

**SCHEME OF INSTRUCTION AND EVALUATION
AND
SYLLABUS
for
M.Tech (Water Resources Engineering)
(Effective from Academic Year 2016-2017)**



**DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
WARANGAL – 506 004**

**M.Tech (Water Resources Engineering)
Scheme of Instruction and Evaluation**

M.Tech (Water Resources Engineering) I – Semester

Course No.	Name of the Course	L–T–P–C
CE5701	Applied Hydrology	4-0-0-4
CE5702	Advanced Fluid Mechanics	4-0-0-4
CE5703	Computational Methods	4-0-0-4
CE5704	Stochastic Hydrology	4-0-0-4
	Elective – I	3-0-0-3
	Elective – II	3-0-0-3
CE5705	Hydrologic Design Lab	0-0-3-2
CE5706	Computational Lab	0-0-3-2
CE5741	Seminar – I	0-0-2-1
	TOTAL	22-0-8-27

II – Semester

Course No.	Name of the Course	L–T–P–C
CE5751	Water Resources Systems Planning and Management	4-0-0-4
CE5752	Geo Hydrology and Groundwater Modelling	4-0-0-4
	Elective - III	3-0-0-3
	Elective – IV	3-0-0-3
	Elective – V	3-0-0-3
	Elective – VI	3-0-0-3
CE5753	Water Resources Systems Design Lab	0-0-3-2
CE5754	Geographic Information Systems (GIS) Lab	0-0-3-2
CE5791	Seminar – II	0-0-2-1
	TOTAL	20-0-8-25

Electives – I & II

Course No.	Name of the Course
CE5711	Hydraulic Transients
CE5712	Design of Water Supply and Sewerage Systems
CE5713	Design of Hydraulic & Hydropower Structures
CE5714	Watershed Management
CE5715	Economics of Water Resources Planning
CE5312	Environmental Impact Assessment and Management

CE5515	Principles of Geomatics
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Electives – III, IV, V & VI

Course No.	Name of the Course
CE5761	Free Surface Flow
CE5762	Urban Water Management
CE5763	River Engineering
CE5764	Land and Water Management
CE5765	Applications of Remote Sensing & GIS in Water Resources & Environmental Engineering
CE5766	Hydrologic Systems Modelling
CE5767	Applications of Soft Computing Techniques
CE5768	Water Quality Modelling
CE5769	Isotope Hydrology
CE5770	Climate Systems
CE5363	Rural Water Supply and Environment Sanitation
CE5365	Bio-remediation

Course No.	Name of the Course	Credits
	III – SEMESTER	
	Industrial Training (8-10 weeks) (Optional)	
CE6742	Comprehensive Viva Voce	2
CE6749	Dissertation Part – A	6
	IV – SEMESTER	
CE6799	Dissertation Part – B	12

SYLLABUS

I Semester

CE5701

APPLIED HYDROLOGY

(4-0-0)4

Physical processes in hydrology, geomorphology, Infiltration models and their applications, Effective Rainfall, Runoff, Direct Runoff Hydrograph, Hydrograph Analysis, unit hydrograph theory and its applications, Rainfall - Runoff Analysis, Conceptual Models, Parametric Unit Hydrograph, Synthetic Unit Hydrograph, Frequency analysis, Flood routing models, Small Watersheds, Wetland hydrology.

READING:

1. Chow, V.T., Maidment, D.R. and Mays, L.W. (2010), "*Applied Hydrology*", Tata McGraw Hill Edition
2. Warren Viessman, Jr. and G L Lewis, (2008), "*Introduction to Hydrology*", Prentice Hall India Pvt. Ltd., New Delhi
3. McCuen R.H. (2005), "*Hydrologic Analysis and Design*", Prentice Hall Inc. N York.
4. Patra, K C (2008), "*Hydrology and Water Resources Engineering*", Narosa Publications

CE 5702

ADVANCED FLUID MECHANICS (4-0-0)4

Structure of Fluid Mechanics, control volume approach. Reynolds Transport Theorem, Conservation laws, Potential Flow, Navier - Stokes Equations, Exact and Approximate Solutions, Boundary Layer Theory, Turbulence modeling, Dimensional Analysis, Diffusion and Dispersion of Pollutant in a Fluid Medium, Geophysical fluid dynamics – geostrophic flow, geostrophic balance.

READING:

- Schlichting, H and K. Gresten (2004) "*Boundary Layer theory*", Springer Publications
Fox, R.W., P J Pitchard and A T McDonald (2009), "*Fluid Mechanics*", Wiley India Pvt. Ltd.
White, F.M. (2011) "*Viscous Fluid Flow*", McGraw Hill Pub. Co, N York
Yalin, M.S. (1971), "*Theory of Hydraulic Models*", McMillan Co., 1971.

CE 5703

COMPUTATIONAL METHODS (4-0-0)4

Numerical integration, Numerical Solution of Ordinary Differential equations, Runge-Kutta methods, Classification of Quasi-linear partial differential equations (PDE), Solution methods for parabolic, elliptical and hyperbolic equations, Finite difference, finite volume and finite element methods, applications of computational methods for open channel flow, pipe flow, flow through porous media and pollution transport

READING:

1. Hoffman, J.D., (2011), "*Numerical Methods for Engineers and Scientists*", CRC Press, Special Indian Edition
2. Schilling, R.J., and S.L. Harris, (2007), "*Applied Numerical Methods for Engineering*", CENGAGE Learning, India Edition
3. Abbot, M.A. and Ververy (1996), "*Computational Hydraulics*", Elsevier Publications

CE 5704

STOCHASTIC HYDROLOGY

(4-0-0)4

Deterministic and Stochastic Hydrology, Probability axioms, Random numbers, Continuous and Discrete distributions, Moments and expectations of distributions, Parameter estimation, Analysis of hydrologic extremes, Frequency analysis, Regional flood frequency analysis, Transformations, Hypothesis Testing, Multivariate regression analysis, Correlation coefficient and its significance in regional analysis, Modelling hydrologic uncertainty, First order Markov process, Markov chain, Data generation, Hydrologic Time Series Analysis, Modelling of Hydrologic Time Series.

READING:

1. Charles T. Haan (1998), "*Statistical Methods in Hydrology*", East West Publishers
2. Kotteguda, N.T., (1982), "*Stochastic Water Resources Technology*", The Macmillan Press, New York

3. McCuen R.H. (2005), *Hydrologic Analysis and Design*", Prentice Hall Inc. N York
4. Kotteguda, N.T. and Renzo Resso, (1998), "*Statistics, Probability and Reliability for Civil and Environmental Engineers*", McGraw Hill Companies Inc., New York

CE 5705

HYDROLOGIC DESIGN LAB

(0-0-3) 2

Analysis of Precipitation Data, Construction of IDF curves, Estimation of Evaporation and Evapotranspiration, Determination of Yield from A Catchment, Derivation of Unit Hydrograph, Estimation of Design Flood, Regional Flood Frequency Analysis, Hydrologic and Hydraulic flood routing, Derivation of Synthetic Unit Hydrograph

READING:

1. Chow, V.T., Maidment, D.R. and Mays, L.W. (2010), "*Applied Hydrology*", Tata McGraw Hill Edition
2. 2 Warren Viessman, Jr. and G L Lewis, (2008), "*Introduction to Hydrology*", Prentice Hall India Pvt. Ltd., New Delhi
3. McCuen R.H. (2005), *Hydrologic Analysis and Design*", Prentice Hall Inc. N York.

CE 5706

COMPUTATIONAL LAB

(0-0-3) 2

Introduction to R software, statistical computing using R – data analysis, frequency analysis, parameter estimation, regression, Applications of numerical methods – back water computation, flood routing, one dimensional pollution transport, Introduction to EPANET, SWMM, MIKE-Urban, MIKE-Flood, HEC-RAS and other related software

CE 5751

WATER RESOURCES SYSTEMS PLANNING AND MANAGEMENT(4-0-0)4

General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Planning and Development, Economic Analysis of Water Resources Systems, Methods of Systems Analysis, Deterministic, Stochastic, Fuzzy Optimisation, Simulation, and Multi Objective Optimisation techniques for planning, design and operation of water resources and environmental engineering systems.

READING:

1. Loucks, D.P. and Eelco van Beek (2005), "*Water Resources Systems Planning and Management – An introduction to methods, models and applications*", Studies and Reports in Hydrology, UNESCO Publishing
2. Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1982) "*Water Resources Systems Planning and Analysis*", Prentice Hall Inc. N York
3. Vedula, S. and P P Mujumdar (2005) "*Water Resources Systems Modeling Techniques and Analysis*", Tata McGraw Hill Pub. Co., New Delhi
4. Charles S. Revelle, E. Earl Whitlatch and Jeff R. Wright (2004), "*Civil and Environmental Systems Engineering*" Pearson Education Inc., New Jersey.

CE 5752:

GEOHYDROLOGY & GROUNDWATER MODELLING (4-0-0)4

Geo-hydrology, Surface and Subsurface Geophysical Explorations, Well Hydraulics- Image well theory. Groundwater Modelling, Water Well Design and Drilling, Groundwater Management, Conjunctive Use, Artificial Recharge of Groundwater, Groundwater Quality Modelling.

READING:

1. Todd, D.K., L W Mays (2011), "*Groundwater Hydrology*", John Wiley & Sons, Singapore
2. Karamouz, M., A. Ahmadi and M Akhbari (2011), "*Groundwater Hydrology: Engineering, Planning and Management*", CRC Press
3. Davis, S.N. and De Weist, R.J.M. (1966), "*Hydrogeology*", John Wiley & Sons, N York
4. Domenico (1972), "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc. N York

5. Walton, W.C. (1970) "Groundwater Resources Evaluation", McGraw Hill Inc. N York

CE 5753 WATER RESOURCES SYSTEMS DESIGN (0-0-3) 2

Determining storage capacity of a reservoir, development of storage-yield-reliability relationship for a reservoir, developing optimal operating policy for a single and multi reservoir system, crop planning and irrigation scheduling, water quality management in a river, optimal design of water distribution networks, simulation of operation of a reservoir, simulation of an aquifer, performance evaluation of an irrigation system

READING:

1. Loucks, D.P. and Eelco van Beek (2005), "Water Resources Systems Planning and Management – An introduction to methods, models and applications", *Studies and Reports in Hydrology*, UNESCO Publishing
2. Vedula, S. and P P Mujumdar (2005) "Water Resources Systems Modeling Techniques and Analysis", Tata McGraw Hill Pub. Co., New Delhi
3. Charles S. Revelle, E. Earl Whitlatch and Jeff R. Wright (2004), "Civil and Environmental Systems Engineering" Pearson Education Inc., New Jersey.

CE 5754 REMOTE SENSING & GEOGRAPHIC INFORMATION SYSTEM LAB (0-0-3) 2

Study of Different Types of Satellite Data Products - Visual Interpretation of Satellite Data of different resolutions, Digitization of Points and Lines, Editing Map Elements, Attribute Data Entry and Manipulation Spatial Analysis, Map Generation with Patterns and Legends

READING:

1. Lillesand, T.M and Kiefer, R.W. *Remote Sensing and Image Interpretation* - John Wiley and Sons, 2008
2. ArcGIS 10.0 Manuals, ESRI, 2010

CE 5711 HYDRAULIC TRANSIENTS

Causes of transients in pipes, water hammer, governing equations, solution by method of characteristics, transients in pumping schemes and hydro electric power schemes, transient bubble flow and transient control, Unsteady free surface flow, governing equations for 2D flow, Bousinesque equations, finite difference solutions, dam break analysis

READING:

1. M.H. Choudhary, *Applied Hydraulic Transients*, Van Nostrand Reinhold, New York, 1997,
2. Watters, G.Z, *Analysis and control of pipe flow in pipes*, Butter Worth Publishers, 1984.

CE 5712 DESIGN OF WATER SUPPLY AND SEWERAGE SYSTEMS

Water quality standards, Planning, analysis and design of water distribution systems, Basic concepts of water treatment, Conventional treatment processes, Design of water treatment units, Characteristics of municipal waste water, Wastewater collection and conveyance systems, Design of sewers, Design of municipal wastewater treatment systems

READING:

1. Viessman Jr., Mark J. Hammer, E M Perez, P A Chadik (2009), "Water Supply and Pollution Control", *PHI Learning*, New Delhi
2. Qasin Syed, R. Motley Edward, and M. Zhu Guang (2011), "Water Works Engineering: Planning, Design and Operation", *PHI Learning*, New Delhi

READING:

1. Chow, .V.T. (1979) "*Open Channel Hydraulics*", McGraw Hill Inc. N York
2. Subramanya, K (2008) "*Flow in Open Channels*", Tata McGraw Hill Pub.
3. Terry Sturm (2011), "*Open Channel Hydraulics*", Tata McGraw Hill Pub.
4. French, R.H. (1986), "*Open Channel Hydraulics*", McGraw Hill Pub Co., N York

CE 5762**URBAN WATER MANAGEMENT**

Trends of urbanisation and industrialization, Urban water supply demand forecast, Urban hydrological cycle, Master drainage plans, Estimation of urban stormwater quantity, Wastewater collection systems, Design of storm sewer network systems, Storage facilities. Interaction between urban drainage and solid waste management, Stormwater Management, Operation and maintenance of urban drainage system.

READING:

1. Geiger, W.F., Marsalek, J. Zudima and Rawls, G.J (1987), "*Manual on Drainage in Urban Areas*", 2 Volumes, UNESCO, Paris.
2. Wanielista, M.P., and Yousef, Y.A. (1993), "*Storm water Management*" John Wiley and Sons, Inc., New York.
3. Hall, M.J., (1984), "*Urban Hydrology*", Elsevier Applied Science Publishers.
4. Stahre, P., Urbonas, B., (1990), "*Stormwater Detention for Drainage, water quality and CSO Management*", Prentice Hall, New Jersey.

CE 5763**RIVER ENGINEERING**

River morphology, Plan form variations and river channel pattern, Characteristics of braided and meandering rivers, River dynamics, River gauging, Sediment transport in rivers, Bed load and suspended load transport for uniform and non-uniform bed material, Total load equations, sediment sampling, Reservoir planning, Reservoir sedimentation, River training works, Principles of stabilisation and rectification of rivers, River bank stability analysis, Design of river training works like groynes, guide banks, gabions, Hydraulic modelling of rivers

READING:

1. Garde, R.J., (2006), "*River Morphology*", New Age International Publishers
2. Garde, R.J. and Ranga Raju, K.G., (2006), "*Mechanics of Sediment Transportation and Alluvial Stream Problems*", Wiley Eastern Limited
3. Julien, Pierre, Y., (2002), "*River Mechanics*", Cambridge University Press
4. Jansen, P.P.H., (1994), "*Principals of River Engineering*", VSSD Publications

CE 5764**LAND AND WATER MANAGEMENT**

Planning of Irrigation Projects, Command Area Development Programmes, Classification of Irrigable Soils, Soil Survey, Soil Management, Soil - Plant - Water Relationships, Irrigation Management, Diagnostic Analysis of Irrigation System, Micro Irrigation, Water Logging, Reclamation, Water Quality for Irrigation, Participatory Irrigation Management, Strategies, Conflict Management, Legal aspects in water sharing and management

READING:

1. Majumdar D.K. (2000), "*Irrigation Water Management*", Prentice Hall of India, N.Delhi
2. Murthy, V.V.N. (1999), "*Land and Water Management Engineering*", Kalyani Publishers, Ludhiana.
3. Scwabe G.O., Fangmeir, D.D. and Elliot W.J.(1996), "*Soil and Water Management Systems*", John Wiley and Sons, N York
4. Michael, B. A.M. (1990), "Irrigation", Vikas Publishing House Pvt. Ltd. N Delhi

CE 5765 APPLICATIONS OF RS & GIS IN WATER RESOURCES AND ENVIRONMENTAL ENGG

Radiation principles, Electromagnetic spectrum, Ideal remote sensing system, Energy interaction, Multi concept of remote sensing, Fundamentals of microwave remote sensing, Basic pattern recognition concepts, Principles of interpretation, Geographic Information Systems, Modeling in GIS, DEM, DTM, path analysis, Introduction to GIS packages, Application of RS and GIS to Water Resources and Environmental Engineering.

READING:

1. Meijerink M J, HAM de Brouwer , C M Mannaerts, C R Velenzuela, (1994), "*Introduction to the Use of Geographical Information Systems for Practical Hydrology*", ITC publication no. 23, UNESCO, Paris
2. Lillesand T M and R W Keifer (1994), "*Remote Sensing and Image Interpretation*", John Wiley & Sons, N York
3. Swain P H and S M Davis (1987), "*Remote Sensing – The Quantitative Approach*", McGraw-Hill Pub. Co. N York
4. Agarwal C S and P K Garg (2000), "*Textbook on Remote Sensing in Natural Resources Monitoring and Management*", Wheeler Publishing , Allahabad.

CE 5766

HYDROLOGIC SYSTEMS MODELLING

Systems Approach, Nature of Problems in Engineering Hydrology, Response Functions of Linear Systems, Derivation of Non Parametric Unit Hydrograph, Rainfall - Runoff Conceptual Models, Continuous hydrologic systems analysis, Discrete hydrologic systems, Concepts of distributed hydrologic modeling, Modeling of hydrologic processes like infiltration, evaporation, evapotranspiration and overland flow, Estimation of Parameters of Flood Routing Models, Flood Forecasting, Drought analysis, Role of remote sensing and GIS in hydrological modeling, Impact of land use changes and climate change on hydrology, Review of commonly used hydrologic models

READING:

1. Chow, V.T., Maidment, D.R., and Mays, L.W., *Applied Hydrology*, McGraw Hill Inc. N York, 2010
2. McCuen R.H., *Hydrologic Analysis and Design*, Prentice Hall Inc. N York, 2005
3. Singh, V.P., *Hydrologic Systems*, Prentice Hall Inc., N York, 1986
4. Mujumdar, P.P. and D. Nagesh Kumar, *Floods in a Changing Climate – Hydrologic Modeling*, Cambridge University Press, New York, 2012

CE 5767

APPLICATIONS OF SOFT COMPUTING TECHNIQUES

Information and uncertainty, Chance versus ambiguity, Classical sets and fuzzy sets, Logic and reasoning, Fuzzy set operations and fuzzy relations, Membership Functions, Fuzzy Systems, Decision Making with Fuzzy Information. Fuzzy Classification and Pattern Recognition, Artificial Neural Networks (ANN), Types of ANN, Learning algorithms, Neuro-Fuzzy Systems, Applications in Civil Engineering.

READING:

1. Haykin (2008), "*Neural Networks: A Comprehensive Foundation*", Prentice Hall India, New Delhi
2. Rajasekaran S., and Vijayalakshmi Pai G.A. (2003), *Nueral Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications*, Prentice-Hall India, New Delhi
3. Jang, J.R., Sun Chuen-tsai, and Mizutani Eiji, (2009), "*Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*", PHI Learning

CE 5768

WATER QUALITY MODELLING

Basic water quality characteristics, Physical, chemical and biological phenomenon, Reaction kinetics, Mathematical models of physical systems, completely and incompletely mixed systems, Natural

transport systems, Transport of contaminants in environment, sources of pollution, water quality modelling in rivers, lakes and groundwater systems

READING:

1. Chin, David A., (2006), "*Water Quality Engineering in Natural Systems*", Wiley – Interscience.
2. Sincero, A.P. and Sincero, G.A. (1999) "*Environmental Engineering - A Design Approach*", Prentice Hall of India, N Delhi
3. Thomann, R.V., Mueller, J.A., (1987), "*Principles of Surface Water Quality Modelling and Control*", Harper and Row Publishers

CE 5769

ISOTOPE HYDROLOGY

Isotopes, their classifications and characteristics, law of radioactivity and radio isotopes and basic principles of absorption and scattering of alpha and beta particles, gamma rays and neutrons, Principles of detection of radioactive and stable isotopes and related Instruments, Environmental isotopes and their variations in nature. Isotope applications to hydrology, Isotopes as tracers. isotopes as sealed sources for soil moisture variation, recharge to ground water, snow melt equivalent and suspended sediment concentration studies, Sediment and ground water dating technique for studying sedimentation in water bodies and dynamics of surface and ground water bodies, Use of isotopes for study of interrelation of hydrologic elements and interconnection of water bodies, Case Studies

READING:

1. Clark, I. And Fritz. P (2000), "*Environmental Isotopes in Hydrogeology*", Lewis Publishers.
2. Mazor, E. (2000), "*Chemical and Isotopic Groundwater Hydrology*", 2nd Edition. Marcel Dekker Inc.
3. Rao, S.M. (2006), "*Practical Isotope Hydrology*", New India Publishing Agency, New Delhi
4. IAEA (1997), "*Stable Isotope Hydrology, Deuterium and Oxygen- 18 in Water Cycle*", IAEA, Vienna, Austria, Technical report series no. 210
5. IAEA (1997), "*Guide Book on Nuclear Techniques in Hydrology*", IAEA, Vienna, Austria Technical Report Series No. 91
6. Gupta, S. K., (2011), "*Modern Hydrology and Sustainable Water Development*", Wiley Blackwell

CE 5770

CLIMATE SYSTEMS

Earth Climate and its historic evolution, climate change and its reasons, Climate classification, composition of the atmosphere, atmospheric thermodynamics and kinetic theory of gases, energy balance, greenhouse effect, transport processes in atmosphere, Reynolds transport theorem, atmospheric pressure and wind, atmospheric water and its circulation, precipitation formation processes, large scale circulations, monsoons, tropical cyclones and other disturbances, land surface atmosphere interaction, surface energy balance, evapotranspiration

READING:

1. Lutgens, Frederick K. , Tarbuck, Edward J. (2010), *The Atmosphere: An Introduction to Meteorology*, PHI Publications
2. C. Donald Athens, (2011), *Essentials of Meteorology*, Thompson Brooks/ Cole, CENGAGE Learning
3. Andrew Gettelman, Richard B. Rood (2016), *Demystifying Climate Models – A Users' Guide to Earth System Models*, Springer Open