S. V. NATIONAL INSTITUTE OF TECHNOLOGY, SURAT

TEACHING SCHEME

FOR

M.TECH (CIVIL) WATER RESOURCES ENGINEERING

MARCH 2013

WATER RESOURCES ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

COURSE DETAILS

1. Name of the Department: Civil Engineering
2. Name of the course   :   Post Graduate Program
     (Water Resources Engineering)

Title of Degree	Specialization,	Intake (Full time)	Entry Level Qualification
M.Tech. CIVIL Engineering (Water Resources Engineering)	Water Resources Engineering	25	B.E./ B.Tech. and equivalent (Civil/B-Tech in Water & Irrigation Management /Agriculture Engineering)

3. Course Structure and Scheme of Evaluation (Semester-wise, along with curriculum details)

Sr. No.	Course	Code	Teaching Scheme Hours per week			Credit	Examination Scheme			Total Marks
			L	Tu	P		Theory	Tutorial	Practical	
1	Advanced Fluid Mechanics	CE 661	3	1	0	4	100	25 (10+15) * **	-	125
2	Free Surface Flow	CE 663	3	1	0	4	100	25 (10+15) * **	-	125
3	Advance Hydrologic Analysis and design	CE 665	3	1	0	4	100	25 (10+15) * **		125
4	Computational Techniques in Water Resources Engineering	CE 667	3	0	2	4	100	-	50 (20+30) * **	150
5	Elective I		3	-	-	3	100		-	100
6	Hydraulic Engineering Laboratory-I	CE 675	0	0	3	2	-	-	75 (30+45) * **	75
7	Seminar/G.R.	CE677			2	1			50 (20+30) * **	50
		Total	15	3	7	22	500	75	175	750

List of Elective I

CE 669	Flood Control and River Training Works
CE 679	Computational Hydraulics
CE 671	Irrigation and Drainage Systems Engineering
CE 673	Integrated Watershed Management
CE 681	Basics of Climate Change Studies

Total Contact Hours/week = 25   Total   Credits = 22

*   Internal Evaluation

** External Evaluation

Sr. No.	Course	Code	Teaching Scheme Hours per week			Credit	Examination Scheme			Total Marks
			L	Tu	P		Theory	Tutorial	Practical	
1	Advanced Hydraulic Structures	CE 662	3	1	-	4	100	25 (10+15) * **	-	125
2	Hydraulics of Alluvial Rivers	CE 664	3	1	0	4	100	25 (10+15) * **	-	125
3	Geospatial Technologies in Water Resources Engineering	CE 666	3		2	4	100	-	50 (20+30) * **	150
4	Water Resources Systems	CE 668	3	1	-	4	100	25 (10+15) * **	-	125
5	Elective II		3		-	3	100		-	100
6	Hydraulic Engineering Lab- II	CE 682	0	0	3	2	-	-	75 (30+45) * **	75
7	Seminar/G.R	CE 684			2	1			50	50
		Total	15	3	7	22	500	75	175	750

Total Contact Hours/week = 25   Total   Credits = 22

Elective II
CE 672   Water Supply Distribution Systems
CE 674   Hydro Power Engineering
CE 676   Ground Water engineering
CE 678   Coastal Engineering
CE 682   Stochastic Hydrology

*   Internal Evaluation

** External Evaluation

Sr. No.	Course	Code	Teaching Scheme Hours per week			Credit	Examination Scheme			Total Marks
			L	Tu	P		Theory	Internal	Practical	
1	Seminar	CE 841	-	-	4	1	-	20	30	50
2	Dissertation (Preliminary)	CE 843	-	-	8	4	-	80 *	120 **	200
3	Professional Project	CE 845			6	3		50 *	100 **	150
		Total			18	8		150	250	400

Total Contact Hours/week = 16   Total   Credits = 8

* Internal Evaluation

** External Evaluation

Sr. No.	Course	Code	Teaching Scheme Hours per week			Credit	Examination Scheme			Total Marks
			L	Tu	P		Theory	Internal	Practical	
1	Dissertation	CE 842	-	-	20	10	-	160	240	400
		Total			20	10	-	-	-	400

Total Credits for M.Tech.:

* Internal Evaluation
** External Evaluation

TOTAL CREDIT :22+22+08+10 = 62
TOTAL HOURS : 25+25+18+20 = 88

CE 661	**Advanced Fluid Mechanics**	**3 1 0 4**

Ideal fluid motion

Review of Fluid mechanics, Kinematics of fluid flow, rotational and irrotational fluid flow, elements of particle motion, stream functions and potential functions, Laplace's equation, flow nets, dynamics of fluid flow, Euler's equation in Cartesian, polar, and vector coordinates, application of ideal fluid motion, Two-dimensional flow, Uniform flow, Source and Sink, Free vortex flow, Source and Uniform flow (Flow past a half body), Superimposed flow patterns, Source-Sink pair, Source and Sink pair in a uniform flow, Doublet, Flow past a Rankine oval body (Source, Sink and a Uniform flow),Flow past a Cylinder (Doublet and Uniform flow), Magnus effect, Kutta Joukowski transformation , Method of images

Laminar Flow

Concept and characteristics of laminar flow, Navier-Stokes equations, creeping motion, approximate and exact solutions.

Transition from laminar to turbulent flow

Concept of stability, stability theories, experimental verification, Rouse Index, factors affecting transition.

Turbulent flow

 Classification and characteristics of turbulent flows, Continuity equation, Reynolds equations, Reynolds Average N-S (RANS) Equation, Statistical theories of turbulence, Flow between parallel plates and in a pipe, turbulence models, Coherent Structures and Turbulent bursting.

Laminar and Turbulent boundary flows

Boundary layer concepts, order of magnitude analysis, Boundary layer parameters, Prandtl's boundary layer equations, Blassius solution for laminar boundary layer flows, von-Karman Momentum integral equation, Laminar boundary layer, Turbulent boundary layer flows, Laminar sub layer, Boundary layer separation and controls.

Flow around immersed bodies: Drag and Lift

Introduction, Drag and lift for shear flow, Streamlined and bluff bodies, Drag on a flat plate, Drag & Lift For Shear Flow, Drag on a sphere, Drag and lift on an Airfoil, , Circulation and Lift on a circular cylinder, circulation and lift on an Airfoil, Shear induced Magnus lift.

Transient flow in pipes

Transient flow concept, classification of flow, oscillation of liquid in U tube, water hammer analysis, transient flow equations, effects of air entrainment, causes of transients, role of valving, column separation, gas release methods of controlling transits.

RECOMMENDED BOOKS:

1. Daily J.W. and Harlaman, D R F Fluid Dynamics , Addision Weasly,1966
2. Garde R. J, Turbulent flows, Wiley, 1994
3. Narasimhan S., Engineering Fluid Mechanics, Vol. I, Orient Longman Ltd , 1975
4. Rouse H., Fluid Mechanics for Hydraulic Engineers , Dover Pub., New york, 1961
5. Schlisting H,Gersten K.,Boundary layer theory,8th edition, Springer Publication,2000
6. Streeter S.V.L, Fluid Dynamics, McGraw Hill,2006
7. Yuan S. W., Foundations of Fluid Mechanics, Prentice – Hall India Pvt. Ltd., New Delhi, 1969.

Basic Principles

Review of free surface flow concepts including velocity and pressure distribution, Continuity, Momentum and Energy equation, concept of specific energy, computation of critical flow, channel transitions, critical flow venturi-flume, standing wave flume and broad crested weir in discharge measurement.

Gradually Varied Flow

Gradually varied profile and its computations using direct step method, advanced numerical methods, delivery of canal systems.

Rapid Varied Flow

Hydraulic jump in horizontal and sloped open channel bed and its characteristics

Unsteady open channel flow

Wave celerity, classification of water waves according to relative depth, orbital motions, superposition, wave trains and wave energy, transformation of waves, dissipation of wave energy, positive and negative surges in rectangular channel, Momentum and Continuity equations (Saint Venant Equation), two dimensional unsteady flows and their solution by numerical techniques.

Spatially varied flow

Basic principles and assumptions, dynamic equation and analysis of flow profiles, Numerical integration method, Isoclinal method, spatially varied steady and unsteady surface flows.

Introduction to Hydrodynamic and Pollutant transfer in open channel

RECOMMENDED BOOKS:

1. Chaudhary Hanif M., Open Channelflow, Prantice-Hall of India Pvt. Ltd. New Delhi, 1993.
2. Chow V T, Open Channel Hydraulics, McGraw-Hill Book company, International editions,New Delhi,1973.
3. Subrmanya K, Flow in open channels, Second edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001
4. Srivastava Rajesh, Flow through open channels, Oxford University press, New Delhi, 2008.
5. French , R H, Open channel hydraulics, McGrawhill Publication, New York, 1985.
6. Ranga Raju K.G.,Flow through Open Channels, TATA MC Graw-Graw-Hill Publishing Company Limited, 1997.

CE 665	**Advanced Hydrologic Analysis and Design**	**3 1 0 4**

Mechanism and Measurements of Precipitation and Evaporation
Hydrological processes, Mechanism, Atmospheric water vapour, Green house effect, computation and measurement of precipitation, evaporation, evapotranspiration, abstraction from precipitation., spatial and temporal distribution of rainfall.

Flow through Unsaturated Porous Media
 Unsaturated flow models- Horton's equation, Philips equation and Green-Ampt model Computation of excess rainfall hyetograph from observed flood hydrograph, Green-Ampt infiltration equation and SCS method.

Unit Hydrograph Theory
Unit hydrograph theory, derivation of instantaneous unit hydrograph and synthetic unit hydrograph.

Project hydrology
Design flood PMF storm transportation, PMP and PMF for project by using conceptual models.

Flood Routing
Lumped flow routing, distributed flow routing models including kinematic, diffusion and dynamic wave routing models.

Hydrologic Statistics
Hydrologic statistics, Flood forecasting and flood frequency analysis.

Hydrologic Design
Storm Water Drainage Design
Introduction glacier lake outburst flood (GLOAF)

RECOMMENDED BOOKS:
1. Chow V T, Maidment David R. and Mays Larry W. "Applied Hydrology", McGraw Hill International editions, New Delhi, 1988.
2. Mutreja K.N. "Applied Hydrology" Tata McGraw-Hill Publishing company Ltd., New Delhi,1990.
3. Subramanya K, Engineering Hydrology, Third Edition - Tata McGraw-Hill Publishing company Ltd., New Delhi, 2012.
4. Singh Vijay. P, Elementary Hydrology   Prentice Hall, INDIA,1992.
5. Ojha C S P, Bhunya P and Berndtsson P, "Engineering Hydrology" Oxford University Press, Canada, 2008.

CE 667	<u>**Computational Techniques in Water Resources Engineering**</u>	<u>**3 0 2 4**</u>

Introduction

Introduction to computational Techniques – Database design – Spreadsheet- Usefulness in Water Resources Engineering

Statistical Techniques

Presentation of data – Measures of location and dispersion, - Probability concepts and distribution – Tests of significance – Correlation and Regression, Selection of Suitable technique, error analysis

Numerical Methods

Finite difference schemes – Method of characteristics – Finite element method

Advanced Techniques

Genetic algorithm - Artificial Neural Network - Fuzzy logic – Other data driven methods

Hydro informatics

Introduction – Virtual institute – Web based hydro informatics system

Applications

Application with case studies, Selection of suitable technique, Different types of hydraulic engineering software - Salient features – Capabilities and Limitations

RECOMMENDED BOOKS:

1. Abbott M.B., Hydroinformatics – Information Technology and the Aquatic Environment, Avebury Technical, Aldershot, 1991.

2. Adeli H. and Hung S., Machine Learning – Neural Networks, Genetic Algorithms and Fuzzy Systems, John Wiley, New York, 1995.

3. Chaudhry M.H., Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 1994.

4. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.,2001

5. Govindaraju, R. S. and Rao, A. R. (eds.). Artificial Neural Networks in Hydrology, Kluwer Academic Publishers, Dordrecht, 2000.

6. Rajsekaron S. and Pai G.A. Vijayalakshmi, Neural Networks, Fuzzy Logic and Genetic Algorithams-Synthesis and Applications, PHI Learning Pvt. Ltd., New Delhi, 2010

CE 669	Flood Control and River Training Works	3 0 0 3

Morphology and Hydraulics of Alluvial River

Alluvial streams and their hydraulic geometry, bed level variation of alluvial streams, variation in plan form of alluvial streams, Analytical models of river morphology, Numerical models for morphological studies, flood plain analysis, morphology of some Indian rivers

Flood Control and its Assessment

Types of Floods, Different methods of Flood control, Floods in major Indian river basins, Types and design of flood forecasting and protection systems,Comparison of levees with bypass channels and off stream storage, reservoir operation for flood control and management, flood damage estimation models.

River Training and Flood Protection Work

Guide lines for planning and design of river embankments (levees), Planning, design, construction and maintenance of guide banks and groynes for alluvial rivers, Application of Geo-synthetics and other materials in river training works.

RECOMMENDED BOOKS

1. Chow V T, Maidment David R and Mays Larry W, Applied Hydrology, McGraw-Hill Book Company, New Delhi, 1988.
2. Garde R J and Ranga Raju K G , Mechanics of sediment transportation and alluvial streams problems, New age International (P) Limited, Publishers, New Delhi, 2000.
3. Garde R J , River Morphology, New Age International Publishers, New Delhi, 2006
4. Mays Larry W., Hydraulic Design Handbook, Mc Graw Hill Companies, New Delhi, 1999.
5. BIS 10751(1994), 12094 (2000), 12926 (1995), 8408 (1994)
6. Singh Vijay. P, "Elementary Hydrology " , Prentice Hall, INDIA.,1992
7. Mutreja K.N. ,"Applied Hydrology", Tata McGraw-Hill Publishing company Ltd., New Delhi, 1990.

CE 670   **Computational Hydraulics**   **3 0 0 3**

Basic concepts on fluid motion

Basic Concepts – Lagrangian and Eulerian methods of describing fluid motion, acceleration and deformation of fluid elements, Laws governing fluid motion, continuity, Euler's equation, Energy equation,Saint Venant equation, classification of partial differential equations.

Numerical techniques for solution of differential equations

Review of linear algebra, solution of simultaneous linear algebraic equations-matrix inversion, solvers-direct methods, elimination methods, ill conditioned systems, Gauss-Seidel method, successive over relaxation method. Finite difference, finite element and finite volume methods.

Engineering applications

Application to water resources problems in open channel flows, Pressure Flow , ground water flows, and unsaturated flows through porous media.

RECOMMENDED BOOKS:

1. Gerald, C.F., and Wheatley, P.O., Applied Numerical Analysis, Addison Wesley Publishing Company, NY, 1994.
2. Choudhary, M.H., Open Channel Flows, Prentice Hall of India, 1994.
3. Abbott, M.B., Computational Hydraulics, Pitman Publishing House, 1979.
4. Cunge J.A., Holly, F.M., Verway, A., Practical Aspects of Computational Rive Hydraulics, Pitman Publishing House, 1980.
5. Pinder, G., and Gray, W.G., Finite Element Simulation in Surface and Subsurface Hydrology, Academic Press, NY, 1997.

CE 671   **Irrigation and Drainage Systems Engineering**   **3 0 0 3**

Introduction

Available water resources and its present utilization, Development through five year plans, Roles of various commissions on irrigation and agriculture, National water policy for development, Types of irrigation, Irrigation techniques and quality of irrigation water.

Soil Water Crop Relationship

Determination of soil moisture, estimation of consumptive use and frequency of irrigation, irrigation efficiencies for economical use of water, design of various irrigation methods, assessment water charges, conjunctive use of surface and ground water, multi-crop irrigation scheduling

Modeling of Irrigation Systems

Governing equations and their solutions, computation of inundation front, cumulative infiltration estimation, modeling for sprinklers and other methods of irrigation.

Salt affected land and their reclamation

Salt accumulation in soil water, classification of salts affecting the soils and their characteristics, reclamation of saline and alkaline soils, leaching and salinity control.

Drainage of irrigated soils

Need and purpose of drainage, water logging of agricultural lands and its reclamation, steady state and transient designs of surface and sub-surface drainage systems, drainage by wells.

Soil Erosion and Conservation

Water and wind erosion, design of various types of soil conservation measures.

RECOMMENDED BOOKS

1. Asawa G L, Irrigation and Water Resources Engineering, New Age International Publishers, New Delhi, 2005.

2. Dan Yaron, Salinity in irrigation and water resources, Morcel Dekker Inc. Newyork., 1981

3. Michael A M, Irrigation theory and practices, Vikas Publishing House, New Delhi, 1993.

4. Richard H Cuenca, Irrigation system design – An Engineering Approach, Prentice Hall, Englewood Cliffs, New Jercy, 1989.

5. Dilipkumar Mujumdar, Irrigation Water Management Principles and Practice, PHI Publication New Delhi, 2004.

CE 673   **Integrated Watershed Management**   **3 0 0 3**

Principles of watershed management through distributed hydrological modeling, soil water conservation practices, integrated planning, multidisciplinary approach, management of agricultural land, structural and non structural measures, erosion and soil salinity problems and controlling techniques, gully control, landslide and correction techniques, watershed modeling Preparation of land drainage scheme, types and design of surface drainage as well as subsurface drainage in coastal and interior basins, types and design of water conservation and Catchment Area Treatment Plant for different types of catchments

RECOMMENDED BOOKS:

1. FAO "Watershed management and Field manuals", UN, Rome, 1988.
2. Tideman, E. M., "Watershed Management – Guidelines for Indian conditions", Omega Scientific Publishers, New Delhi, 1996.
3. Sudha V.Menon, Watershed Management: Case Studies, ICFAI University Press, 2008
4. Dr. J.V.S. Murthy, Watershed Management, New Age International (P) Limited Publishers, New Delhi, Reprint 2004

CE 681   **Basics of Climate Change Studies**   **3 0 0 3**

Introduction to hydrological cycle, green house effect, impacts of climate change.

Basics of Climate change study: Climate, weather and Climate Change; Overview of Earth's Atmosphere; Layers of Atmosphere; Temperature, Radiation and Variation; Heat-Balance of Earth Atmosphere System; Temporal Variation of Air temperature; Temperature Change in Soil; Thermal Time and Temperature Extremes, Hydrologic cycle.

Climate Variability: Floods, Droughts, Drought Indicators, Heat waves, Climate Extremes.

Climate Change: Introduction; Causes of Climate Change; Modeling of Climate Change, Global Climate Models, General Circulation Models, Downscaling; IPCC Scenarios, difference between climate change and climate variability.

Statistical Methods in Hydro-climatology: Trend Analysis; Empirical Orthogonal Functions, Principal Component Analysis; Canonical Correlation; Statistical Downscaling with Regression

Ecological Climatology: Leaf energy fluxes and leaf photosynthesis; Plant canopies, ecosystem and vegetation dynamics; Coupled climate vegetation dynamics, Carbon cycle, Introduction to Precipitation Recycling.

Recommended Books:
1. Bonan G. B. ,Ecological Climatology, Cambridge University Press, 2002
2. Burde, G. I., A. Zangvil, 2001: The Estimation of Regional Precipitation Recycling. Part I: Review of Recycling Models. *J. Climate*, **14**, 2497–2508.
3. Campbell, G. G. and Norman J. M., An Introduction to Environmental Biophysics, Springer, 1998
4. H.von storch, A.Navarra, Analysis of Climate Variability, 2nd Edition Springer-Verlag Berlin Heidelberg New York 1999
5. Von Storch and Zwiers F W, Statistical Analysis in Climatic Research, Cambridge, 1999
6. McGuffie, K. and Henderson-Sellers, A Climate Modeling Primer, Wily, 2005
7. IPCC Assessment Report

Experiments related to the following aspects of Hydraulic Engineering:

1. Measurement of velocity distribution in open channel using Pitot tube, current meter and ADV, plotting of isovels and computation of α and β.

2. Establishment of subcritical, critical and supercritical flows in open channel, plotting of specific energy diagram

3. Characteristics of hydraulic jump in open channel.

4. Measurement and computation of Gradually Varied flow profiles in open channel

5. Measurement of development of boundary layer thickness on flat plate

6. Measurement of drag and lift force coefficient for cylinder and spheres

7. Rainfall and Runoff characteristics using Rainfall Simulator.

8. Infiltrometer to study infiltration capacity of different type of soil

9. Cavitation Demonstration and Analysis

| **CE 677** | **Seminar/G.R.** | **0 0 2 1** |

Graduate reports on three specific topics based on subjects of the semester are to be prepared in consultation with the faculty advisor and to be submitted in duplicate typed on A4 sheet. One of the report is to be presented on scheduled date. Minimum one expert lecture be arranged on specific relevant topic by expert from academic institute, industry or relevant field.

Graduate reports are assessed by the P.G. Section at Departmental Level.

CE 662	**Advanced Hydraulic Structures**	3 1 0 4

Planning of Water Resources Engineering Project
Planning and investigations of reservoir and dam sites, Choice of dams, preparation and protection of foundation and abutments.

Gravity Dam
Forces acting on solid gravity dam, modes of failures, stability analysis, elementary and practical profile of gravity dam, internal stresses and stress concentrations in gravity dam, joints, seals, keys in gravity dams, dam safety and hazard mitigation

Embankment Dam
Homogeneous and zoned embankment dams, factors influencing design of embankment dams, criteria for safe design of embankment dam, steps in design of embankment dam, seepage analysis and its control through body and dam foundation, classification of rock fill dams and their design considerations.

Spillways and Energy Dissipaters
Capacity of spillways, components and profile of different types spillways, Non conventional type of spillways, selection and design of energy dissipaters

Diversion Hedworks
Components of diversion head works and their functions, design of weirs and barrages on permeable foundations

Canal Structures
Canal regulation structures and design of cross drainage works, canal drops, operation and maintenance of canals.

Review of codes of practice

RECOMMENDED BOOKS:

1. USBR, Design of gravity dams, A Water Resources Technical Publication, Denver, Colorado, 1976
2. USBR, Design of small dams, A water resources technical publication, Oxford and IBH publishing co., New Delhi, 1974
3. Creager W P, Justin J D and Hinds J., Engineering for dams, Nemchand and Brothers, Roorkee, 1995
4. Khatsuria R M, Hydraulics of spillways and energy dissipaters, CRC Press, 2005
5. Novak P, Hydraulic Structures, Taylor and Francis Group publishers, 2001

CE 664   **Hydraulics of Alluvial Rivers**   <u>3 1 0 4</u>

Introduction, Origin, Properties and Incipient Motion of Sediment Particles

Nature of sediment problems, Origin and formation of sediments, individual and bulk properties of sediments, competent velocity, lift force and critical tractive stress concept on cohesion less and cohesive soils; regimes of flow; Resistance to flow in alluvial streams, resistance relations based on total resistance and division of resistance into grain and form resistance, preparation of stage discharge curves for alluvial streams, velocity distribution in alluvial channel, sediment Petrography (Sediment sampling)

Bed Load Transportation and Saltation

Bed load computation by empirical equations, dimensional considerations and semi theoretical equations for uniform and non-uniform sediments, saltation.

Suspended Load Transportation

Mechanism of suspension, general equations of diffusion. Integration of sediment distribution equation, Differences between actual and theoretical exponents, prediction of reference concentration, Method of integrating curves of concentration and velocity. Simple relations for suspended load, Effect of temperature on suspended load, Wash load, Non equilibrium transport of suspended load.

Total Load Transportation

Microscopic, macroscopic methods. Approximate methods of total load determination, sediment yield from catchments.

Sediment Samplers and Sampling

Bed load and suspended load sampling and computation of total load, Bed mjaterial sampling, Sediment spectrography

Alluvial River Models

Hydraulic geometry of alluvial streams, bed level variation of alluvial streams, aggradations and degradation models, reservoir sedimentation, local scours.

RECOMMENDED BOOKS:

1. Hsieh Wen Shen , River Mechanics, Vol. I & II, H.W.Shen, Colorado,USA, 1971.
2. Garde R. J. and Ranga Raju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi, 2000.
3. Garde R. J., River morphology, New Age International Publisher, New Delhi-110042, 2006.
4. Raudkivi, A. J., Loose boundary hydraulics, Pergamon Press, Oxford (U. K.), 2nd edition, 1976.
5. Yalin, M. S. ,Mechanics of sediment transport, Pergamon Press, Oxford (U K),1971.

CE 666	**Geospatial Technologies in Water Resources Engineering**	**3 0 2 4**

Introduction

Introduction to Geospatial Technologies – Usefulness in Water Resources Engineering

Remote Sensing

Fundamentals of remote sensing - Interpretation - Equipments - Techniques of data acquisition – Satellites and sensors – Digital Image processing

GPS

Introduction to GPS - Working principle of GPS - Measurement and mapping techniques.

GIS

Introduction - Geo referenced data - Data input & output - Data quality and management - GIS analysis functions - Implementation of GIS

Geospatial Analysis

Methods -Measurements - Analysis – GEO visualization

Software

Different geospatial technology software - Salient features – Capabilities and Limitations

Applications

Application of Remote Sensing / GPS / GIS in Water resources Engineering - Case studies, Introduction to Water Resource Information System (WARIS)

RECOMMENDED BOOKS:

1. Agrawal N.K., Essentials of GPS, Spatial Network Pvt. Ltd., Hydrabad, 2004.
2. Bhatta B., Remote Sensing and GIS, Oxford University Press, New Delhi, 2008
3. Lillesand T.M. and Kiefer R. W., Remote Sensing and Image Interpretation, John Willey & Sons, New York, 2004.
4. Stan Aronoff, Geographical Information Systems, WDL Publications, Ottawa, Canada, 1989.
5. Manual of Remote Sensing (Edited), Series of volumes.
6. Lo C.P. and Yeung Albert K.W., Concepts and Techniques of Geographical Information Systems, Prentice-Hall of India Pvt. Ltd. New Delhi, 2006

CE 668   <u>Water Resources Systems</u>   <u>3 1 0 4</u>

Introduction
Introduction to water resources system.

Economics of water resources systems
Principles of Engineering Economics -Equivalence of Kind, Equivalence of Time, Whose Viewpoint, Sunk Cost, Incremental Cost, Intangible Values, Predictive Uncertainty, Planning Alternatives, Objectives of water resources development, Economic Analysis and Discounting Techniques ,Conditions of Project Optimality

Conventional Optimization techniques
Linear programming by graphical, simplex and Karmarkar algorithms, Dynamic programming and stochastic optimization techniques.

Soft computing in optimization
Optimization using fuzzy sets and fuzzy logics, Genetic Algorithm and Artificial Neural Network.

Simulation of water resources system,
System Concept, Parts of the water resources system and its functioning , Calibration of system, Validation of system , Operation of system based on if _ then rules, case studies on reservoir simulation for conflicting objectives, Mathematical models for large scale multi-purpose projects.

Application of optimization techniques to water resources engineering systems
Applications of various optimization techniques to water resources engineering problems, water quality subsystem, optimum operation model for reservoir systems by incremental dynamic programming, sequence of multipurpose projects.

RECOMMENDED BOOKS :

1. Arthur Mass et al, Design of Water Resources Systems, Macmillan,1970.

2. Alvin.S. Goodman, Principles of Water Resources Planning, Prentice Hall, Englewood Cliffs, New Jercey,1984

3. James L. D. and Lee R. R., Economic of Water Resources Planning, McGraw Hill, 1971.

4. Vedula S. and Mujumdar P. P., Water Resources System, Tata McGraw Hill Companies, 2005.

5. W. A. Hall and J. A. Dracup, Water Resources Systems Engineering, McGraw Hill , 1970.

6. Mays L.W., Water Resources System Engineering, John Wiley and Sons, New York,2001.

7. Daniel P. Loucks and Eelco van Beek, Water Resources Systems Planning and Management :An Introduction to Methods, Models and Applications, Prantice Hall India Private Ltd, New Delhi, 1981

8. Kalyanmoy Deb, Optimization for Engineering Design, Algorithm and Examples, Prantice Hall India Private Ltd, New Delhi ,2005

9. Kalyanmoy Deb, Multi objective optimization using Evolutionary Algorithms,Optimization, John Willey and Sons,Chicester, U.K.,2001

10. M.C.Chaturvedi ,Water Resources System Planning and Management, Tata McGraw Hill Publishing Company,1987

11. Goldberg .D.E , Genetic Algorithm in Search, Optimization and Machine learning Technique, Addison Wesley, Reading Mass,1989

CE 672   <u>**Water Supply Distribution Systems**</u>   <u>**3 0 0 3**</u>

Introduction

Introduction to Intake structure, Hydraulics of water treatment processes.

Type of distribution systems

Eequivalent pipe, parameters in distribution system analysis, parameters interrelationship, formulation of equation. Gravity and Rising main, location and design principles.

Analysis of water distribution system

Methods of analysis : (i) Hardy – Cross method (ii) Newton Raphson method and (iii) Linear theory method.

Design and optimization of water distribution system

Design: Trial and error method of design, cost- head loss ratio method. Optimization using linear programming techniques. Surge analysis in water distribution systems, Pump duty stations and detailing valves, Pressure transients in pipe flow.

RECOMMENDED BOOKS :

1. Bhave P R, Analysis of Flow in Water Distribution Network, Technomic Publishing Co., Lancaster, USA, 1996
2. Bhave P R , Optimal Design Of Water Distribution Networks, Narosa publishing house, New Delhi., 2003
3. Streter V L and Wylie E D, Fluid Transients , McGraw Hill Book Co., 2006
4. Pramod R. Bhave and Rajesh Gupta, "Analysis of Water Distribution Networks" Published by Narosa Publishing House, New Delhi and Alpha-Science Publication, UK.

Introduction
Energy sources for power generation, Power scenarios, Demand and supply of power, need of hydropower, General Hydrology, Environment and Hydro Power Development.

Power potential studies
Estimation of available water power, Power duration curve, Storage and pondage, Load studies, Technical terms related to hydropower, System integrated operational studies, Load prediction, Installed capacity, Size and number of units.

Water availability and project hydrology
Introduction, objectives of planning, Planning for water power development, Economics of hydropower development, Economic value of hydropower, Cost of water power, Total annual cost of a hydro project, Operation and maintenance of hydro plants.

Classification and types of hydropower plant
Classifications, types, Storage power development ,components of storage power development, economic aspects, social and rehabilitation aspects, Run-Off-River power development, types of ROR, components of run-off-river power development, Run-of-power development on canal falls, Underground and pumped storage power plants , advantages, types and location of underground power station, its components, types of layout, limitations of underground power plants. Essential requirements of pumped storage power plant (PSPP), economics of PSPP, Cost of power generated, Canal head power plant

Topographical Survey and Geo logical/Geo technical Investigation
Geological investigations studies for water power development, Geo technical investigations studies for water power development.

Small Hydro Power Development
Introduction, Advantages of small hydropower, Classification of small hydropower, Components of small hydropower development, Choice of units, Economics of small hydropower schemes.

Water Conveyance System
Intakes: Types, Location and Alignment of intakes, Losses in Intakes, Air- Entrainment at Intakes, Inlet aeration, Trash racks, Penstocks and Pressure Shafts, Surge shafts Hydraulic Valves and Gates

Power House Planning
General layout of the power house and arrangement of hydropower units, Number and sizes of units, space allocation and dimensions, Super structure, Indoor, Semi-outdoor and Outdoor powerhouse, Lighting and Ventilation, Variation in design of power house, Safety requirements, Operation and maintenance of hydro plants.

BOOKS RECOMMENDED
1.   Barrows H. K., Water Power Engineering, McGraw Hill Book Co., New York.,1943

2.   Dandekar and Sharma, Water Power Engineering, Vikas Publishing House, New Delhi,1996

3.   Deshmukh M.M., Water Power Engineering, Dhanpat Rai Publications, New Delhi, 1998.

4.   Nigam N C Handbook of hydro-power engineering, publishers Nem Chand and sons, Roorkee, 1999

5.   R.K.Sharma AND T.K.Sharma, Water Power Engineering S.CHAND & Company, New Delhi, 2003.

6.   Varshney R.S, Hydropower Structures, Nem chand and Bros., Roorkee (U.P.), 1992.

7.   Guthrie   Brown,Hydropower   Electric   Engineering,Blacki   and Son,London,1958

CE 676   **Groundwater Engineering**   **3 0 0 3**

Introduction

Occurrence of ground water, geological formations as aquifers; types of aquifers, ground water movement, Darcy's law, permeability and its measurement, tracing of ground water movement, fundamental equations for steady and unsteady ground water flow, flow nets.

Well hydraulics

Steady and unsteady flow in confined, semi-confined and unconfined aquifers, radial flow, superposition; multiple well system. Different methods of well construction; construction of well casings and screens, natural and artificial gravel packed wells. Safe yields, estimation, pumping and recuperation tests, Infiltration galleries,

Artificial recharge of ground water

Ground-water replenishment, Artificial recharge of ground water, different methods, merits, demerits , selection criteria for various methods, cone of depression

Groundwater modeling techniques

Porous media models, analog models, electric analog models, digital computer models

Salt water intrusion

Concept, interface and its location, control of intrusion.

Transport of pollutants in Ground Water

Polluant transport, Plume Transport, source identification, tracer methods.

RECOMMENDED BOOKS :

1. David Keith Todd, Groundwater Hydrology , John Wiley publishers , 2004
2. Jacob and Bear, Hydraulics of Groundwater, McGraw Hill, 1997
3. Mutreja K.N., Applied Hydrology, Tata McGraw-Hill Publishing company Ltd., New Delhi, 1990
4. Raghunath, Groundwater & Well Hydraulics, Wiley Eastern Ltd, New Delhi, 1992
5. Singh Vijay. P, Elementary Hydrology, Prentice Hall, INDIA,1992

Motion parameters – wind, tide, currant and data collection and analysis

Formulation of wave motion problem, assumption made in two dimensional cases, small amplitude wave theory, orbital motion and pressure, wave energy, finite amplitude wave theory, Stokes's wave theory (third order), mass transport, Gerstner theory, solitary wave theory, generation of waves, wave forecasting, decay of waves.

Reflection of waves, clapotis or standing waves, superposition of waves, refraction, refraction diagrams, wave fronts and orthogonal methods, diffraction of waves around semi infinite break waters, detached break water of finite length, diffraction through openings.

Forces on vertical walls due to non breaking waves, breaking waves and broken waves base on linear theory, forces on circular cylinders.

Long term and short term changes of shores, factors influencing beach characteristics , beach wave interaction, beach profile modification , littoral drift, stability of shores, shore erosion due to sea level, on shore and off shore transport, long shore transport, interaction of shore structures, shore erosion, mud banks.

Coastal structures, description and effects of break waters, sea walls, groynes of various types, beach nourishment, design of sea walls, break waters, tetra pod, tribar etc.

Harbour types and features, ship Features related to port planning, site investigation & selection, port layout, on-shore and offshore structures, cargo handling equipments, Navigational aids.

Causes and occurrences of Tsunami and storms.

RECOMMENDED BOOKS :

1. Arthar, T. Ippen, Estuary and coastline hydrodynamics , McGraw Hill Book Co.(1964)
2. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structures, McGraw Hill Book Company.(1972).
3. Henry F. Cornik, Dock and Harbour Engineering Vol.–I to IV, Charles Griffin & Company Ltd., London.(1988)
4. Robert, L. Weigel, Oceanographical Engineering, Prentice Hall Inc.(1964)
5. Robert M.Sorensen, Basic Coastal Engineering , Springer, (2006)

Fundamental of Statistics

Concept of Probability, discrete and continuous variables, Probability distributions including fitting to hydrological data.

Time series Analysis

Definitions and classification of Time Series and Stochastic processes, Trend analysis, periodicity, Auto-correlation and spectral analysis.

Stochastic Models

Univariate models: classification of models, univariate annual models with normal and nonnormal distributions, univariate annual models obeying Hurst's law, univariate seasonal models.

Multivariate models: Multisite Annual Models, Multisite AR models for seasonal flows

Case Studies

Examples related to fitting probability distributions, trend analysis, stochastic models in hydrologic forecasting

RECOMMENDED BOOKS:

1. Jayarami Reddy P, Stochastic hydrology, Laxmi Publication, New Delhi, 1997.

2. Kottegoda N T, Stochastic Water Resources Technology, The MACMILAN PRESS LTD, 1980.

3. Ven Te Chow, Editor, Handbook of Applied Hydrology, McGraw-Hill, New York, 1964.

4. V. Yevjevich, Stochastic Process in Hydrology, Water Resources Publications, Fort Collins, Colorado,1972.

5. Hann, C.T., Statistical Methods in Hydrology, First East-West Press Edition, New Delhi, 1995.

1. Study of submergence characteristics and measurement of discharge using critical flow Venturi-flume.

2. Study of submergence characteristics and measurement of discharge using broad crested weir.

3. Incipient motion of sediments in mobile boundary channel

4. Flow through porous media using ground water flow unit.

5. Measurements of bed shear stress by Preston tube

6. Seepage analysis of earthen dam using Electrical analogy

7. Water Hammer pressure analysis

8. Measurement of soil moisture using Tensiometer

9. Analysis of Surge Tank

10. Hele-Shaw apparatus to study fresh water – soil water interface

| **CE 684** | **Seminar/G.R.** | **0 0 2 1** |

Graduate reports on three specific topics based on the subjects of the semester are to be prepared in consultation with the faculty advisor and to be submitted in duplicate typed on A4 sheet. One of the report is to be presented on scheduled date. Minimum one expert lecture be arranged on specific relevant topic by expert from academic institute, industry or relevant field.

Graduate reports are assessed by the P.G. Section at Departmental Level.

CE 841	**SEMINAR / G.R.**	**0 0 4 2**

Graduate reports on four specific topics are to be prepared in consultation with the faculty advisor and to be submitted in duplicate typed on A4 sheet. Two reports are to be presented on scheduled date. Minimum two expert lectures be arranged on specific relevant topic by expert from academic institute, industry or relevant field.

Graduate reports are assessed by the P.G. Section at Departmental Level

CE 854	Professional Project	0 0 6 3

Design project on specific topic is to be prepared in consultation with faculty advisor and is

required to be submitted in duplicate typed on A4 sheet. It is to be assessed by P.G. Center.

The students may be allowed to depute for Internship in any nearby IIT, Industry or relevant laboratory/ industry /institution, if Institute Rules permits, by approval of competent authority

Dissertation Preliminaries should clearly identify the goals/objectives and scope of the dissertation work taken up by the student. Details of data identification and field surveys should be clearly highlighted. The study approach and literature review should be discussed. A report shall be submitted at the end of the semester, which shall be assessed.

CE 842 **Dissertation** **0 0 20 10**

TEACHING SCHEME   : 20 HOURS

EXAM SCHEME   : 400 MARKS

                                    INT. ASS. : 160 MARKS

                                    EXT. ASS. : 240 MARKS

CREDIT: 10