



**Department of Soil and Water
Conservation Engineering
Mahatma Phule Krishi Vidyapeeth
Rahuri-413 722, Dist. Ahmednagar (MS)**



Master's Programme in Soil & Water Conservation Engineering

Course Layout

Minimum Credit Requirements

Sr. No.	Subject	Minimum credit(s)
1	Major	20
2	Minor	09
3	Supporting	05
4	Seminar	01
5	Research	20
	Total	55
	Non Credit Compulsory Course	06

Sr. No.	Course Number	Course Title	Credits
A) Major Subjects (Min. 9 Credits)			
1	SWCE 501*	Watershed Hydrology	3 (2+1)
2	SWCE 502*	Design of Soil and Water Conservation Structures	3 (2+1)
3	SWCE 503*	Open Channel Flow for Runoff Water	3 (3+0)
4	SWCE 504*	Watershed Management and Modelling	3 (2+1)
5	SWCE 505	Project Planning for Land and Water Resources	3 (3+0)
6	SWCE 506	GIS and Remote Sensing for Natural Resources Management	3 (2+1)
7	SWCE 507	Land Development and Earth Moving Machinery	2 (2+0)
8	SWCE 508	Advances in Runoff Water Harvesting	2 (1+1)
9	SWCE 509	Fluvial Hydraulics	3 (2+1)
10	SWCE 510	Statistical Hydrology	3 (3+0)

11	SWCE 511	Dams and Reservoir Operations	3 (2+1)
12	SWCE 592*	Special Problem	1 (0+1)
13	SWCE 595 [#]	Industry/ Institute Training	NC
B) Minor Subjects (Min. 9 Credits)			
1	MATH 501	Higher Engineering Mathematics	3 (2+1)
2	MATH 502	Methods of Numerical Analysis	2 (1+1)
3	MATH 503	Advanced Calculus for Engineers	2 (2+0)
4	STAT 511	Statistical Methods for Applied Science	3 (2+1)
5	STAT 512	Experimental Design	3 (2+1)
6	IDE 504	Ground Water Engineering	3 (2+1)
7	IDE 505	Crop Environmental Engineering	2 (2+0)
8	IDE 507	Flow through Porous Media	2 (2+0)
9	IDE 511	Introductory Hydro Informatics	3 (2+1)
C) Supporting Courses (Min. 5 Credits)			
1	BSCT 501	Computer Graphics	3 (2+1)
2	BSCT 502	Computer Languages for Engineering Applications	3 (1+2)
3	MATH 504	Neural Network and its Applications	3 (2+1)
4	AE 502	Similitude in Engineering	3 (2+1)
5	AE 503	Applied Instrumentation	3 (2+1)
6	FMPE 521	Computer Aided System Design	2 (0+2)
D) Seminar			
1	SWCE 591	Master's Seminar	0+1=1
E) Master's Research			
1	SWCE 599	Master Research	0+20=20
F) Non Credit Compulsory Courses			
1	PGS 501	Library and Information Services	1 (0+1)
2	PGS 502	Technical Writing and Communications Skills	1 (0+1)
3	PGS 503 (e-Course)	Intellectual Property and its Management in Agriculture	1 (1+0)
4	PGS 504	Basic Concepts in Laboratory Techniques	1 (0+1)
5	PGS 505 (e-Course)	Agricultural Research, Research Ethics and Rural Development Programmes	1 (1+0)
6	PGS 506 (e-Course)	Disaster Management	1 (1+0)

* Compulsory #Minimum of three weeks

Course Contents

A) MAJOR SUBJECT

SWCE 501*	Watershed Hydrology	3 (2+1)
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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 dimensionless 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 Books:

Chow VT, David, M & Mays LW. 1988. *Applied Hydrology*. McGraw Hill.
 Ghanshyam Das 2000. *Hydrology and Soil Conservation Engineering*. Prentice Hall.
 Tideman EM. 1996. *Watershed Management*. Omega Scientific Publ.

SWCE 502*	DESIGN OF SOIL AND WATER CONSERVATION STRUCTURES	3 (2+1)
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Theory:

UNIT I

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 II

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

UNIT III

Earthen dams, seepage through dams and stability analysis.

UNIT IV

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 Books:

Garde RJ & Ranga Raju KG. 1977. *Mechanics of Sediment Transport and Alluvial 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.

SWCE 503* OPEN CHANNEL FLOW FOR RUNOFF WATER 3 (3+0)

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 Books:

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

SWCE 504*	WATERSHED MANAGEMENT AND MODELLING	3 (2+1)
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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 watershed evaluation report. Application of Models of flood and drought phenomenon. Application of watershed models.

Suggested Books:

Isobel W Heathcote. 1998. *Integrated Watershed Management: Principles and Practice*. Wiley Publ.
 Kenneth N Brooks, Peter F Ffolliott, Hans M Gregersen, Leonard F. DeBano. 1991. *Hydrology and the Management of Watersheds*. Wiley-Blackwell.

SWCE 505	PROJECT PLANNING FOR LAND AND WATER RESOURCES	3 (3+0)
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Theory:
UNIT I
Concepts and significance of optimization in land and 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 land and water resources.

UNIT IV

Economic analysis, present worth value and related problems.

Suggested Books:

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

Loucks DP, J.R. Stedinger and D.A. Haith. 1981. *Water Resource System Planning and Analysis*. Prentice Hall.

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

SWCE 506 GIS AND REMOTE SENSING FOR NATURAL RESOURCES MANAGEMENT 3 (2+1)

Theory:

UNIT I

Basic principles of remote sensing and sensors. Elements of photogrammetry.

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

SWCE 507 LAND DEVELOPMENT AND EARTH MOVING MACHINERY 2 (2+0)

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. LASER guided leveler with global positioning system.
UNIT IV
Boring machines. Different methods of boring.

Suggested Books:

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 of Excavation*. McGraw Hill.

Peurifoy RL. 1956. *Construction, Planning, Equipment and Methods*. McGraw Hill.

Roger V Amato & Donald J Heimburger 2003. *Classic Vintage Crawlers and Dozers*. B Heimburger House Publ.

G. Singh, C Venkataramanan, G. Sastry and B.P. Joshi. 1990. *Manual of Soil and Water Conservation Engineering*. Oxford & IBH.

SWCE 508 ADVANCES IN RUNOFF WATER HARVESTING 2 (1+1)

Theory:
UNIT I
Importance and principles of water harvesting, water harvesting techniques, Water harvesting practices in different regions of India
UNIT II
Assessment of runoff water potential of a basin and impact of watershed development works on runoff potential of basin, Design procedure and cost estimation of different runoff water harvesting structures, economic analysis of water harvesting structures.
UNIT III
Introduction to use of RS and GIS for planning, designing and monitoring water harvesting system. Impact assessment of water harvesting structures.

Practical:

Exercises on above topics.

Suggested Books:

J.S. Samra, V.N. Sharda and A.K. Sikka. 2002. *Water Harvesting and recycling: Indian Experiences*. Published by CSWCRTI, Dehradun.

V.N. Sharda, A.K. Sikka and G.P. Juyal. 2006. *Participatory Integrated Watershed Management: A Field Manual*. Published by CSWCRTI, Dehradun.

G. Singh, C Venkataramanan, G. Sastry and B.P. Joshi. 1990. *Manual of Soil and Water Conservation Practices*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

SWCE 509	FLUVIAL HYDRAULICS	3 (2+1)
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Theory:
UNIT I
Sediment properties, Sediment problems. Incipient motion of sediment particles.
UNIT II
Regimes of flow. Resistance to flow.
UNIT III
Sediment deposition process. Estimation of sediment load. Bed load. Suspended load. Total load transport.
UNIT IV
Alluvial streams and their hydraulic geometry. Bed level variations in alluvial streams.
UNIT V
Sediment samples and sampling. Alluvial river models. Sediment transport through pipes. Bed level variations in alluvial streams. River models.

Practical:

Problems on determination of sediment properties, regimes of flow, resistance to flow, incipient motion, bed load, suspended load, total load transport and sediment transport.

Suggested Books:

Garde RJ & Ranga Raju KG. 2001. *Mechanics of Sediment Transport and Alluvial Stream Problems*.

Howard H Chang. 1988. *Fluvial Process in River Engineering*. John Wiley & Sons.

Raudkivi AJ. 1990. *Loose Boundary Hydraulics*. Pergamon Press.

SWCE 510	STATISTICAL HYDROLOGY	3 (2+0)
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Theory:
UNIT I
Probability concepts. Discrete and continuous frequency distributions; Hyper geometric distribution, Bernoulli and Poisson process, Normal distribution, Other Continuous probability distributions- Uniform, Exponential, Gamma, Log-Normal, Extreme value, beta, Pearson.
UNIT II
Graphical and mathematical construction of probability paper, probability plotting.
UNIT III
Fitting empirical Distributions to precipitation and other hydrologic variables. Analytical frequency analysis, Regional frequency analysis.
UNIT IV
Linear, Multiple linear regression and application. Hypothesis testing, chi-square, t, F, K-S test.

Suggested Books:

Haan, C.T. 1977. *Statistical Methods in Hydrology*. Iowa State Uni. Press, Ames.
 Mutreja, K.N. (1986) *Applied Hydrology*. Tata McGraw Hill Book Co., New Delhi.
 Chow, V.T. (Ed) (1964) *Handbook of Applied Hydrology*. McGraw Hill Book Co., New York.

SWCE 511	DAMS AND RESERVOIR OPERATIONS	3 (2+1)
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Theory:
UNIT I
Dams classification. Suitable site selection for dams & reservoirs. Survey & planning of storage projects.
UNIT II
Type of concrete dams. Forces acting on concrete dams. Stability analysis. Methods of design of gravity dams. Temperature control for dams.
UNIT III
Earth dams and their types. Methods of construction. Causes of failure & remedial measures. Seepage and stability analysis of earth dams.
UNIT IV
Foundation treatment. Abutment grouting. Instrumentation in dams.
UNIT V
Spill way and spillway capacities and spillway gates.
UNIT VI
Reservoir planning, Storage, sedimentation, Losses, Economics. Flood routing.

Practical:

Exercises on above topics.

Suggested Books:

Bharat Singh. 2002. Earthen Dams. New Chand & Bros., Roorkee.

Creager WP, Justin JD, Hinds J. 1945. *Engineering for Dams*. Vols. I-III. John Wiley & Sons.

Sharma HD. 1981. *Concrete Dams*. Metropolitan.

SWCE 592	SPECIAL PROBLE	1 (0+1)
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Special Problem related to any topic in Soil and Water Conservation Engineering. A report on the study to be submitted for evaluation.

SWCE 595[#]	INDUSTRY/ INSTITUTE TRAINING	NC
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Minimum of three weeks training at the end of II semester.

B) MINOR SUBJECTS (09 CREDITS)

SWCE 501	HIGHER ENGINEERING MATHEMATICS	3 (2+1)
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Theory:
UNIT I
Review of Calculus - differential and integral; Vectors; basic operations, unit vector and direction cosines, vector products and identities;
UNIT II
Differential calculus of functions of several variables; functions, domains and regions, limits and continuity, partial derivative, total differential implicit functions - interse function and Jacobians directional derivatives.
UNIT III
The Laplacians in polar, cylindrical and spherical coordinates; Vector differential calculus; vector and scalar fields, gradients, divergence and curl of a vector; integral calculus of function of several variables; numerical evaluation of definite and indefinite integral; improper integral;
UNIT IV
Two dimensional theory; Limits and integral in plane, line integral as integral of vectors, Green's theorem, independence of path; Fourier series convergence, generalization, Fourier cosine and sine series, Uniqueness theorem

Practical:

Application of differential calculus, application of cylindrical and spherical coordinates, two dimensional theory, Fourier series, Green's theorem

Suggested Books:

Scarborough G. 2000. *Numerical Mathematical analysis*. Oxford and IBH publishing company Pvt. Ltd.

Sokolnikoff I.S. and Redheffer R.M. 1966. *Mathematics of Physics and Modern Engineering*. McGraw-Hill, New York.

Kreyszig E. 1971. *Advanced Engineering Mathematics*. Wiley Eastern private Ltd.

Snedden I.N. 1957. *Elements of practical differential equations*, McGraw-Hill, New York.

Churchill R.V. 1960. *Complex variables and applications*. McGraw-Hill, New York.

Kaplan W. 1959. *Advanced Calculus*. Addison Wesley

Chattergy K. 2000. *Integral calculus and differential equations*. Tata McGraw-Hill, New Delhi.

Codington D. 2000. *Theory of ordinary differential calculus*. Tata McGraw-Hill, New Delhi.

SWCE 502 METHODS OF NUMERICAL ANALYSIS 2 2 (1+1)

Theory:**UNIT I**

Numerical methods for systems of linear equations,
eigen values, interpolation, differentiation.

UNIT II

Least squares. Numerical solution of differential equations and non linear equations in several variables.

Practical:

Practice on matrix manipulation, Exercises on solution of the systems of linear and non linear equations, solution of differential equations.

Suggested Books:

Scarborough G. 2000. *Numerical Mathematical analysis*. Oxford and IBH publishing company Pvt. Ltd.

Chapra C. 2000. *Numerical Methods for Engineers*. Tata McGraw-Hill, New Delhi.

Atkinson K. 1993. *Elementary Numerical Analysis*. 2nd Edition, John Wiley.

Epperson J.F. 2002. *An introduction to numerical methods and analysis*. John Wiley.

SWCE 503	ADVANCED CALCULUS FOR ENGINEERS	2 (2+0)
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Theory:
UNIT I
Plane analytic geometry, differential and integral calculus and applications,
UNIT II
Transcendental functions, techniques of integration and multiple integrals,
UNIT III
Vector calculus, analytic geometry in space, partial differentiation applications.

Suggested Books:

Stein S and Barcellos A. 1992. *Calculus and analytical geometry*. Tata McGraw-Hill, New Delhi.
Hildbrand F. 1976. *Advanced calculus for applications*. 2nd edition, Prantice Hall
Anton H. 1995. *Calculus and analytical geometry*. 5th edition, John Wiley

STAT 511	STATISTICAL METHODS FOR APPLIED SCIENCE	2 (2+1)
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Theory:
UNIT I
Measures of central tendency and dispersion Theory of probability: classical, empirical, axiomatic probability, random variable and mathematical expectation
UNIT II
Discrete and Continuous probability distribution: Binomial, Poisson, Normal, and their application. Concept of sampling distribution: Chi-square, t, and F distribution. Test of significance based on Normal, Chi-square, t and F distribution. Large sample theory (Z-test).
Unit III
Correlation and regression: Simple and multiple linear regression model, Stepwise regression, Estimation of parameters, Correlation, Partial and multiple correlation. Rank correlation, Path analysis, Test of significance of correlation coefficients and regression coefficients, coefficient of multiple determination. Polynomial regression model and their fitting, Estimation of parameters.
Unit IV
Non-parametric tests: sign, Mann-Whitney U test, Run test, Median test.

Practical:

Calculation of mean, median, mode, variance and standard deviation etc. Fitting of Binomial, Poisson and Normal distributions, Large sample test, t, F and Chi-square test, Correlation, Partial and multiple correlation, Rank correlation and linear, multiple and non-linear regression, Path analysis, Non- parametric tests.

Suggested Books:

Snedecor G.W. & W.G. Cochran. 1967. *Statistical Methods*. Sixth Edition, Oxford & IBH Publishing Company, Bombay, W.

Anderson, T.W. 1984. *An Introduction to Multivariate Statistical Analysis*. 2nd Ed. John Wiley.

Ostle, B.1967. *Statistics in Research*. Oxford & IBH Publishing Company.

Robert, G. D., Steel and James H. Torrie. 1971. *Principles and Procedures of Statistics: Biometrical Approach*. McGraw Hill International Book Company, New York

Gupta S. C, V.K. Kapoor. 1991. *Fundamental of mathematical statistics*, Sultan

STAT 512	EXPERIMENTAL DESIGN	3 (2+1)
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Theory:

UNIT I

Need of designing of experiments, characteristics of a good design. Basic principle of designs randomization, replication and local control.

UNIT II

Uniformity trial, size and shape of plots and blocks, analysis of variances, completely randomized design, randomized block design and Latin square design.

UNIT III

Factorial experiments,(Symmetrical and aSymmetrical 23, 32), orthogonality and partitioning of degree of freedom. Concept of confounding in Factorial experiments. Factorial experiments with control treatment, Fitting of quadratic equation and determination of optimum doses.

UNIT IV

Split plot and strip plot design, Analysis of covariance and missing plot techniques in RBD and Latin square design. Transformations, Concept of multi observational data.

Practical:

Analysis of data from CRD, RBD, LSD, Analysis of factorial experiments. Analysis with missing data, Split plot and Strip plot designs, Transformation of data, Analysis of Covariance.
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Suggested Books:

Panse, V.G. and P.V.Sukhatme, 1978. *Statistical Mehtods for Agricultural Workers* - IIIrd Edition, - I.C.A.R., New Delhi Publications.

Cochran, W. G. & Cox, G. M., 1957. *Experimental Designs* – IInd Edition, John Wiley & Sons, Inc. New York.

Snedecor G. W. & W. G. Cochran, 1967. *Statistical Methods* – VIth Edition, Oxford & IBH Publishing Company, Bombay

Gomez K. A. & A. A. Gomez. 1984. *Statistical procedures for Agricultural Research* –IInd Edition., John Wiley and Sons, New York

Nigam, A.K. and V.K.Gupta, 1979. *Handbook of Analysis of Agricultural Experiments*, 1st Edition, published by Indian Agril. Statistics Research Institute.

Das, M.N. and N.C. Giri, 1986 *Design of Analysis of Experiments*- IInd Edition, Published by Wiley Reastern Ltd. New Delhi.
 Oskar Kempthorne, 1952. *The Design and Analysis of Experiments* 1st Edition, Publisher: John Wiley and Sons, New York

IDE 504	GROUND WATER ENGINEERING	3 (2+1)
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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 Books:

Boonstra J & de Ridder NA. 1981. *Numerical Modeling of Groundwater Basins*. 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*. McGraw-Hill.
 Huisman L. 1972. *Groundwater Recovery*. MacMillan.
 Polubarinova Kochina 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.

IDE 505	CROP ENVIRONMENTAL ENGINEERING	2 (2+0)
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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, evapotranspiration 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 Books:

Ghildyal BP & Tripathy RP. 1987. *Fundamental of Soil Physics*. Wiley Eastern.
 Slatyor OP. 1967. *Plant Water Relationship*. Academic Press.

IDE 507	FLOW THROUGH POROUS MEDIA	2 (2+0)
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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 Books:

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 Fluids through Porous Media*. JW Edwards.

Patrick A Domenico & Schwartz FW. 1998. *Physical and Chemical Hydrogeology*. John Wiley & Sons.

Remson I, Hornberger GM & Moiz Fred J. 1971. *Numerical Methods in Subsurface Hydrology*. Wiley Interscience.

IDE 511	INTRODUCTORY HYDRO INFORMATICS	3 (2+1)
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Theory:
UNIT I
Introduction to Hydroinformatics, Need and Applications of Hydroinformatics. Various tools in Hydroinformatics. The role of internet and web technologies in Hydroinformatics and gathering data. Sources of data, Telemetry/SCADA and other techniques of data collection.
UNIT II
Process of schematisation/discretisation (in space and time domain). The role of calibration and validation process in modelling. Solution of simple advection equation using FDM, sample code to show how these equations are used. Introduction to basic concepts of hydraulic modelling and governing equations. Use flow simulation models in networks. Hydrologic model-concept and need. Classification of hydrologic models. Physical, empirical, lumped, distributed models with examples, deterministic and probabilistic models. Introduction to popular hydrologic models
UNIT III
Physically-Based Vs Data-Driven Models. Examples of data-driven modelling. Introduction to modern techniques used in hydroinformatics: artificial intelligence, expert systems, neural networks. The use of artificial intelligence (AI) techniques for prediction, simulation, identification, classification and optimisation in the water resources engineering field. Example application of Artificial neural networks and Fuzzy logic techniques to water resources engineering.
UNIT IV
Potential benefits of applying optimisation to water resources problems. Optimisation techniques including evolutionary algorithms (genetic algorithms and genetic programming). Applications of genetic algorithms for water resources.
UNIT V
What is GIS? Fundamentals, Components and Various data structure of GIS, Need of GIS, Applications of GIS. Introduction to ArcView GIS, How to use ArcView GIS to build various themes, query themes, perform spatial analysis & 3D analysis. 3D and 2D data visualisation. What is decision support systems (DSS) and spatial decision support system (SDSS). Components of DSS and SDSS. How to build DSS & SDSS. Demonstration of DSS for water resources problems.

Practical:

Data sources, collection and organization of data Use of Telemetry/SCADA for data collection Schematization/ discretisation of data

Application of Artificial neural networks and Fuzzy logic techniques to water resources engineering
 Applications of genetic algorithms for water resources
 Application of GIS
 Building of DSS and SDSS
 Demonstration of DSS for water resources problems.

Suggested Books:

Pratihari, D.K. 2008. *Soft Computing*. Narosa Publications.
 Praveen Kumar and Marukus. 2005. *Hydroinformatics: Data Integrative Approaches in Computation, Analysis, and Modeling*. CRC Press, Taylor and Francis Group.
 Robert J. Abraham; Linda M. See; Dimitri P. Solomatine. 2008. *Practical Hydroinformatics*. Springer Publications
 Kishan Mehrotra, Chilukuri K. Mohan and Sanjay Ranka. 1996. *Elements of Artificial Neural Networks*. The MIT Press.
 Melanie Mitchell. 1998. *An Introduction to Genetic Algorithms*. The MIT Press
 Thomas Bäck. 1996. *Evolutionary algorithms in theory and practice: evolution strategies, evolutionary programming, genetic algorithms*. Oxford University Press.
 Sakawa, Masatoshi. 2001. *Genetic Algorithms and Fuzzy Multiobjective Optimization*. Operations Research/Computer Science Interfaces Series. Springer Publications.
 Randy L. Haupt. 2004. *Practical genetic algorithms*. Wiley-IEEE
 Kazuo Tanaka, Tak Niimura. 1996. *An Introduction to Fuzzy Logic for Practical Applications*. Springer Verlag.
 Masao Mukaidono, Hiroaki Kikuchi. 2001. *Fuzzy Logic for Beginners*. World Scientific Pub Co Inc.
 Vilem Novak, Jiri Mockor, Irina Perfilieva. 1999. *Mathematical Principles of Fuzzy Logic*. Kluwer Academic Pub.

B) SUPPORTING COURSES (05 CREDITS)		
BSCT 501	COMPUTER GRAPHICS	3 (2+1)

Theory:
UNIT I
Graphic display devices, Interactive devices, Line and circle plotting techniques by using Bresenham's algorithm, Windowing and clipping, Sutherland Copen algorithm, Cyrus and Beck method.
UNIT II
Curve drawing using Hermite Polynomial, Bezier curve, B Splines, Picture Transformation, translation, rotation, Scaling and Mirroring
UNIT III
3D Graphics, 3D transformation rotation about an arbitrary axis. Curved surface generation, Hidden surface removal.
UNIT IV
Orthogonal Projection and multiple views, Isometric projection, Perspective projection, 3D Clipping
UNIT V

Generation of solids, Sweep method, Interpolation, Graphic Standards, CGS Modeling, Applications of Computer Graphics.

Practical:

Practical problems on above topics.

Suggested Books:

Hearn Donald.1996. *Computer Graphics*. PHI.
Schaum. Series. 2004. *Computer Graphics*. TMH.

**BSCT 502 COMPUTER LANGUAGES FOR ENGINEERING APPLICATIONS
3 (1+2)**

Theory:

UNIT I

Programming concepts.

UNIT II

Introduction to C language.

UNIT III

Application of C language for engineering applications.

Practical:

Hands on for development of programs in C and other languages

Suggested Books:

Tan A. 1999. *C programming for enginners and computer science*. McGraw-Hill, New York.
E. Balgurusamy 2007. *ANSI C*. Tata McGraw-Hill, New Delhi.

MATH 504 NEURAL NETWORK AND ITS APPLICATIONS 3 (2+1)

Theory:

UNIT I

Introduction to neural network and its comparison with biological system. Perceptron and linear separable functions, multi-layers perceptrons.

UNIT II

Back propagation, one basic learning algorithm for feed-forward neural network, variation and improvement for back-propagation algorithm, Generalisation of learning algorithm.

UNIT III

Recurrent Networks: Hopfield networks and Boltzmann Machine.

UNIT IV
Unsupervised learning and self organized features maps.
UNIT V
Application of neural network in function approximation, time series predictions, pattern recognition, control systems and optimization in engineering problems.

Practical:

Development of neural network by back-propagation learning algorithm using MATLAB for function approximation, time series predictions, pattern recognition, control systems and optimization in engineering problems.

Suggested Books:

Haykins S.1999. *Neural Network- Comprehensive Study*. PHI.
Hertz J, Krogh A & Palmer RG. 1991. *Introduction to Theory of Neural Computation*. Addison-Wesley.

AE 502	SIMILITUDE IN ENGINEERING	3 (2+1)
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Theory:
UNIT I
Dimensions and units.
UNIT II
Dimensional and similarity analysis. Theory of models.
UNIT III
True, distorted and dissimilar models.
UNIT IV
Application to different systems with special reference to Structural and fluid flow systems, Analogues.

Practical:

Equations for the period of simple pendulum.
Uniform rectangular cantilever beam.
Spring mass level system. Investigation of extrapolation.
Deflection of a cantilever beam. Prediction of the deflection of a beam using a model.
Analogue model experiments

Suggested Books:

Green Murphy.1950. *Similitude in Engineering*. Ronald Press.
Huntley HE. 1974. *Dimensional Analysis*. Dover Publ.
Stephen J Klin.1965. *Similitude and Approximation Theory*. McGraw Hill.

AE 503	APPLIED INSTRUMENTATION	3 (2+1)
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Theory:
UNIT I
Basic instrumentation systems and transducer principles. Displacement Transducers: Potentiometer, LVDT, Piezoelectric and capacitive transducers. Digital Transducers. Velocity transducers – Analog and Digital
UNIT II
Acceleration and absolute motion measurement. Force transducer _ Strain Gauge, Hydraulic load cell, Cantilever type and Probing ring. Method of separation of force – Torque, Power and Energy measuring techniques.
UNIT III
Temperature measurement using Bi-metals, PTRs, Thermistors, Thermocouples, Electronic IC sensors and Pyrometers. Heat flux measurement. Humidity measurement – Dry and Wet bulb, Hair hygrometer and Humister. Soil and Grain moisture transducers, pressure measurement – Manometers, Bourdon Tube, Diaphragm type transducer. High pressure and vacuum sensing techniques.
UNIT IV
Flow transducers, Positive displacement, venturimeter, Rotameter, Drag force, Ultrasonic, Electromagnetic, Hot wire anemometers. Time and frequency measurement.
UNIT V
Level measurement, OD and pH measurement, PCO ₂ and grain quality measurement. Biomedical measurement – BP, ECG etc., Ultrasonic flaw detection, Spectroscopy.

Practical:

<p>Study the characteristics of various transducers: Potentiometer, LVDT, Proximity sensors and Photo pickups, Load cell, Thermistor and Thermocouple, LM 335/AD 590</p> <p>Study of various Analog interfacing blocks: Attenuators, Amplifiers, A/D converters, Filters, digital interfaces using Wave shapers and level shifters.</p> <p>Practice of using interfaces and developing suitable software for data acquisition through PC/Microcomputer: Use of Microcomputer kit, Study the use of 8255 I/O IC, Study the use of printer port in a PC. Data acquisition through PC/Kit.</p>

Suggested Books:

Doebelin EO.1990. *Measurement Systems Applications and Design*. Tata McGraw Hill.

Nakra BC &Chaudhary KK. 2004. *Instrumentation Measurement and Analysis*. Tata McGraw Hill.

Sawhney AK. 2008. *Electrical and Electronics Measurement and Instrumentation*. Dhanpat Rai & Sons.

FMPE 521	COMPUTER AIDED SYSTEM DESIGN	2 (0+2)
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Practical:

Introduction to computer aided design, Geometric modeling and interactive graphics, Computer aided analysis and synthesis of common mechanical components. Application of numerical methods and optimal techniques to machine design problems. Computer aided selection of standard mechanical components. Introduction to FEM. Preparation of engineering drawings of machine / implement components, design of plough share / furrow openers / plough discs, and other components of farm machinery, preparation of bill of material and costing.

Suggested Books:

Rammurthy, T. 2001. *Computer Aided Mechanical Design and Analysis*. Tata McGraw Hill, New Delhi.

Mukhopadhyay, M. 2000. *Matrix, Finite Element, Computer and Structural analysis*, Oxford & IBH Publishing Co. Pvt Ltd.

Krishnamoorthy, G. 2001. *Finite Element Analysis. Theory and Programming*. Tata McGraw Hill, New Delhi.

Knudra, C.V. 2000. *Numerical Control and Computer Aided Manufacturing*. Tata McGraw Hill, New Delhi.

Zeid, K. 2000. *CAD/CAM Theory and Practice*. Tata McGraw Hill, New Delhi.

B) SEMINAR (01 Credit)		
SWCE 591	MASTER'S SEMINAR	1 (0+1)

Student will have to deliver seminar(s) on the topics related to Soil and Water Conservation Engineering in consultation with Research Guide.

E) RESEARCH (20 Credits)		
SWCE 599	MASTER RESEARCH	20 (0+20)

Student will have to carry out the research and submit the thesis in consultation with Research Guide.

F) NON CREDIT COMPULSORY COURSES (06 Credits)**PGS 501 LIBRARY AND INFORMATION SERVICES 01 (0+01)****Practical:**

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM

Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; eresources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 1 (0+1)**Practical:**

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Books:

Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.

Collins' Cobuild English Dictionary. 1995. Harper Collins.

Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.

Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.

James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.

Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.

Mohan K. 2005. *Speaking English Effectively*. MacMillan India.

Richard WS. 1969. *Technical Writing*. Barnes & Noble.

Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.

Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.

Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (e-Course)	1 (0+1)
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Theory:

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Books:

Erbisch FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.

Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.

Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.

Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.

Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES**1 (0+1)****Practical:**

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Books:

Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.

Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (e-Course)**1 (1+0)****Theory:****UNIT I**

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Books:

Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.

Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.

Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

PGS 506	DISASTER MANAGEMENT (e-Course)	1 (1+0)
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Theory:
UNIT I
Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion
UNIT II
Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.
UNIT III
Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Books:

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.