Ph.D. Programme in Soil and Water Engineering

Course No.	*Course Title*	*Credits*
1st Semester		
SWE 701	Hydrology of Monsoon	2+1
SWE 702	Water Loses and its measures in Irrigation System	2+1
SWE 703	Computer Techniques in Hydrology	2+1
2nd semester		
SWE 751	Groundwater recharge	3+0
SWE 752	Numerical Hydraulics	2+1
SWE 753	Seminar-I	1+0
3rd Semester		
SWE-849	Seminar-II	1+0
4th Semester		
	Nil	
5th Semester		
	Nil	
6th Semester		
SWE 999	Seminar-III	1+0
SWE 1000	Doctoral Research	0+45

SWE-501 Watershed Hydrology (2+1)

Theory

Hydrologic processes and systems. Hydrologic problems of small watersheds. Hydrologic characteristics of watersheds. Measurement and analysis of hydrologic parameters, rainfall- runoff models, stream flow measurement and analysis of data. Hydrograph analysis. Unit hydrograph theory, synthetic and dimension less hydrograph, convolution of unit hydrograph. Concept of hydraulic flood routing, reservoir and channel routing. Definition and concept of different types of hydrologic models for simulation of hydrologic problems.

Practical

Rainfall analysis, runoff computation, construction of hydrographs, delineation of watershed, hydrograph analysis, reservoir and channel routing, hydrologic models, visit to dam sites.

SWE-502 Open Channel Flow (3+0)

Theory

Open channel and their properties, energy and momentum, critical flow computation and application. Uniform flow; gradually varied flow theory and analysis, methods of computation.Design of transitions. Spatially and rapidly varied flows.Hydraulic jump and its use as energy dissipater, flow through channel of non-linear alignment and flow through non-prismatic channel sections.Unsteady flow, gradually varied unsteady flow and rapidly varied unsteady flow.

SWE-551 Design of Farm Irrigation System (3+1)

Theory

Irrigation principles, losses, conveyance, distribution, application, scheduling parameters, water budgeting.Surface irrigation, hydraulics of water advance and recession, hydraulic resistance to flow, gravity irrigation.Design of border irrigation, furrow irrigation, check basin irrigation, sub irrigation methods and concepts.Design criteria of sprinkler and micro irrigation systems, hydraulics of sprinkler and micro irrigation systems. Design of lateral, sub-main and main line of sprinkler and micro irrigation. Fertigation aspects.Underground water conveyance system, evaluation of irrigation systems and practices.

Practical

Design and evaluation of border, furrow, check basin, sprinkler and micro irrigation, computation of frictional losses, Design of underground water conveyance systems, economics of irrigation methods, visit to mechanized farms. Evaluation of different uniformities and pressure distribution. Pressure – discharge relationships for different water emitting devices. Micro irrigation design exercises.

SWE-552 Soil and Water Conservation Engineering (2+1)

Theory

Probability and continuous frequency distribution, fitting empirical distributions. Layout and planning of soil and water conservation measures, design principles of soil and water structures including contour bunds and terraces, gully control measures. Hydraulic jump and energy dissipaters for soil conservation structures, hydrologic, hydraulic and structural design of drop structures. Sediment deposition process. Estimation of sediment load and stability analysis of earthen dams.Rainwater harvesting, Flood control and stream bank protection measures.

Practical

Design of Drop spillway, chute spillway, drop inlet spillway, hydraulic jump calculation, design of bench terrace, contour bunds and contour trenches, design and problems on earthen dam.

SWE-553 Groundwater Engineering (2+1)

Theory

Properties affecting groundwater storage and movement, groundwater balance studies.Well hydraulics, two dimensional flow, steady and unsteady state flow in confined, unconfined and semi-confined aquifers, steady flow in sloping aquifers, partial penetrating wells. Analysis of multi-aquifers.Flow analysis in interfering wells. Pumping tests and determination of aquifer parameters. Groundwater modeling for water resources planning. Techniques for groundwater recharge.

Practical

Water table contour maps and determination of groundwater flow, estimation of aquifer characteristics, problems on non leaky and leaky aquifers, analysis of pumping test data. Computation of interference of wells, groundwater computer simulation models.

SWE-554 Crop Environmental Engineering (2+1)

Theory

Aerial and edaphic environments for plant growth, energy and mass transfer in and above crop canopies. Climatic changes and plant response to environmental stresses, evapotranspiration models. Instrumentation and techniques for monitoring plant environments. Processes and aspects of growth and development, soil-root interface, root sink functions. Water movement in soil-plant atmosphere continuum, artificial environments and plant behaviour.Design and operation of controlled environment facilities and their instrumentation. Crop growth and yield modeling.

Practical

Measurement and interpretation of environmental parameters relevant to crop growth. Establishment of soil moisture characteristic curves and their interpretation. Design of polyhouse and other controlled environment chambers. Estimation of evapotranspiration by different methods and their comparisons. Estimation of crop, water requirement. Estimation of irrigation requirement.

SWE-555 Soil Erosion, Transportation, and Sedimentation (2+1)

Theory

The processes, factors responsible for and consequences of erosion. Kinetic energy of rainfall. Overland flow process and sediment transportation, sediment transport in stream flow. Sediment deposition process and reduction in live storage of reservoirs.Universal soil loss equation – its applicability and its refinements.Instantaneous unit sediment graph- its development and use. Measurement of sediment flow and depositions.Rainfall simulators in erosion study, erosion control and silt detention structures and their design. Watershed management and catchment area treatment for controlling soil erosion. Influence of watershed geomorphologic characteristics in soil erosion. Conceptual, physical process based and empirical models for quantifying sedimentation. Use of GIS for modeling erosion and sedimentation.

Practical

Computation of soil erosion index and estimation of soil erodibility factors. Water sampling in natural streams or in hydraulic flumes for finding sediment concentration. Analysis of recorded information on run off and sediment flow and developing relation between them. Analysis of

watershed map for calculation of hypsometric integral and other geomorphologic parameters for assessing the water erosion status and watershed prioritizing for soil conservation treatment.

SWE-556 Watershed Management and Modeling (2+1)

Theory

Problems of desertification and degradation. Models of sediment yield Survey, monitoring, reclamation and conservation of agricultural and forest lands, hill slopes and ravines. Concept of operational watershed. National land use policy, legal and social aspects. Watershed management research instrumentation and measurement, problem identification, simulation and synthesis. Modeling of flood and drought phenomenon, drought management and dry farming

Practical

Preparation of watershed development proposal, preparation of water shed evaluation report. Application of Models of flood and drought phenomenon. Application of watershed models.

SWE-557 GIS and Remote Sensing for land and water resource management (2+1)

Theory

Basic principles of remote sensing and sensors. Elements of photogrametry. Electromagnetic spectrum. Energy interaction with surface features, Aerial photo and satellite imagery. Photo and image interpretation.Principles of Geographical Information System tools, their types and capabilities, Advantages of GIS over conventional methods.Importance of ground truth establishment, GIS and remote sensing for land and water resources data collection, analysis and interpretation, Application of GIS in water and land resource development and management.

Practical

Familiarization with remote sensing and GIS hardware, software and their principle of working, Methods of establishing ground truth, Comparison between ground truth and remotely sensed data, Application of GIS packages.

SWE-601 Agricultural Drainage System (2+1)

Theory

Theories and applications of surface and sub-surface drainage, steady state, unsteady state drainage equations for layered and non-layered soils, horizontal sub-surface drainage. Principle and applications of Earnst, Glover Dumm, Kraijenhoff-van-Deleur equations. Salt balance, leaching requirement and management practices under drained conditions.Design of different components of sub-surface drainage systems, theories of vertical drainage and multiple well point system.Disposal of drainage effluents, Management of drainage projects of waterlogged and saline soils, case studies.

Practical

Measurement of in-situ hydraulic conductivity, estimation of drainage coefficient and leaching requirements, Delineation of waterlogged areas through isobar, isobath and topographic maps. Design of surface and subsurface drainage systems, design of filter and envelop materials.

SWE-602 Design of Pumps for Irrigation and Drainage (2+1)

Theory

Basic hydraulic design of centrifugal pump, water hammering problem in centrifugal pump.Principle and performance characteristics of vertical turbine pump, submersible pump and axial flow pump and their design. Non-conventional energy sources for pumping, wind mills, micro turbines,solar pumps, hydraulic ram- their selection and design criteria. Design of pumping station, techno-economic evaluation. Energy conservation measures for pumping systems

Practical

Testing of centrifugal and reciprocating pumps. Performance evaluation of different pumps and evaluation of characteristic curves.

SWE-603 Water Resources System Engineering (3+0)

Theory

Concepts and significance of optimization in water resources, objective functions, deterministic and stochastic inputs.Mathematical programming techniques, linear programming and its extension: gradient method, simplex method, non-linear programming classical optimization.Geometric programming and dynamic programming, application of optimization techniques for water resources.Development and management including conjunctive use, crop production functions and irrigation optimization.

SWE-604 Irrigation Management (3+0)

Theory

Principle of resource management. Land and water as capital resources in agriculture. Land and water as limited and degradable resources, water supply and demand for agriculture. Water production function. Modeling for optimal water use. Optimizing water use for maximum production. Influence of other inputs and their relation with water. Operational parameters and constraints of canal system, losses of irrigation water and their minimization. Canal water distribution system and water pricing. Parameters and indices for evaluation of canal system performance. On farm irrigation management. Small scale vs. regional scale modeling of irrigation management. Importance of land management for better irrigation management.

SWE-651 Flow Through Porous Media (3+0)

Theory

Aquifer and fluid properties, forces holding water in soils, hydrodynamics in porous media and limitations of governing laws. Differential equations of saturated flow, initial and boundary conditions. Dupuit and Bussinesq approximations and linearization techniques. Stream functions, potential functions and flow net theory. Analysis of seepage from canals ,ditches and through earthen dams. Unsaturated flow theory, infiltration and capillary rise flux dynamics. Hydro-dynamic dispersion in soil-aquifer system.

SWE-652 Command Area Development (2+1)

Theory

Concept of command area development as an integral approach, command area project formulation, major, medium and minor projects. Various clearances involved in project approval, command area in India. Command area activities and their prioritization. Source of fund for command area development works. Structure of command area development organization. Legal aspects of natural development, partnership among developers. Managers and users of natural resources in a command area, diagnostic analysis and performance appraisal of command area projects.

Practical

Study of canal, tanks and tube wells ion a command area. Study of design and operational parameters of a command area. Study of water balance in a command area, study of the impact of the command area project on crop yield and environment. Conflict resolution through PRA exercise. Diagnostic analysis of the problems of the command area through PRA and field observation. Analysis of equity in water distribution. Consideration of preparation of rostering schedule. Study of the functioning of the irrigation cooperatives / water user's association, preparation of command area development plan.

SWE-701 Hydrology of Monsoon (2+1)

Theory

Physics of monsoon. Origin and occurrence. Monsoon distribution under Indian context and global pattern. Effective monsoon. Its parameterization and statistical interpretation. Isohyetal mapping of monsoon and effective monsoon. And its hydrological significance. Hydrological aspects of drought and floods and its significance to agriculture. Surface and sub surface run off of monsoon. Harvesting of monsoon water.

Practical

Estimation of effective monsoon and its probable date of onset from rainfall records. Preparation of isohyetal maps of monsoon and effective monsoon. Estimation of runoff from monsoon rainfall. Preparation of monsoon hydrographs.

SWE-702 Water Losses and its Measures in Irrigation System (2+1)

Theory

Losses of water in irrigation systems: hydraulics of water losses, quantification of water losses in different methods.Measures against water losses : lining in surface irrigation system, water saving techniques in irrigation methods and selection of irrigation methods. Research and development regarding saving of irrigation water.

Practical

Measurement of seepage loss in irrigation channel. Study of different lining materials.

SWE-703 Computer Techniques in Hydrology (2+1)

Theory

Basics of the languages BASIC, c and c^{++}, writing programs on channel dimensioning, test of consistency of rainfall records, estimation of missing rainfall, determination of consumptive use, analysis of risk and frequency of hydrological events, estimation of surface runoff, preparation of unit hydrograph, construction of S curve.

Practical

Running of the above programs on hydrological events.

SWE-751 Ground Water Recharge

(3+0)

Theory

Concept, need, purpose and principles of artificial recharge. Planning of artificial recharge schemes : establishing the need, estimation of sub surface capacity, prioritization of areas of artificial recharge, availability of source of water areas of rechargeInvestigation and planning: general and detailed studies, appraisal of economic viability, finalization of physical plan and preparation of the report of the scheme.Artificial recharge techniques and plan: flooding, ditches and furrows, bench terraces, contour bunds, contour trenches, gully plugs, *nala* bunds and check dams, percolation tanks, stream channel modification/augmentation, recharge wells, gravity head recharge wells, recharge pits and shafts, induced recharge, sub surface dykes/underground dams/underground *bandharas*.Rooftop water harvesting: concept, components, data required for rain water harvesting sytem, feasibility, technical suitability, economic viability, social acceptance, water quality.Impact assessment. Economic evaluation of recharge scheme. Operation and maintenance.

SWE-752 Numerical Hydraulics (2+1)

Theory

Numerical solutions of a non linear equation : Trial and error, regula falsi, fixed point iteration and Newton Raphson methods. Integration by trapezoidal and Simpson's rules.Application of numerical methods: determination of dimensions of a trapezoidal channel, determination of steady state back water curve in prismatic and non prismatic channels. Mathematical modeling of flood propagation in rivers: Saint Venant equation and its solution, flood routing.

Practical

Writing and running of programs on solution of non linear equations by different methods. Determination of back water curve and dimensions of trapezoidal channels. Numerical solutions of flood routing and Saint Venant equation.
