture stress and plant response; water requirement of crops, concept of evapotranspiration (ET).
- Measurement and estimation of ET, water and irrigation requirement of crops. Depth of irrigation. frequency of irrigation, irrigation efficiencies;
- Surface methods of water application: border, check basin and furrow irrigation-adaptability, specification and design considerations.

- Water logging-causes and impacts; drainage, objectives of drainage.
- Surface drainage coefficient types of surface drainage, design of surface drains.
- Sub-surface drainage: purpose and benefits. Investigations of design parameters-hydraulic conductivity, drainable porosity, water table.
- Derivation of Hooghoudt's and Ernst's drain spacing equations; design of subsurface drainage system; drainage materials, drainage pipes, drain envelope; layout, construction and installation of drains.

Unit V-Ground water, wells and Pump

- Occurrence and movement of ground water; aquifer and its types; classification of wells, fully penetrating tubewells and open wells, familiarization of various types of bore wells; design of openwells.
- Groundwater exploration techniques; methods of drilling of wells: percussion, rotary, reverse rotary.
- Design of tubewell and gravel pack, installation of well screen, completion and development of well.
- Groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's, Theis recovery method; well interference, multiple well systems.
- Estimation of ground water potential, quality of ground water; artificial groundwater recharge techniques; pumping systems: water lifting devices.
- Different types of pumps, classification of pumps, component parts of centrifugal pumps, priming
- Pump selection, installation and trouble shooting, performance curves, effect of speed on capacity, head and power.
- Effect of change of impeller dimensions on performance characteristics.
- Hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics.
- Deep well turbine pump and submersible pump.

Unit-VI Artificial Intelligence

- Foundation and history of artificial intelligent, problems and techniques -AI programming languages.
- Introduction to LISP and PROLOG-problem spaces and searches, blind search strategies.
- Breadth first- Depth first-heuristic search techniques Hill climbing: best first-A* algorithm AO* algorithm – game tree. Min max algorithms, game playing – alpha beta pruning. Knowledge representation issues, predicate logic.
- Logic programming, semantic nets-frames and inheritance, constraint propagation, representing knowledge usingrules, rules based deduction systems.
- Reasoning under uncertainty, review of probability.
- Baye's probabilistic interferences and Dempster shafer theory, Heuristic methods, symbolic reasoning under uncertainty.
- Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non monotonic reasoning.
- Planning and planning in situational calculus, representation for planning, partial order planning algorithm.

- Principles of Natural language processing, rule based systems architecture, Expert systems and knowledge acquisition concepts.
- AI application to robotics, and current trends in intelligent systems.

Unit-VII Farm Machinery and Equipment

- Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines.
- Machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage.
- Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows. Cultivators, Identification of major functional components.
- Sowing, planting & transplanting equipment. Introduction to seed drills. no-till drills, and strip-till drills. Introduction to planters, bed-planters and other planting equipment.
- Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/planters.
- Threshing systems -manual and mechanical systems. Types of threshing drums and their applications.
- Types of threshers- tangential and axial, their constructional details and cleaning systems.
- Study of straw combines -working principle and constructional details. Study of root crop diggers-principle of operation, blade adjustment and approach angle, and calculation of material handled.
- Study of potato and groundnut diggers.
- Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools.

Unit-VIII Tractor and Automotive Engine

- Study of sources of farm power-conventional & non-conventional energy sources. Classification of tractors and IC engines.
- Study of engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines.
- Need of governors, governor types and governor characteristics. Study of need for transmission system in a tractor.
- Transmission system-types, major functional systems.
- Study of clutch -need, types, functional requirements, construction and principle of operation. Study of tractor power outlets-PTO. PTO standards, types and functional requirements.
- Traction. Traction terminology.
- Determination and importance of moment of inertia of a tractor. Study of tractor static equilibrium, tractor stability especially at turns.
- Determination of maximum drawbar pulls. Familiarization with tractor as aspring-mass system.
- Ergonomic considerations and operational safety.
- Tractor testing. Deciphering the engine test codes.

Unit-IX Precision Agriculture and Crop Residue Management

- Precision Agriculture- need and functional requirements.
- Familiarization with issues relating to natural resources.
- Familiarization with equipment for precision agriculture including sowing and planting machines.
- Power sprayers and land clearing machines.
- Laser guided land levellers, straw-chopper, straw-balers, grain Combines etc.
- GIS based precision agriculture and its applications.
- Sensors and application of sensors for data generation.
- Database management. System concept.
- System approach in farm Machinery management, problems on machinery selection.
- Concept of crop residue management.

Unit- X Post Harvest Technology & Food processing

- Processing of farm crops cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed processing.
- Theory of mixing- types of mixtures for dry and paste materials, rate of mixing and power requirement, mixing index.
- Theory of separation, size and unsized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens pneumatic separation.
- Theory of filtration, study of different types of filters, rate of filtration pressure drop during filtration.
- Study of different types of material handling systems; belt chain and screw conveyor bucket elevator, pneumatic conveying.
- Moisture content and methods for determination, importance of EMC and methods of its determination, EMC curve and EMC model, principle of drying, theory of diffusion, mechanism of drying-falling rate, constant rate, thin layer and deep bed drying and their analysis.
- Critical moisture content, drying models, calculation of drying air temperature and air flow rate, air pressure within the grain bed. Shred's and Hukill's curve, different methods of drying including puff drying, foam mat drying, Freeze drying.
- Study of different types of dryers- performance, Energy utilization pattern and efficiency study of drying and dehydration of agricultural products.
- Types and causes of spoilage in storage, conditions for storage of perishable product, functional requirement of storage, control of temperature and relative humidity inside storage. Modified atmospheric storage and control of its environment, air movement inside the storage.
- Storage condition for various fruits and vegetables under cold and CA storage system. Economic, aspects of storage.

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