

Detailed Contents of Courses for the M.Engg Programme in Civil Engineering

Water Resources Engineering

CE-556 Water Resources Planning and Management

Introduction, History of water resources planning and development, Importance of water resources planning, Planning objectives, Protocols employed at local, provincial, federal, regional and international levels, Investigation data and analysis, Demand projection, Water productivity parasites and constraints, Land-Water-Human resources interaction, Plan formulation, evaluation and approval, Comprehensive regional planning, Stakeholder involvement in water resources planning, Social and environmental impact assessment, Institutional arrangements for planning and implementation, Engineering economy in water resources planning, Introduction to surface water / groundwater / conjunctive water management.

CE-557 Legal & Financial Aspects of Water Resources

Sources of Water, Uses of Water, General concepts of water governance, International Laws (riparian and prior appropriation doctrines), Legal schemes for securing and allocating water rights in surface water and groundwater for private and public uses in Pakistan, Water Treatise and Accords (Indus Waters Treaty, Water Apportionment Accord, similar case studies), Institutional Framework, Groundwater management regimes, Issues and national water sector strategy, Evolving role of science, economics, and policy in water allocation law, Major paradigm shifts in water governance through integrated water resource management. Legislation on harmful effects of water.

CE-558 Sustainable Water Resources Management

Historical perspective of water use and development, Water facts and trends, Introduction to sustainable development and its importance, Related terminologies, SWRM strategies, Sustaining healthy freshwater ecosystems, Hydrologic aspects of water sustainability, Human impacts on hydrologic ecosystem and mitigation, Water resources – agriculture, environment, and society, Flood control management strategies, Economics of water; value of water, water affordability and marketing. Emerging water management issues and resolutions.

CE-559 Remote Sensing In Water Resources

History and scope of remote sensing, Concepts of remote sensing, Photogrammetry, Satellite characteristics, Remote sensing imagery types, Remote sensing satellites, Image resolution, Pre-processing, Image rectification, enhancement and classification, Accuracy assessment, Applications of satellite remote sensing in water resources i.e., for identifying drainage basin networks, for watershed dynamics analysis, flood inundation modeling and mapping, Evaluation of surface and ground water resources, Image processing software exercises, Introduction to Geographical Information Systems (GIS).

CE-560 Reservoir Operations

Introduction on the functions of reservoirs and possible problems, Operation purposes, Storage-yield concepts; flow-duration curve development, mass-curve analysis and sequent- peak analysis; Flood management and reservoir operation; formation and process of floods, Techniques for flood prevention in reservoirs, Relationship between flood management and reservoir operation, Reservoir simulation for flood control, urban water supply, hydropower and multipurpose operation, Automatic reservoir operation system; Sedimentation in reservoirs, Preventative methods for the sedimentation in reservoirs, Impacts of sedimentation on the function of reservoirs, Management for sedimentation in reservoirs and techniques for capacity restoration, Ecological environment in water reservoirs and protection & restoration techniques.

CE-577 Irrigation System Design and Management

Introduction/overview of irrigation and its purpose: horticulture, urban landscaping, agriculture, soil-water-plant relationships, irrigation water requirements, computation of evapotranspiration by various methods, performance evaluation of irrigation systems, surface irrigation system-design principles, Design of basin, border and furrow irrigation, Trickle irrigation and sprinkler irrigation – design and operation, irrigation management, irrigation and drainage interactions, environmental consideration.

CE-578 Groundwater Resource Management (Prerequisite EM-505 Operations Research)

Introduction to groundwater resources engineering and management, groundwater resources protection and water supply; Technical aspects as well as the legal, regulatory and policy aspects of groundwater resources management; Development of groundwater resource; simulation/optimisation models for GWM; embedding and response matrix approaches, Conjunctive use of groundwater and surface water and planning of groundwater resources projects.

CE-579 Water Quality Management

Water quality parameters-Indicators, sources, causes and effects; Nature of water systems; Objectives and case studies of water quality management; Water quality monitoring, modeling and forecasting in water systems; Management practices and methodologies for reuse, recycling and treatment of contaminated water; A system approach to water quality management: Institutional, environmental, and ethical aspects.

CE-581 Hydroclimatology

Hydroclimatic Systems; Hydrologic Cycle: Applications, Components of hydrologic cycles and estimation Surface Water Hydrology: Methods of measuring surface runoff, stream flow, base flow etc. Climate and Stream flow forecasting, Verification measures, Watershed Geomorphology: Basin characteristics, Soil characteristics, Landuse Routing Methods: Muskingham etc. Continuous and event based Modeling Climate Change Impact and Modeling: Water Resources System Effect, Case Studies Climate Change, Floods (Types Analysis, Prediction); Droughts (Climatic, Hydrologic, Agriculture) ; Risk Assessment

CE-582 Water Resources Modelling

Interpretation of hydrologic/hydraulic principles and underlying procedures for surface water modeling; Quantification of water quantity (e.g. floods, droughts, climate change impacts etc.) and quality (e.g. contamination of groundwater, lakes and river due to point and non-point sources) problems using computer models. Classify and evaluate the methodology for hydrological process and preparation of input data files for different models (e.g. HEC-HMS, SWAT, HSPF, RUSLE, etc.) to actual watersheds. Model Evaluation: Uncertainty and Sensitivity Analysis, Calibration, and Validation Model Applications: Impact estimation of drought, flood, erosion, contaminant, climate change etc. Water Quality Assessment: Different process representations of contaminant and sediment transport

CE-583 Groundwater Engineering

Groundwater origin and Occurrence: Geologic formation and groundwater distribution, Global distribution of groundwater levels. Hydrologic Budget: Surface water, soil water and groundwater budget. Aquifer characteristics: Homogeneous and non homogeneous aquifers, Isotropic and anisotropic aquifers, storage coefficient and specific yield, hydraulic conductivity, transmissivity and their determination. Steady Well Hydraulics: Dupuit-Forchheimer assumptions, Boussinesq equation, differential equations for confined flow, flow equations with vertical accretion, one dimensional flow radial flow, aquifer boundaries, leaky aquifers, one dimensional flow and radial flow in leaky aquifers. Unsteady well hydraulic: Unsteady radial flow towards a fully penetrating well, radial flow in leaky aquifer, drawdown with variable pumping rate, one dimensional flow with distributed recharge. Superposition of wells: Principle of superposition, drawdown due to a well field, pinging near hydrologic boundaries, fully penetrating and partially penetrating well considerations. Pumping test data analysis: Methods, data collection, data analysis, methods of determining aquifer, characteristics using test data. Groundwater quality: Water analysis, irrigation water quality criteria, groundwater pollution. Introduction to Groundwater Modeling. USGS MODFLOW, MT3D, etc.

CE-584 Drainage Engineering

Drainage Concepts: Need and benefits of drainage, sources of excess water, surface and subsurface drainage. Drainage Investigations: Purpose and scope of drainage investigations, based data collection (Topography, slope, soil profile, soil characteristics, salinity, water table, crops, climate, surface runoff, hydraulic conductivity, infiltration rate), diagnosis and nature of drainage problem, drainage coefficient, stage of project preparation-Identification, reconnaissance, feasibility and final Stage. Field Drainage System and Methods: Surface drainage, vertical drainage, pipe drainage, layout patterns for groundwater drainage; organic, natural and synthetic drainage envelop materials, drain pipes, construction equipment, design, construction and operational problems. Storm water management: Design of storm sewers and detention, Highway drainage and culverts. Design Methods: Pipe drainage-flow patterns, components of head loss, Homogenous and non Homogenous soils, Hooghoudt formula, Earnst formula and Glover-Dumm formulae. Application of drainage design methods to selected problems: Use of nomographs for drainage design. Surface drainage factors affecting, design formula, safe velocity and grades. Performance Assessment of drainage systems: Need, performance parameters and criteria. System Problems: Back filling, installation below water table, blocking and clogging, sediment outflow and performance efficiency.

CE-585 Hydraulic Structure Engineering

Water conveying channels and structures, Non uniform flow; longitudinal water surface backwater curve computation for irregular channels, backwater curve computation for regular channels, discharge problems. Unsteady flow: Introduction, equation of motion, method of characteristics, positive and negative waves, surge formation, dam break problem. Flood routing: Storage routing, kinematic routing, diffusion analogy, dynamic routing. Wind generated waves, Shallow and deep water waves, Storm surges, Harbour resonance, Hydraulic loading on structures – static and dynamic effects, Codes of practice, Design and construction of offshore structures, Dams and barrages, Design of weirs and barrages, Dams in general – types and selection, Designing of reservoir capacity with capacity-elevation and area-elevation curves of a reservoir site, Design and construction of gravity dams, Water for hydroelectric generation, Tidal power – Principle, Components, Ebb-cycle, Tide-cycle, Estimate of energy and power, etc. Penstocks, Water hammer and surge tanks, Gates in hydraulic installations, Spillways, River training and control works.

CE-523 Coastal Processes

Coastal sediment properties and analysis, long-shore transport processes and rates; sediment budget; response of beaches to wave action and structures; tidal inlets, mechanical bypassing; beach nourishment; wind transport in sand dune stabilisation, sediment tracing.

CE-524 Coastal Management

Introduction of key processes operating in the coastal zone and to management techniques appropriate to these processes and environments. Emphasis on policy, regulatory and intergovernmental complexities that characterize coastal zone management in coastal nations.