SOIL AND WATER ENGINEERING

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
SWE 501*	WATERSHED HYDROLOGY	2+1
SWE 502*	DESIGN OF FARM IRRIGATION SYSTEMS	2+1
SWE 503*	AGRICULTURAL DRAINAGE SYSTEMS	2+1
SWE 504*	GROUND WATER ENGINEERING	2+1
SWE 505	SOIL AND WATER CONSERVATION ENGINEERING	2+1
SWE 506	CROP ENVIRONMENTAL ENGINEERING	2+0
SWE 507	DESIGN OF PUMPS FOR IRRIGATION AND DRAINAGE	2+0
SWE 508	OPEN CHANNEL FLOW	3+0
SWE 509	FLOW THROUGH POROUS MEDIA	2+0
SWE 510	WATER RESOURCES SYSTEM ENGINEERING	3+0
SWE 511	GIS AND REMOTE SENSING FOR LAND AND WATER RESOURCE MANAGEMENT	2+1
SWE 512	WATERSHED MANAGEMENT AND MODELLING	2+1
SWE 513	LAND DEVELOPMENT AND EARTH MOVING MACHINERY	2+0
SWE 514*	OPTIMIZATION IN WATER RESOURSES MANAGEMENT	2+1
SWE 591	MASTER'S SEMINAR	1+0
SWE 592	SPECIAL PROBLEM	0+1
SWE 595#	INDUSTRY/ INSTITUE TRAINING	NC
SWE 599	MASTER RESEARCH	20
SWE 601**	ADVANCED HYDROLOGY	3+0
SWE 602**	SOIL AND WATER SYSTEMS' SIMULATION AND MODELLING	2+1
SWE 603	MODELLING SOIL EROSION PROCESSES	2+1
SWE 604	ADVANCED HYDRO-MECHANICS IN SOIL AQUIFER SYSTEMS	3+0
SWE 605	HYDRO-CHEMICAL MODELLING AND POLLUTANT MANAGEMENT	3+0
SWE 606	PLANT GROWTH MODELLING AND SIMULATION	3+0
SWE 607	ADVANCES IN IRRIGATION AND DRAINAGE	2+0
SWE 608	ADVANCES IN MICRO IRRIGATION	3+0
SWE 609**	ADVANES IN AGRICULTURAL WATER MANAGEMENT	3+0
SWE 691	DOCTORAL SEMINAR I	1+0
SWE 692	DOCTORAL SEMINAR II	1+0
SWE 693	SPECIAL PROBLEM	0+1
SWE 694	CASE STUDY	0+1
SWE 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; ** Compulsory for Doctoral programme

SWE 595 – Minimum of Three Weeks Training

Note: Some of the identified Minor/Supporting fields are Mechanical Engineering, Processing& Food Engineering, Energy in Agriculture, Civil Engineering, Computer Science, Electrical Engineering, Mathematics and Statistics; The contents of some of the identified Minor/Supporting courses have been given.

SOIL AND WATER ENGINEERING
Course Contents

SWE 501 WATERSHED HYDROLOGY 2+1 Objective

To acquaint and equip the students about hydrological process and analysis of hydrological data required for design process.

Theory

UNIT I

Hydrologic processes and systems; Hydrologic problems of small watersheds; Hydrologic characteristics of watersheds.

UNIT II

Measurement and analysis of hydrologic parameters, rainfall- runoff models, stream flow measurement and analysis of data.

UNIT III

Hydrograph analysis; Unit hydrograph theory; Synthetic and dimension less hydrograph, convolution of unit hydrograph.

UNIT IV

Concept of hydraulic flood routing, flood routing (reservoir and channel routing).

UNIT V

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.

Suggested Readings

Chow VT, David, M & Mays LW. 1988. *Applied Hydrology*. McGraw Hill.Ghanshyan Das 2000. *Hydrology and Soil Conservation Engineering*. Prentice Hall.

Tideman EM. 1996. *Watershed Management*. Omega Scientific Publ.

SWE 502 DESIGN OF FARM IRRIGATION SYSTEMS 2+1 Objective

To acquaint and equip with the irrigation principles, design consideration of surface irrigation and micro irrigation systems and their evaluation system.

Theory

UNIT I

Concepts of Irrigation; Irrigation principles, losses, conveyance, distribution; Application, scheduling parameters, water budgeting.

UNIT II

Surface irrigation, hydraulics of water advance and recession, hydraulic resistance to flow, gravity irrigation.

UNIT III

Design of Border irrigation, furrow irrigation, check basin irrigation; Sub Irrigation methods and concepts.

UNIT IV

Preliminary design criteria of sprinkler and micro irrigation systems, hydraulics of sprinkler and micro irrigation systems.Design of lateral, submain and main line of sprinkler and micro irrigation.Fertigation aspects.

UNIT V

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.

Suggested Readings

Finkel HJ. 1983. *Handbook of Irrigation Technology*. Vols. I-II. CRC Press.

Ivan E Henk. 1951. *Irrigation Engineering*. Vol. I. John Wiley & Sons.Karmeli D, Peri G &Todes M. 1985.*Irrigation Systems: Design and Operation*.Oxford Univ. Press.

Pillsbury AF. 1972. *Sprinkler Irrigation*. FAO Agricultural Development Paper No. 88, FAO.

Rydzewski 1987.*Irrigation Development Planning*. John Wiley & Sons.Sivanappan RK, Padmakumari O & Kumar V. 1987.*Drip Irrigation*. Keerthy Publ. House.

Sivanappan RK. 1987. *Sprinkler Irrigation*. Oxford & IBH.

SWE 503 AGRICULTURAL DRAINAGE SYSTEMS 2+1 Objective

To acquaint and equip with the importance and phenomenon of drainage system along with design consideration of surface and sub-surface drainage systems.

Theory

UNIT I

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.

UNIT II

Principle and applications of Earnst, Glover Dumm, Kraijenhoff-van-de-leur equations.

UNIT III

Salt balance, leaching requirement and management practices under drained conditions.

UNIT IV

Design of different components of sub-surface drainage systems, theories of vertical drainage and multiple well point system.

UNIT V

Disposal of drainage effluents, Management of drainage projects of water-logged 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 sub-surface drainage systems, design of filter and envelop materials.

Suggested Readings

Battacharaya AK &MichealAM. 2003. *Land Drainage*. Vikas Publ. Clande
Ayres & Daniel Scoates A.E. 1989.*Level Drainage and Reclamation*.McGraw Hill.
Luthin JN. 1978. *Drainage Engineering*. Wiley Eastern.
Ritzema HP. (Ed.). 1994. *Drainage Principles and Applications*. ILRI
Roe CE 1966.*Engineering for Agricultural Drainage*.McGraw Hill.

SWE 504 GROUNDWATER ENGINEERING 2+1 Objective

To acquaint and equip with the occurrence, development and hydraulics of groundwater flow.

Theory

UNIT I

Properties affecting groundwater storage and movement, groundwater balance studies.

UNIT II

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.

UNIT III

Flow analysis in interfering wells. Pumping tests and determination of aquifer parameters.

UNIT IV

Groundwater modeling for water resources planning.UNIT V

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.

Suggested Readings

Boonstra J & de Ridder NA. 1981. *Numerical Modeling of GroundwaterBasins*. ILRI.
Domenico PA. 1972. *Concept and Models in Groundwater Hydrology*. McGraw Hill.
Hantush MS. (Ed.). 1964. *Advances in Hydro Sciences*. Vol. I. Academic Press.
Harr ME 1990.*Ground Water and Seepage*.Wiley Eastern.Huisman L. 1972. *Groundwater Recovery*. MacMillan.
PolubarinovaKochina P Ya 1962.*Theory of Ground Water Movement*.Princeton Univ. Press.
Raghunath HM. 1992. *Ground Water*.Wiley Eastern. Todd DK. 1997. *Ground Water Hydrology*.Wiley Eastern.

SWE 505 SOIL AND WATER CONSERVATION ENGINEERING 2+1

Objective

To acquaint and equip students with the process of degradation soil and water conservation and their remedial measures including design of structures.

Theory

UNIT I

Probability and continuous frequency distribution; Fitting empirical distributions.

UNIT II

Layout and planning of soil and water conservation measures; Design principles of soil and water structures including contour bunds and terraces; Gully control measures.

UNIT III

Hydraulic jump and energy dissipaters for soil conservation structures; Hydrologic, hydraulic and structural design of drop structures.

UNIT IV

Sediment deposition process.Estimation of sediment load, earthen dams, seepage through dams and stability analysis.

UNIT V

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, silt detention tanks and check dams, visit to soil conservation structures sites.

Suggested Readings

Garde RJ &RangaRaju KG. 1977. *Mechanics of Sediment Transport andAlluvial Stream Problems*. Willey Eastern.

Gurmel Singh *et al.* 1994. *Manual of Soil and Water Conservation Practices*.Oxford & IBH.

Hudson N.1971.*Soil Conservation*. B.T. Batsford Ltd.

Murthy VVN. 1998. *Land and Water Management Engineering*. Kalyani.USDA 1969.*A Manual on Conservation of Soil and Water*.Oxford & IBH.

SWE 506CROP ENVIRONMENTAL ENGINEERING 2+0

Objective

To acquaint and equip with the process of soil-water-plant relationship and their interaction for crop growth.

Theory

UNIT I

Aerial and edaphic environments for plant growth, energy and mass transfer in and above crop canopies.

UNIT II

Climatic changes and plant response to environmental stresses, evapo-transpiration models.Instrumentation and techniques for monitoring plant environments.

UNIT III

Processes and aspects of growth and development, soil-root interface, root sink functions.

UNIT IV

Water movement in soil-plant atmosphere continuum, artificial environments and plant behaviour.

UNIT V

Design and operation of controlled environment facilities and their instrumentation. Crop growth and yield modeling.

Suggested Readings

Ghildyal BP &Tripathy RP. 1987. *Fundamental of Soil Physics*. Wiley Eastern.

Slatyor OP. 1967. *Plant Water Relationship*.Academic Press.

SWE 507 DESIGN OF PUMPS FOR IRRIGATION AND DRAINAGE 2+0

Objective

To acquaint and equip with requirement of pumps for irrigation and drainage system and their design features.

Theory

UNIT I

Basic hydraulic design of centrifugal pump, water hammering problem in centrifugal pump.

UNIT II

Principle and performance characteristics of vertical turbine pump, submersible pump and axial flow pump and their design.

UNIT III

Non-conventional energy sources for pumping, wind mills, micro turbines, solar pumps, hydraulic ram- their selection and design criteria.

UNIT IV

Design of pumping station, techno-economic evaluation. Energy conservation measures for pumping systems

Suggested Readings

Church AH &JagdishLal 1973. *Centrifugal Pumps and Blowers*. Metropolitan Book Co.

Michael AM &Khepar SD. 1989.*Water Well and Pump Engineering*. Tata McGraw Hill.

Michael AM. 1990. *Irrigation Theory and Practice*. Vikas Publ. House.

Modi PN & Seth SM. 2000 *Hydraulic and Fluid Mechanics*. Standard Book House.

SWE 508 OPEN CHANNEL FLOW 3+0

Objective

To acquaint and equip with the hydraulics of surface water flow phenomenon in open channels.

Theory

UNIT I

Open channel and their properties, energy and momentum, critical flow computation and application.

UNIT II

Uniform flow; gradually varied flow theory and analysis, methods of computation.

UNIT III

Practical problems such as design of transitions, flow passing Islands etc. spatially varied flow, rapidly varied flow.

UNIT IV

Hydraulic jump and its use as energy dissipator, flow through channel of non-linear alignment and flow through non-prismatic channel sections.

UNIT V

Unsteady flow, gradually varied unsteady flow and rapidly varied unsteady flow.

Suggested Readings

Chaudhry MH. 1993. *Open Channel Flow*. Prentice Hall.
Chow VT. 1959. *Open Channel Hydraulics*. Mc-Graw Hill.
Henederson FM. 1966. *Open Channel Flow*. MacMillan.

SWE 509 FLOW THROUGH POROUS MEDIA 2+0 Objective

To acquaint and equip with the hydraulics and process of water flow in the water bearing formation under saturated as well as unsaturated conditions.

Theory

UNIT I

Aquifer and fluid properties, forces holding water in soils, hydrodynamics in porous media and limitations of governing laws.

UNIT II

Differential equations of saturated flow, initial and boundary conditions.Dupuit and Business approximations and linearization techniques.

UNIT III

Stream functions, potential functions and flow net theory. Analysis of seepage from canals and ditches.

UNIT IV

Unsaturated flow theory, Infiltration and capillary rise flux dynamics. Hydro-dynamic dispersion in soil-aquifer system.

Suggested Readings

Harr Milton E. 1962. *Groundwater and Seepage*.McGraw-Hill. Jacob Beer 1972. *Dynamics of Fluid Flow in Porous Media*.Elsevier.
Muskat M & Wyckoff RD. 1946.*The Flow of Homogeneous Fluidsthrough Porous Media*. JW Edwards.
Patrick A Domenico& Schwartz FW. 1998. *Physical and ChemicalHydrogeology*. John Wiley & Sons.
Remson I, Hornberger GM &Moiz Fred J. 1971.*Numerical Methods inSubsurface Hydrology*.Wiley Interscience.

SWE 510 WATER RESOURCES SYSTEM ENGINEERING 3+0

Objective

To acquaint and equip with the techniques for optimization of water resources for achieving maximum output.

Theory

UNIT I

Concepts and significance of optimization in water resources, objective functions, deterministic and stochastic inputs.

UNIT II

Mathematical programming techniques, linear programming and its extension: gradient method, simplex method, non-linear programming classical optimization.

UNIT III

Geometric programming and dynamic programming, application of optimization techniques for water resources.

UNIT IV

Development and management including conjunctive use, crop production functions and irrigation optimization.

Suggested Readings

Larry WM. 1996. *Water Resources Handbook*.McGraw-Hill.

Loucks DP *et al.* 1981. *Water Resource System Planning and Analysis*.Prentice Hall.

Rao SS. 1978. *Optimization Theory and Applications*.Wiley Eastern.

SWE 511 GIS AND REMOTE SENSING FOR LAND AND WATER RESOURCE MANAGEMENT 2+1

Objective

To acquaint and equip with the techniques of Remote Sensing and application of GIS for land and water resources management.

Theory

UNIT I

Basic principles of remote sensing and sensors.Elements of photogrametry.UNIT II

Electromagnetic spectrum. Energy interaction with surface features, Aerial photo and satellite imagery. Photo and image interpretation.

UNIT III

Principles of Geographical Information System tools, their types and capabilities, Advantages of GIS over conventional methods.

UNIT IV

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.

Suggested Reading

De Mess MN. 2004. *Fundamental of Geographic Information System*. John Wiley & Sons.

Lille Sand T &Kaiffer R.1987.*Remote Sensing and Image Interpretation.* John Wiley & Sons.

Sabbins F.1987. *Remote Sensing Principle and Interpretation*. Freeman

SWE 512 WATERSHED MANAGEMENT AND MODELLING 2+1 Objective

To acquaint and equip the students with the watershed management modeling and modeling systems

Theory

UNIT I

Problems of desertification and degradation. Models of sediment yield

UNIT II

Survey, monitoring, reclamation and conservation of agricultural and forest lands, hill slopes and ravines

UNIT III

Concept of operational watershed. National land use policy, legal and social aspects

UNIT IV

Watershed management research instrumentation and measurement, problem identification, simulation and synthesis

UNIT V

Modelling 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.

Suggested Readings

Isobel W Heathcote**.** 1998. *Integrated Watershed Management: Principlesand Practice.* Wiley Publ.

Kenneth N Brooks, Peter F Ffolliott, Hans M Gregersen, Leonard F DeBano. 1991. *Hydrology and the Management of Watersheds*. Wiley-Blackwell.

SWE 513 LAND DEVELOPMENT AND EARTH MOVING MACHINERY 2+0

Objective

To acquaint and equip the students with the Land Development and Earth Moving Machinery modeling and modeling systems.

Theory

UNIT I

Objectives, methods and equipment for land clearing and development.Machinery selection, mechanics of operation and vegetation types.

UNIT II

Earth moving machinery and earthmoving mechanics.Grading of sloppy lands. Principles of mechanisms used in crawler mounted tractors.

UNIT III

Earth diggers and ditchers. Bull dozers and scrapers. Elevating and self powered graders.Automation of earth moving and grading machines.Lazer guided leveler with global positioning system.

UNIT IV

Boring machines.Different methods of boring.

Suggested Readings

Dutta SK. 1987. *Soil Conservation and Land Management*.International Distributors, Dehradun.

Eric C Orlem.1997. *Earth-Moving Machines*.Motorbooks International.Kuhar JE. 1977. *The Precision Farming Guide for Agriculturalist*. Lori J. Dhabalt, USA.
Nichols HL & Day DH.1998.*Moving the Earth.The Work Book ofExcavation*.McGraw Hill.
Peurifoy RL. 1956. *Construction, Planning, Equipment and Methods*. McGraw Hill.
Roger V Amato & Donald J Heimburger 2003.*Classic Vintage Crawlersand Dozers*.B Heimburger House Publ.
Singh G.1991. *Manual of Soil and Water Conservation Engineering*.Oxford & IBH.

SWE 601 ADVANCED HYDROLOGY 3+0 Objective

To acquaint and equip the students with advanced hydrological process, analysis of hydrological data and their application for modeling.

Theory

UNIT I

Hydrologic models, processes and systems. Uncertainty in hydrological event.Statistical homogeneity.

UNIT II

Probabilistic concept.Frequency analysis.Co-relation and regression analysis.Probability distribution of hydrological variables.

UNIT III

Time series analysis. Markov processes.

UNIT IV

Formulation of various steps of statistical models and their application in hydrology.

Suggested Readings

Garg SK.1987. *Hydrology and Water Resources Engineering.*Khanna Publ.
Hann CT. *Advanced Hydrology*. Oxford Publ. House.
Linseley RK Jr., Kohler MA &Paulhus JLH. 1975. *Applied Hydrology*. McGraw Hill.
Mutreja KN.1986. *Applied Hydrology*.Tata McGraw Hill.

SWE 602 SOIL AND WATER SYSTEMS' SIMULATION AND MODELLING 2+1

Objective

To acquaint and equip the students with the simulation of soil water systems and modeling techniques.

Theory

UNIT I

Systems engineering for water management; Complexity of resources management process, systems analysis.

UNIT II

Rainfall-runoff models - Infiltration models, Simulation methods, structure of a water balance model.

UNIT III

Channel flow simulation - parameters and calibration - Streamflow statistics, surface water storage requirements.

UNIT IV

Flood control storage capacity; total reservoir capacity - surface water allocations. Ground water models.

UNIT V

Design of nodal network, General systems frame work – Description of the model; Irregular boundaries, General –Numerical approaches.

Practical

Rainfall - Runoff models - Infiltration models - Stanford watershed model (SWM) - channel flow simulation problems - stream flow statistics – model parameters and input data requirements of various softwares of surface hydrology and groundwater – Hydrologic Modelling System – Soil Water Management Model – Soil Water Assessment Tool – Catchments, Simulation Hydrology Model – Stream flow model and use of dimensionless unit hydrograph – Generalized groundwater models.

Suggested Readings

Biswas AK. 1976. *Systems Approach to Water Management*. McGrawHill.Cox DR & Mille HD. 1965.*The Theory of Stochastic Processes*. John Wiley & Sons.

Eagleson PS. 1970.*Dynamic Hydrology*.McGraw Hill.

HimmelBlau DM & Bischoff KB. 1968. *Process Analysis and SimulationDeterministic Systems*. John Wiley & Sons.

Linsley RK, Kohler MA &Paulhus JLH. 1949. *Applied Hydrology*.McGraw Hill.

Schwar RS &Friedland B. 1965.*Linear Systems*.McGraw Hill.

VenTe Chow, David R Maidment& Mays LW. 1998. *Applied Hydrology*. McGraw Hill.

SWE 603 MODELLING SOIL EROSION PROCESSES 2+1 Objective

To acquaint and equip the students with the advance erosion process along with tools required and application of soil erosion models.

Theory

UNIT I

Overland flow, basic theory of particle movement and sediment transport; sediment deposition process.

UNIT II

Estimation of sediment load; mechanics of soil erosion by water and wind.UNIT III

Water and wind erosion control measures.UNIT IV

Universal soil loss equation; stochastic models and dynamic models.

Practical

Computation of soil erosion index; Estimation of soil erodibility factor; Design of erosion control structures. Computation of suspended load and sediment load using empirical formulae; Application of sediment yield models, prediction of sediment loss – computation of reservoir sedimentation – sounding method.

Suggested Readings

Garde RJ &RangaRaju KG. 1977. *Mechanics of Sediment Transport andAlluvial Stream Problems*. Wiley Eastern Ltd.

Morgan RPC. (Ed. D. A. Davidson). 1986. *Soil Erosion and Conservation*. ELBS,Longman.

USDA. 1969. *A Manual on Conservation of Soil and Water*. Oxford & IBH.

SWE 604 ADVANCED HYDO-MECHANICS IN SOIL AQUIFER SYSTEMS 3+0

Objective

To acquaint and equip the students with the advance soil-aquifer-water mechanics and various techniques for the analysis of the system

Theory

UNIT I

Soil aquifer system. Flow of water in partially saturated soils. Partial differential equation of flow.

UNIT II

Determination of unsaturated hydraulic conductivity and models for its estimation.

UNIT III

Infiltration and exfiltration from soils in absence and presence of water table.Movement of groundwater in fractured and swelling porous media.UNIT IV

Spatial variability.Theory of krigging. Statistical approaches in soil water dynamics.

Suggested Readings

Kirkham & Powers.1972.*Advanced Soil Physics*.John Wiley & Sons.Muskut M.1937. *The Flow of Homogeneous Fluid through Porous Media*.

McGraw Hill.

SWE 605 HYDRO-CHEMICAL MODELLING AND POLLUTANT MANAGEMENT 3+0

Objective

To acquaint and equip the students with the hydrodynamics of fluid and pollutant flow and the impact analysis of contaminant transport through modeling

Theory

UNIT I

Hydrodynamics in flow through porous media, Hydrodynamic dispersion, diffusion, convection equation.

UNIT II

Analytical and numerical models of contaminant transport in unsaturated soil profile and ground water.

UNIT III

Water quality management in lakes and reservoirs; physical characteristics; hydrologic and chemical budgets; bio-geochemical processes of pollutants; assessment methods.

UNIT IV

Classical wastewater problems; Water reclamation, reuse, water quality constraints and considerations for reuse in irrigation and industry; Biological wastewater treatment.

UNIT V

Modern stream pollution problem.Quality of groundwater and souces of contaminants. Cost economics – environment impact assessment.

Suggested Readings

Larry W Mays 1996. *Water Resources Handbook*.McGraw Hill.

Metcalf and Eddey 1994.*Wastewater Treatment Engineering and Reuse*.John Wiley.

Soli J Arceivala 1998. *Wastewater Treatment for Pollution Control*. Tata McGraw-Hill.

SWE 606 PLANT GROWTH MODELLING AND SIMULATION 3+0

Objective

To acquaint and equip the students with the simulation and modeling techniques in the soil, plant and water environment for crop growth.

Theory

UNIT I

Introduction to crop growth modeling.Simulation and simulation techniques.Types of models and modeling approaches.

UNIT II

Relational diagram for principal process, structures of a generalized agricultural simulator.

UNIT III

Input environment and techniques of monitoring plant environment, process and aspect of growth and development. Input yield models.

UNIT IV

Quantitative analysis of plant processes light photo-syntheses, respiration, growth, water uptake etc. and their mathematical modeling.

Suggested Readings

Loomis RS, Connor DJ.1992. *Crop Ecology: Productivity and Management in Agricultural System.*Cambridge Univ. Press.Spedding CRW. 1979. *An Introduction to Agricultural Systems.* Applied Science Publ.

Thornley JHM & Johnson IR. 1990. *Plant and Crop Modelling. AMathematical Approach to Plant and Crop Physiology*. ClarendonPress. Oxford Science Publ.

SWE 607 ADVANCES IN IRRIGATION AND DRAINAGE 2+0

Objective

To acquaint and equip the students with the advance application of irrigation and drainage system along with applicability of various models.

Theory

UNIT I

Advances in surface irrigation systems- surge irrigation: effect of surgingon surface flow hydraulics, cablegation: water supply management.

UNIT II

Atomization in sprinkler and micro irrigation system; multipurpose and special uses of micro irrigation.

UNIT III

Synthetic materials for drainage systems. Environmental issues related to drainage. Socio-economic impacts of drainage systems.

UNIT IV

Controlled drainage for reducing agricultural non point pollution. Application of simulation models for drainage systems.

Suggested Readings

FAO. 1982. *Mechanized Sprinkler Irrigation*. FAO Irrigation & Drainage Paper 35.

FAO. 1989. *Guidelines for Designing and Evaluating Surface IrrigationSystem*. FAO Irrigation & Drainage Paper 45.

Keller J &Bliesner RD. 1990.*Sprinkler and Trickle Irrigation*.Chapman & Hall.

Ritzema HP. (Ed.). 1994. *Drainage Principles and Applications*. ILRI.Walker WR &Skogerboe GV. 1987. *Surface Irrigation: Theory and Practice*.Prentice Hall.

SOIL AND WATER ENGINEERING

List of Journals

- Ground Water
- Journal of Hydrology
- Journal of Soil Conservation
- Journal of Water Management
- Transactions of ASAE
- Transactions of ASCE
- Water Resource Research

Suggested Broad Topics for Master's and Doctoral Research

- Groundwater Modeling
- HydrolgicModelling of Watersheds
- Conjunctive use of surface and groundwater
- Design and evaluation of irrigation and drainage systems and soil conservation measures
- Rainfall runoff modeling
- Evaluation of canal command area
- Water productivity analysis
- Water and energy saving technologies
- Application of modern tools such as Remote Sensing, GIS and simulation modeling for soil and water management strategies

SUGGESTED MINOR/SUPPORTING COURSES
Civil Engineering

Some identified Monor/Supporting courses

Code	Course Title	Credits
CE 501	OPEN CHANNEL FLOW	3+0
CE 502	DAMS & RESERVOIR OPERATIONS	3+1
CE 503	WATER QUALITY AND POLLUTION CONTROL	3+1
CE 504	FLUVIAL HYDRAULICS	2+1
CE 505	EXPERIMENTAL STRESS ANALYSIS	2+1
CE 506	SIMILITUDE IN ENGINEERING	2+1
CE 507	CONTROL OF POLLUTION FROM SOLID WASTES	2+0
CE 601	PROBABILISTIC APPROACH IN DESIGN	2+0
CE 602	RANDOM VIBRATIONS	2+0
CE 603	DESIGN OF BINS AND SILOS	2+1
CSE 501	COMPUTER GRAPHIS	2+1
CSE 502	NEURAL NETWORK AND ITS APPLICATIONS	2+1
EE 501	APPLIED INSTRUMENTATION	2+1
EE 502	PROCESS CONTROL SYSTEMS	2+1
ME 501	MECHANISM ANALYSIS AND SYNTHESES	3+0
ME 502	VIBRATIONS	3+0

Civil Engineering

CE 501 OPEN CHANNEL FLOW 3+0 Objective

To acquaint and equip with different techniques of Open Channel Flow and its importance in the engineering.

Theory

UNIT I

Open channel and their properties. Energy and momentum principles.Critical flow computations and applications.

UNIT II

Uniform flow.Its development.Formula and design computation.UNIT III

Boundary layer concept.Surface roughness.Velocity distribution and instability of uniform flow.

UNIT IV

Gradually varied flow theory and analysis. Method of computations.UNIT V

Hydraulic jump and its use as levelling energy dissipation

UNIT VI

Spatially varied flow.Unsteady flow.Rapidly varied flow.

Suggested Readings

Henderson FM.1966.*Open Channel Flow*. Macmillan.

Subramaninum 1960.*Open Channel Flow*. McGraw Hill.Ven T Chow. 1959. *Open Channel Flow*. McGraw Hill.