43 IRRIGATION & DRAINAGE ENGINEERING

Unit 1: Soil-Water-Plant Relationships

Evaporation – free water surface and soil. Evapotranspiration – Different methods of Estimation – Separation of Evaporation and Transpiration components. Irrigation requirement, critical stages of crop growth in relation to irrigation. Irrigation scheduling. Plant water relations, concept of plant water potential. 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.Flow of water in saturated and partially saturated soils- Richards Equation-Infiltration rate - unsaturated hydraulic conductivity models.Field water budget: water gains and water losses from soil, deep percolation beyond root zone, capillary rise. 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.

Unit 2: 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, Impulse momentum theory, Vortex, Applications of energy and momentum equations, Water Hammer.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, Moody diagram, 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. Design of different types of irrigation channels. Irrigation water measurement: using velocity area method, water meters, weirs, notches, flumes, orifices etc. Water conveyance and control. Conveyance losses and lining of irrigation channels. Irrigation water delivery and distribution.

Unit 3: 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.

Unit 4: Irrigation Systems

History of irrigation in India. Management of irrigation water. Major irrigation projects in India. Methods of irrigation, surface methods, overhead methods, Merits and demerits of various methods. Hydraulics of furrow, check basin and border irrigation. Quality of irrigation water and irrigation with poor quality water. On farm water management, socio-economic aspects of on farm water management.Command area development organizational structures and activities. Irrigation water users association concept and responsibilities. Environmental considerations in land and water resources management.Lift Irrigation systems and Underground Pipe systems-Structures-Valves- Design- Optimal Pipe selection methods.Drip and Sprinkler Irrigation system- Types- Design-Installation-Evaluation- Fertigation-Operation & Maintenance-economics. Automation of Irrigation systems-Principles and Components.

Unit 5: Protected Cultivation & Landscaping

Types of Protected Cultivation Net house and Green house - orientation and layout. Energy Balance.Structural design & Construction of green houses –Design of Cooling and heating Systems in Green houses –Natural ventilation, Foggers, Fan-pad and heaters Soil less culture, Hydroponics and Aeroponics, Design of Irrigation systems in Green houses,Automation of climate control in protected structures. Landscape surveying with Theodolite and Total station, Landscape creation, Landscape irrigation- surface drip –subsurface drip – pop up sprinklers – spacing methods, design, Installation and automation

Unit 6: Drainage Systems

Problem soils and their distribution in India. Excess salt and salt tolerant crops. Hydrological imbalances and their corrective measures. Concept of critical water table depths for crop growth. Contribution of shallow water table to crop water requirements. Management strategies for flood prone areas and crop calendar for flood affected areas. Crop production and alternate use of problematic soils. Theories and applications of surface and sub-surface drainage, steady state, unsteady state drainage equations for layered and non-layered soils. Principle and applications of Hooghoudt, Ernst, Glover Dumm, Kraijenhoff-van-deleur equations.Design of surface and subsurface drainage systems, vertical drainage, Disposal of drainage effluents, Management of drainage projects of waterlogged and saline soils.

Unit 7: Hydrology of Agricultural Lands, Farm ponds and Percolation ponds

Hydrologic cycle, precipitation, infiltration and surface runoff. Measurement and analysis of hydrologic data.Intensity duration frequency analysis**.** Hortonian and saturation overland flow theories, partial source areaconcept of surface runoff generation. Rainfall and run off relationships, stream gauging and runoff measurement.Different methods of surface runoff

estimation, hydrographs, S-hydrograph, IUH, Synthetic hydrograph, unithydrograph theory and its application. Hydrologic flood routing**:** channel and reservoir routing.

Design, construction and Management of Farm Ponds and Percolation ponds

Unit 8: Precision Agriculture

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Geodesy and its basic principles; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; System Simulation- Concepts and principles, Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs.