SCHEME OF SYLLABUS FOR M.TECH. IN WATER RESOURCES ENGINEERING (EFFECTIVE FROM 2005 BATCH)

FIRST SEMESTER

S.NO.	Course No.	Subject	L	T	P	C
1	MTHM-101	Applied Statistics	2	3	0	3
2	WRE-102	Hydrologic Elements and Analysis	2	3	0	3
3	WRE-103	Fluid Mechanics	2	3	0	3
4	WRE-104	Lab-1	0	0	3	1
5	WRE-111	Elective-I	2	3	0	3
6	WRE-112	Elective-II	2	3	0	3
Total Credits						16

ELECTIVES:

ELECTIVE-I :

Water Quality and Environment
River Engineering
Water Management
Water Power Engineering

ELECTIVE-II :

1. Concrete Technology.
2. Numerical Methods .
3. Computer Applications.
4. Seismic Microzonation.

2ND SEMESTER

S.NO.	Course No.	Subject	L	T	P	C
1	WRE-201	Water Resources System	2	3	0	3

2	WRE-202	Open Channel Flow	2	3	0	3
3	WRE-203	Ground Water Hydrology	2	3	0	3
4	WRE-204	Lab-2	0	0	3	1
5	WRE-211	Elective-III	2	3	0	3
6	WRE-212	Elective-IV	2	3	0	3
Total Credits						16

ELECTIVES:

ELECTIVE-III :

Embankment Dams
Surface Water Quality Modelling
Remote Sensing Applications in Water Resources Engineering
Foundation Engineering.

ELECTIVE-IV:

Rock Mechanics and Tunneling.
Construction Techniques and Management.
Finite Element Analysis.

3RD SEMESTER

S.NO.	Course No.	Subject	L	T	P	C
1	WRE-301	Socio-Economic and Environmental Evaluation of Water Resources Projects	2	3	0	3
2	WRE-302	Hydraulic Structures	2	3	0	3
3	WRE-303	Dissertation (Mid term Evaluation)	0	0	0	6
4	WRE-304	Seminar	0	0	4	2
5	WRE-305	Site Visit/ Data Collection	0	0	0	2
Total Credits						16

4th SEMESTER

S.NO.	Course No.	Subject	L	T	P	C

1	WRE-401	Dissertation	0	0	0	12
Total Credits						12

DISSERTATION

The dissertation involves a detailed study of a Water Resources related, problem (actual field/ Research) which a student has to carry out under the supervision of one of the faculty members of the Department.

Part-time students will be eligible to take up the 3rd semester regular in their 5th semester, only when they have successfully completed the first and 2nd semesters.

SYLLABUS FOR M.TECH (WATER RESOURCES ENGG.) 1ST SEMESTER

NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR,

Syllabus for M.tech. In Water ResourCes

ENGINEERING

APPLIED STATISTICS

SEMESTER: IST	L	T	P	C
COURSE NO. MTHM-101	2	3	0	3

Basic Concepts of Probability Theory

Probability, Random variables, Moments, Moment generating functions, Standard distributions,Two dimensional random variables ,Central limit theorem.

2. **Estimation Theory**

Principle of least squares – Regression and Correlation (Multiple and Partial), Estimation of parameters – Maximum likelihood estimates – Method of moments.

3. Testing of Hypothesis

Sampling distributions – Tests based on normal. , chi-square and F- distributions , Analysis of variance – One way and two way classifications.

Random Process

Classification – Stationary random process – Markov process – Markov chains , Poisson process , Birth and death process , Simple queuing applications.

Time Series

Characteristics and representation , Moving averages , Exponential smoothing , Auto regressive process – Other related models.

6. Laplace Transform:

Laplace transforms of elementary functions, shifting theorem, change of scale property, Inverse Laplace transforms, Laplace Transforms of derivatives, Laplace Transforms of integrals.

REFRENCES:

Fruend, John, E., and Miller Irwin, Probability and Statistics for Engineers, Prentice Hall, 1980.

2. Bhat U.N. Elements of Applied Stochastic Processes, Wiley Series in Probability and Mathematical Statistics, Second Edition, 1984.
3. Anderson, O. D. and Perryman M.R. Time Series Analysis, North-Holland, Amesterdam, 1981.

Anderson, O. D. Time Series Analysis, Theory and Practice I. North-Holland Amsterdam, 1982.

Srinivasan, S. K. , and Mehata, K.M. Probability and Random Processes, Tata Mc Graw Hill, 1981.

John, B. , Kennedy and Adam, M. Neville, Basic Statistical Methods ; Harper and Row Publishers, New York, 1986.

Laplace Transform (Schaum Series) by Spiegel

HYDROLOGIC ELEMENTS AND ANALYSIS

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-102	2	3	0	3

INTRODUCTION

Historical background, hydrological cycle, hydrologic problems, water balance.

Precipitation: - Definition, types, forms, measurement – network design, Non-recording and recording (automatic) precipitation gauges. Analysis of data , Supplementing missing data, consistency of record, hyetograph, mass curve analysis, depth areas duration analysis. Rainfall frequency analysis , Station year method.

Evapotranspiration:- Evaporation, transpiration, evapotranspitation, Factors affecting, measurement, network design, estimation of evaporation and evapotranspiration , Evaporation retardation.

Infiltration:- Capacity, rates and indices, factors affecting, measurement of infiltration , estimation of infiltration capacity from hydrograph analysis.

Hydrometry :- Measurement of discharge, selection of site for stage and discharge measuring station non-recording and recording gauges, Accuracy and frequency of observed data, discharge measurement by area Velocity method and slope area method , Chemical methods.

Runoff :- Runoff, runoff cycle, components of runoff, factors affecting runoff , storage effects of runoff from snowmelt, Estimation of average monthly and annual runoff , rainfall - runoff relationships.

Hydrograph and its components: Master recession curve, Base flow and its separation , Unit hydrograph theory and its application for isolated and complex storms , Synthetic unit hydrograph, S- curve, Unit hydrograph of varied durations, Instantaneous unit hydrograph, conceptual models.

Computation of peak flow:- Rational and Empirical relationships,

Flood frequency analysis, Recurrence interval design flood.
Flood routing: Routing through reservoirs and channels , Graphical Methods

REFERECNES:

1. Ven-Te Chow, David R. Maidment, Larry W. Mays; Applied Hydrology Mc Graw hill Publications, 1995.
2. Vijay P. Singh ;Elementary Huydrology, Prentice hall of India, 1994.
3. H.M. Ragunath; Hydrology, Wily Eastern Ltd, 1996.
4. Ven-Te Chow et al. Handbook of Applied Hydrology; Mc Graw Hill Publication, 1995.

FLUID MECHANICS

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-103	2	3	0	3

Equations of motion in general orthogoral coordinate system; Dimensional analysis, Laminar Flow; Boundary layer theory – Laminar boundary layer, turbulent boundary layer; stability analysis of the boundary layer, Turbulence description by statistical methods, Phenomenological method; diffusion , Fluid machinery.

REFERENCES:

Kumar, D.S. "Fluid Mechanics". S.K. Kataria & Sons Publishers, New Delhi, 1998.

Bansal,R.K. "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New,Delhi, 2000.

Garde, R.J."Turbulent Flow", New Age International (P) Ltd. Publishers, New Delhi,2005.

Daiy and Harleman ; Fluid Dynamics , Addition Wesely , New York, 1973.
R.A. Granger; Fluid Mechanics, Dover Publications, New York, 1995.

Lab.-1

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-104	0	0	3	1

Expt. No.1: To determine the infiltration rate of a particular plot of land using double ring infiltrometer, and construct infiltration capacity curves.
Expt. No.2: To study the variation of meteorological parameters, such as, air temperature, relative humidity, wind speed and wind direction using thermohygrometer and anemometer.
Expt. No.3: To study the variation of hydrological parameters, such as, water level and water temperature/ conductivity in a bore well., using water level recorder.
Expt. No.4: Free vortex experiment.
Expt. No.5: Forced vortex experiment.
Expt. No.6: Reynold's Experiment.
Expt. No.7: Flow visualization experiment.
Expt. No.8: Performance characteristics of turbines.

WATER QUALITY AND ENVIRONMENT (Elective -I)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-111	2	3	0	3

1. Introduction:
The composition and characteristics of natural waters. Effect of Temperature, Equilibria in water systems.

2. Water Quality Characteristics :
Physical, Chemical and Biological Characteristics of Water. Standard methods of determination of important physical and chemical parameters of water quality, eg. PH, turbidity, electrical conductivity, total Solids, alkalinity, hardness etc., Units of measurements and expression of results, Bacteriological Indicators, and determination of Coliforms

3. Instrumental Methods of Chemical Analysis:
Concepts of Instrumental/ Analysis on Selective Electordes, Atomic Absorption spectrophotometric methods, potentiometry including o_2 electrodes, Gas chromatography.

4. Concepts in Organic and Biochemical Methods:
Biochemical cycles of C, N, P and S, Trace Organics, Detergents, Pesticides, Fertilisers , etc.

5. Water Quality Representation and Standards:
Water Quality Criteria, Guidelines, and Standards for Various uses.

6. Water Pollution
Natural factors affecting water quality and pollution from various wastes , mechanisms of surface water pollution, point and Non-point sources , Effect of Geological formations on Water quality.

7. Water Quality in Receiving Water Bodies:

Lakes and Impoundments , Stratification and Eutrophication , Water Quality in Rivers , self purification and Reaeration , Dissolved Oxygen Balance in Rivers , Thermal Pollutions.

8. **Ground Water Quality:**
   Sources and Mechanisms of Groundwater Pollution. Groundwater Pollution from Lnadfills and Waste Dumps.
9. **Case Studies:**
   Case Studies on Environmental Impact of Dam and Irrigation Schemes , and Land Reclamation Projects.

REFERENCES :

Metcalf And Edduy, Inc.; Waste Water Engineering, Treatment, Disposal, Reuse, Tata McGraw Hill.

Masters G.M.; Introduction to Environmental Engineering and Science, Pretice hall of India, 1994.

Garg, S.K." Water Supply Engineering", Vol.1, Khanna Publishers,New Delhi,2003.

RIVER ENGINEERING (Elective-I)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-111	2	3	0	3

Introduction to sediment and Fluvial hydraulics, nature of problems; Origin and properties of sediments; Incipient motion of sediment particles; Regimes of flow; Resistance to flow; Bed lead, Suspended load and total load transport; sediment samplers; Design of Stable channels; Alluvial stream and their hydraulic geometry; Variation in plan form of streams; River training and bank protection; Cut-offs ; Alluvial river models; transport through pipes.

REFERENCES:

Yang, C.T."Sediment transport theory and Practice", McGraw-Hill, New York,1996.

Graf, W.H."Hydraulics of sediment transport", McGraw-Hill, New York,1971.

Raudkivi, A.J."Loose boundary hydraulics", 2nd ed., Pergamon Press. 1976

F.M.Henderson, "Open Channel Flow", MacMillan, New York, 1996

H.H.Chang;" Fluvial Processes in River Engineering", John Wiley, 1988.

Garde, R.J. and Ranga Raju, K.G." Mechanics of Sediment Transport and Alluvial Stream Problems", New Age International (P) Ltd. Publications, New Delhi,2006.

Jansen, P. Ph, Van Bendegon L., De vries, M. (1979) Principles of River Engineering ; Pitman, London.
Garde, R.J."History of Fluvial Hydraulics", New Age International (P) Ltd. Publishers, New Delhi,1995.
Garde, R.J."River Morphology", New Age International (P) Ltd. Publishers, New Delhi,2006.

WATER MANAGEMENT (Elective-I)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-111	2	3	0	3

Moisture –crop relationship. Irrigation requirements, Irrigation efficiencies (Conveyance losses lined/unlined channels).Trickle, sprinkler and furrow irrigation. of arid lands. Drainage of irrigation land. . Salinity of soil. Salinity control. Quality of irrigation water ; contaminants and their effect on various crop types. Operation of reservoirs. Water management Policy during droughts. Predicting effect of water shortages on crops.

REFERENCES:

1. Hansen, V.E. et al.; Irrigation Principles and Practice, John Willey and Sons, inc. New York 1980.
2. Michael A.M. Irrigation-Theory and Practice, Vikas Publishing House, New Delhi 1990.
3. Richard H. Cuenca; Irrigation System Design – An Engineering Approach, prentice hall Inc. New Jersy, 1986.
4. Zimmerman J.D.; Irrigation, John Wiley and Sons Inc. New York, 1986.

WATER POWER ENGINEERING (Elective-I)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-111	2	3	0	3

Introduction :
Development of water power, Estimation of Hydropower potential, Comparison of Hydro, thermal and nuclear power.
Analysis of Stream flow Demand: Flow duration curve, firm power, secondary power, Load and Load duration curves, Load factor, etc.
Types of Hydropower Plants:
Classification of hydropower plants, Run-of-river plants, Valley dam plants, High head diversion plants, Diversion Canal plants, Pumped storage plants , Tidal power plants.
Water Conveyance System:

Power canals, Alignment, Design of power canals, Flumes, Covered conduits and tunnels , Drainage and ventilation in tunnels. Penstocks:- Alignment, types of penstocks, economic diameter of penstocks, Anchor blocks.

Dams:

Selection of site, preliminary investigations, Final investigations, Types of dams:- Rigid dams, Gravity dams, Arch and buttress dams, Basic principles of design and details of construction.

Embankment Dams:

Earthen dams, rockfill dams, Design considerations.

Spillways:

Types , spillway gates , Design of stilling basins.

Types of Turbines and their utility :

Layout and parts of the generation system

Power house details :

Forebay, Intakes , Balancing Reservoir, Ecsape , Surge Shafts/ Inclined Shafts. General Layout of power house and arrangement of hydropower units.

Underground Power Stations : General

Transmission System :

General Introduction , Basic principles of design and construction.

Financial Implications of hydropower plants .

REFERENCES.

1. Barrows, H.K."Water Power Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1999.
2. Nigam, P.S. " Handbook of Hydroelectric Engineering"
3. Dandekar, M.M. " Water Power Engineering"
4. Deshmukh, M.M. "Water Power Engineering", Danpat Rai & Sons, Nai Sarak, Delhi,1978.
5. Varshney, R.S. "Hydropower Structures", Nem Chand Brothers, Roorkee, 2001.
6. Arora, K.R. " Irrigation water power and Water Resources Engineering", Standard Publishers Distributors, Delhi,2002.
7. Creager and Justin. "Hydro Electric Handbook", John Wiley & Sons, New York

CONCRETE TECHNOLOGY(Elective-II)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-112	2	3	0	3

Concrete Making Materials:

Aggregates – Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates.

2. Cement:

Chemical compoisition, Hydration of cement, structure of hydrated cement, special cements, water chemical admixtures.

Concrete:

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength.

Mix Design:

Principles of concrete mix design, Methods of concrete mix design, Testing of concrete.

Special Concretes:

Light weight concrete, Fibre reinforced concrete, Polymer concrete, Super plasticized concrete, Properties and applicatons.

Concreting Methods:

Process of manufacturing of concrete, Methods of Transportation, placing and curing. Extreme weather concreting, Special concreting methods.

REFERENCES:

1. Neville, A.M. and Brookes, J.J. "Concrete Technology", Pearson Publishers,New Delhi,1994.
2. Neville, A.M. "Properties of Concrete" Pearson Publishers,New Delhi, 2004.
3. Shetty,M.S. "Concrete Technology", S.Chand & Company, New Delhi,2002.
4. Gambhir, M.L. "Concrete Technology", Tata McGraw Hill New Delhi, 1995.
5. Rudhani,G."Light Weight Concrete", Academic Kiado Publishing Home of Hungarian Academy of Sciences,1963.

NUMERICAL METHODS (ELECTIVE-II)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-112	2	3	0	3

Numerical analysis, finite differences, interpolation, numerical solution of algebraic and transcendental equations, iterative algorithms, convergence, Newton-Rapjson procedure, solution of polynomial and simultaneous linear equations, numerical integration, Euler-Maclaurin formula, Newton-Cotes formula, error estimates, numerical solutions of ordinary differential equations: method of Euler, Taylor, Adams Runge-Kutta and predictor-corrector procedures, stability of solution, solution of boundary value problems, finite differences techniques, stability and convergence of solution, finite element method. **Special functions.** Legendre's special function, Rodrigue's formula, generating functions for Legendre's polynomials and recurrence formulae, Bessel's function, recurrence formulae, Bessel's function of integral order.

Books recommended:

Numerical methods for Scientists and Engineers by M.K. Jain, S.R. Iyengar & R.K. Jain, Wiley Eastern Ltd.

Mathematical Numerical Analyis By S.C. Scarborough, Oxford and IBH Publishing Company.

Introductory methods in Numerical Analysis by S.S. Sastry, Prentice Hall of India.

Theory and problems in Numerical Methods by T. Veeranjan and T. Ramachandran, Tata McGraw-Hill Publishing Company, New Delhi-2004.
Numerical Methods for Mathematics Sciences and Engineering 2nd ed. By John H. Mathews, Prentice Hall of India, New Delhi 2003.
Advanced Engineering Mathematics by R.K. Jain & S.R.K. Iyengar, Narosa-2001.

COMPUTER APPLICATIONS (Elective-II)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-112	2	3	-	3

Introduction:

Digital Computer Systems, problem solving techniques, introduction to programming languages, computer language and C++, source programme, Compilation and debugging.

C++ Programming Basics:

Using Turbo C++ , Basic program construction, preprocessor directive, #include, #define, Header and Library functions, Keywords, INPUT-OUTPUT Statements, comments, Constants, Variables, and operators, Formatting statements, ENDL and SETW manipulators.

Loops, Decision and Arrays:

WHILE, DO-WHILE and FOR loops, general structure and control. IF, IF-ELSE statements, SWITCH, BREAK, CONTINUE statements, GOTO and labels, ARRAY fundamentals, types, use and manipulation of 2-D arrays as Matrices.

FUNCTIONS:

Concept of modularization of structured programming. Basics of functions, their types declaration, definition and structure.

Object Oriented Programming Concept:

General concepts of Object Oriented Programming , Objects and Classes, Member Functions , user defined data , Pointers ,etc.

File Processing:

Streams , String I/O, Character I/O, Object I/O, input-output with Multiple objects, File Pointers, Disk I/O with Member Functions, Error Handing, Printer Output.

Practical Applications:

Programming for mathematical models of Civil Engineering problems and Management information systems, use of general purpose programmes.

Refernces:

i. Object Oriented Programming with C++ by Robert Lafore
ii. Object Oriented Programming with C++ by S.K. Panday.

SEISMIC MICROZONATION (Elective-II)

SEMESTER: IST	L	T	P	C
COURSE NO. WRE-112	2	3	0	3

Earthquake source: Earthquake source mechanisms. Review of moment tensors. Seismic inversion problem for a flat structure. Strong motion seismology. Reservoir-Induced earthquakes.

Prediction of Strong ground motion: A theoretical study of the dependence of the Peak Ground Acceleration on source and structure parameters. High frequency earthquake strong ground motion in laterally varying media and the effect of fault zone. Physical mechanisms contributing to the seismic attenuation in the crust. Dynamic fracture mechanics. Near-field and far-field ground motions.

Strong motion data: Data acquisition and processing in strong motion seismology. Array analysis and synthesis mapping of strong seismic motion. Accelerogram spectral properties and prediction of peak values. Statistical model for peak ground motion from local to regional distances. Seismic intensity and its applications to engineering: a few case studies from Japan and Turkey.

Complete strong motion synthetics: Numerical modelling of realistic fault rupture processes: Kinematic dislocation models, 3-D modelling of spontaneous fault rupture processes. Stochastic simulation of high frequency ground motions based on seismological models of radiated spectra. Use of random vibration theory to predict peak amplitudes of transient signals. SHAKE?91. Fault surface integral and techniques for earthquake ground motion calculation with applications to source parameterization to finite faults. Path effects in strong motion seismology.

Hazard assessment: Probabilistic models for assessment of strong ground motion. Seismic source regionalization. Seismic risk and its estimation.

Site response and engineering application: Site response analysis using classical spectral ratio, generalized inverse technique, horizontal-to-vertical spectral ratio or receiver function, network average and Nakamura ratio. Determination of in-situ shear-wave velocity and Q-factor. Site amplification and its relation to surficial geologic condition. Constitutive relationships for soil dynamics. Soil structure interaction effects on strong ground motion. Engineering uses of strong motion data and seismic microzonation.

BOOKS RECOMMENDED:

1. Fundamentals of earthquake engineering by Newmark N.M. and Rosenblueth E.
2. Geotechnical Earthquake Engineering By Kramer, S.L
3. Wai-Fah Chen & Scawthorn, Charles. " Earthquake Engineering Handbook", CRC Press London.

SYLLABUS FOR M.TECH (WATER RESOURCES ENGG.) 2ND SEMESTER

WATER RESOURCES SYSTEMS

SEMESTER: 2ND	L	T	P	C

COURSE NO. WRE-201 2 3 0 3

Objective of water resources development, economic analysis and discounting techniques, conditions of project optimality. Graphic optimization techniques for multipurpose projects, analytical optimization techniques for water resources projects by linear Programming. Nonlinear programming and dynamic programming, Optimization by simulation, mathematical models for large scale Multipurpose projects, different case studies , stochastic optimization Techniques, water quality subsystems, optimum operation model for Reservoir systems by incremental dynamic programming, sequencing of
Multipurpose project.

REFERENCES

1. Arthur Mass et el., Design of Water Resources Systems, MacMillan, 1962.
2. L.D. James and R.R.Lee, Economics of Water Resources Planning, McGraw-Hill New York, 1971.
3. Loucks, D.P., J.R. Stedinger D.A., Haith: Water Resources ystems, Planning and Analysis, Prentice Hall, 1981.
4. Biwaswas A.K. Systems Approach to Water Management , McGraw Hill, Kogakusha Ltd., 1976.
5. Votruba L. Analysis of Water Resources Systems Elsevier, 1988.

OPEN CHANNEL FLOW

SEMESTER: 2ND L T P C
COURSE NO. WRE-202 2 3 0 3

Basic Fluid Flow Concepts, Classification of channels basic equation; Uniform flow in rigid boundary channels, Shear stress and its distribution, conveyance of a channel, relation with depth; Mobile boundary channels, regimes, resistance to flow, design of alluvial channels, specific energy, Specific forces and Critical depth; Gradually varied flow-types and governing equation, non-Prismatic channels; Hydraulic Jumps, Forced hydraulic Jump, Jump in rectangular and non-rectangular channels; Channel Controls and transition, Subcritical and Supercritical flow transition; Unsteady flow, Waves, Celerity of a wave, Surge, Method of characteristics, Flood Routing etc.

References:

V.T.Chow ; Open Channel Hydraulics, McGraw Hill Publishing Co., Inc., 1986.

Henderson F.M; Open Channel Flow, Mac Millan Publishing Co., New York, 1986.

Richard H.H. French; Open Channel Hydraulics, Mac Millan Publishing Co. New York, 1986.

K. Subramanaya; Open Channel Flow, Tata McGraw Hill Publishing Co., 1983.

GROUND WATER HYDROLOGY

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-203	2	3	0	3

Occurrence of ground water , types of aquifers, ground water in different formations , ground water movement, mechanics of well flow into fully and partially penetrating wells in confined aquifers, leaky aquifers, unconfined aquifers, approximate solutions, aquifer tests, well design criteria, ground water control.

Techniques of artificial recharge, solution to transit problems of ground water mounds, theory of subsurface drainage, stream aquifer systems, ground water quality, Sea water intrusion into coastal aquifers, approximate solutions, multiple well systems, hydrogeologic systems analysis, digital and analogue models for evaluation of aquifer response, ground water development and management.

References:

A. El-Kadi; Ground water Models for Resource Analysis and Management, Lewis Publications, Boca Raton, 1995.

S. Ne-Zheng; Inverse Problems in Ground water Modelling, Kluwer Academic Dordrecht, 1994.

USEPA; Handbook of Groundwater, Vols. I & II, Scientific Publications, Jodhpur Reprint, 1994.

E. Custodio(Editor); Study and Modelling of Salt water Intrusion into Aquifers, CIMNE publications, Barcelona, Spain ,1993.

W.c. Walton; Groundwater Modellling Utilities, Lewis Publications, Boca-Raton, 1992.

K.R. Karanth; Groundwater Assessment Development and Management, Tata McGraw Hill New Delhi,1990.

R. Willis and W.W.G. Yeh; Groundwater Systems Planning and Management, Prentice Hall New Jersey, 1987.

Lab.-2

SEMESTER: 2nd	L	T	P	C
COURSE NO. WRE-204	0	0	3	1

Expt. No.1: To study the variation of discharge with brink depth in a laboratory flume.

Expt. No.2: To study the formation of hydraulic jump in a laboratory channel.

Expt. No.3: To study the permeability of a soil sample using constant/ varying head permeameter.

Expt. No.4: To study gradually varied flow water surface profiles in a laboratory flume.

Expt. No.5: To study the velocity distribution in an open channel and to determine the energy and momentum correction factors.

EMBANKMSENT DAM (Elective-III)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-211	2	3	0	3

Introduction, Types and advantages of Embankment dams, Factors affecting the design of Embankment dams, safety criteria, Theoritical analysis of seepage through embankment and its applications, Control of seepage through embankment dams, Stability analysis including seismic stability, Construction methods, Instrumentation, Typical problems and their solutions in Embankment dams.

References:

1. Anderson, M.G. and Richards, K.S.; Slope Stability, John Wiley, 1987.
2. Sherard, J.L.;Woodward, R.J. Gizienski; and Clevenger, W.A.; Earth and Earth Rock Dams, John Wiley, 1963.
3. Chowdhury, D.F.; Slope Analysis, Prentice Hall, 1988.
4. McCarthy, R.N.; Essentials of Soil Mechanics and Foundations, Prentice Hall, 1988.
5. Bramhead, E.N; The Stability of Slopes, Blackey Academic and Professionals Publications, Glasgow,1986.

SURFACE WATER QUALITY MODELLING (ELECTIVE-III)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-211	2	3	0	3

River hydrology and derivation of stream equation. Distributon of water quality in Estuaries. Derivation of estuary equation. Physical and hydrologic characteristics of lakes. Finite difference steady state lake models. Waste load allocation principles. Nature of inputs. Fate of indicator bacteria, pathogens and viruses in water. Engineering control for dissolved oxygen in streams and rivers, lakes and estuaries.

References:

1. Thoman, R.V. and Mueller, J.A; Principles of Surface Water Quality Modelling and Control, Harper and Row Publishers, New York.

GIS, GPS AND REMOTE SENSING APPLICATIONS IN CIVIL ENGINEERING (ELECTIVE-III)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-211	2	3	0	3

Principles of GIS, GPS and Remote Sensing:
Basic concepts of GIS & GPS, introduction to remote sensing, remote sensing system, electromagnetic spectrum, black body, atmospheric windows, spectral characteristics of earth's surface, range of sensing system.

GPS:
Basic concepts, components, factors affecting, GPS setup, accessories, segments-satellites & receivers, GPS applications, Case studies

Platforms, Sensors and Data Products:
Ground aircraft, Spacecraft platforms, photographic sensors, scanners, radiometers, radar and mission planning, data types and format, scale and legend.

Interpretation and Analysis Techniques:
Multispectral, multitemporal, multisensoral, multistage concepts, photo interpretation techniques for aerial photo and satellite imagery, interpretation elements, false colour composition, etc.

Photogrammetry:
Photogrammetry- Basic application, applications of aerial photo interpretation to water resources engineering.

Digital Analysis:
Preprocessing and processing, image restoration/enhancement procedures, pattern recognition concepts, classification algorithms, post processing procedures.

Structure of GIS:
Cartography, Geographic mapping process, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, database management systems, Raster data representation, Vector data representation, Assessment of data quality, Managing data errors, Geographic data standards.

GIS Data Processing, Analysis and Modeling: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts, and nearest neighbour analysis – Network analysis – Surface modeling – DTM.

Application in Civil Engineering:
River drainage and flood flow, watershed delineation and characteristic studies, command area mapping, drought assessment, groundwater inventory, soil moisture study, water quality assessment and monitoring, Land use data acquisition, disaster management.

References:

1. Thomas, M. Lillisandand R.W.Kiefer; Remote Sensing and Image Interpretation, John Wiley, 1987.
2. Sabins and Floyd, F.J.R; Remote Sensing Principles and Interpretation, W.H. Freeman, Sanfrancisco, 1978.
3. C. Elachi; Introduction to Physics and Techniques of Remote Sensing, New York Wiley, 1987.
4. Phillip, H. Swain and Shirley, M. Davis; Remote Sensing- The Quantitative Approach, McGraw Hill Publications , 1978.
5. Johnson, R. Jenson; Introductory Digital Image Processing, Prentice hall , 1986.

6. Ian Heywood, S. Cornelius and S. Carver, An Introduction to Geographical Information
Systems, Pub. By Pearson Education (Singapore) Pvt. Ltd., Printed in Replica Press Pvt.
Ltd.,
India, 2001
7. Agarwal, N. K., Essentials of GPS, Spatial Networks Pvt. Ltd., Hyderabad, 2004

FOUNDATION ENGINEERING (ELECTIVE-III)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-211	2	3	0	3

Overview of basic principles of geotechnical engineering, Geotechnical site investigations,

Introduction to Foundation Engineering

- Construction materials, Engineered structures, foundation materials.
- Load transfer device/interfacing element, superstructures, foundation structures/sub-structures, Need for load transfer device , objectives.
- Principles of foundation Engineering, challenging problems.
- Design requirements/ information needed for foundation design.
- Classification of foundations (Flexible, rigid, shallow and deep foundations).

Terminology involved in Foundation Analysis and Design

Gross bearing capacity, ultimate bearing capacity, net-ultimate bearing capacity, safe bearing capacity, net safe bearing capacity, safe bearing pressure, allowable bearing pressure.

Design Criteria for Foundation Design

Locatoin and depth criteria, shear failure criteria (safe bearing capacity criteria), settlement criteria (safe bearing pressure criteria).

Factors for Selection of Type of Foundation

Function of the structure and the loads it must carry, sub-surface condition of the soil, cost of super-structure.

Basic Design parameters for safe foundation design

- service loads (DL,LL,WL,EQL,SL,etc and their combination and reduction factors)
- safe bearing capacity
- size of footing (structural design by limit state design as in case of other RC members)
- soil pressure on foundation
- conventional analysis of foundations subjected to vertical loads and moments
- thickness of footing and its requirements
- minimum reinforcement requirement (IS:456)

Bearing Capacity of Shallow foundations

1. Bearing capacity based on the classical earth pressure theory of Rankine
2. Semi-empirical solutions based on theory of plasticity

(a). Prandtl's theory (b). Terzaghi's theory (c). Meyerhof's theory

(d). Brinch Hansen's theory (e). Vesic's theory (f). Balla's theory
(g). Skempton's theory (h). Caquot & Kerisel's theory
(i). Frochlicl's theory

3. Exact methods based on theory of plasticity:
   (a). Sokolovski's theory (1960) (b). KO etal's (1973) Non-dimensional sol.
4. Semigraphical methods of :
   (a). Fellinius for clay soils, and
   (b). Button, Brown, Meyerhof and Vesic for two layer stratified deposits.
5. Penetration Tests (insitu-tests):
   (a). SPT- Standard penetration test,
   (b). SCPT- Static cone penetration test
   (c). DCPT- Dynamic cone penetration test
   (d). PMT- pressure meter test.
   (e). VST- vane shear test.
   (f). PLT- plate load test (Insitu- test).

Settlement of shallow foundations, Need for Raft foundations and design methods.
Pile Foundations

Types of piles, selection and installation, behaviour of single pile under vertical load : load transfer mechanism, methods of determining ultimate load bearing capacity of a single pile (c, c-ϕ & ϕ soils)- skin resistance (straight shaft, tapered piles) point bearing capacity, vertical bearing capacity of pile groups, settlement of pile groups, effect of negative skin friction on bearing capacity.

Vertical Piles Subjected to lateral loads:

Solution for laterally loaded single pile, closed form solution for pile of infinite length, P-y curves for the solution of laterally loaded piles in sand and clay, modulous of subgrade reaction, finite difference method,

Pile groups subjected to vertical and lateral loads.

Design and construction of well foundations/caissons

Foundations on expansive and collapsible soils.

Foundation soil improvements.

Books Recommended:

Kasmalkar, J.B. (1997). Foundation Engineering, Pune Vidyarthi Graha Prakashan-1786, Pune-411030.

Bowels, Joseph E.(1996). Practical Foundation Engineering Handbook. 5th edition, McGraw-Hill, New York.

Das, Braja M. (1999). Principles of foundation Engineering, 4th edition, PWS publishing, Pacific Grov. Calif.

Peck, Ralph B., Hansen, Walter E., and Thornburn, Thomas H. (1974). Foundation Engineering. John Wiley & Sons, New York.

Praksh, Shamsher, and Sharma, Hari D. (1990). Pile foundation in Engineering Practice, John Wiley & Sons, New York.

Som, N.N., and Das, S.C. (2003). Foundation Engineering: Principles and Practice. Prentice –Hall of India Pvt. Ltd. New Delhi-001.

Varghese, P.C. (2005). Foundation Engineering Prentice –Hall of India Pvt. Ltd. New Delhi-001.
Tomlonson, Michael J. (1995). Foundation Design and Construction. 6th edition. John Wiley & Sons, New York.

ROCK MECHANICS AND TUNNELING(Elective-IV)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-212	2	3	0	3

Rock Mechanics

Classification and index properties of rocks, Rock strength and failure criteria, initial stresses in rocks, influence of joints and their orientation in distribution of stresses-deformability of rocks.
Measurement of insitu, laboratory and insitu measurements of shearing, tensile and compressive strength, deformability of rocks.
Simple engineering applications in rock mechanics, underground openings, rock slopes, foundations, mining subsidence – case studies,
Rock bolt systems- installation techniques, testing of rock bolts, choice of rock bolts.

Tunnelling

Tunnel Engineering: Necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape of a tunnel, method of constructions, methods of tunneling in hard rocks - full face method - heading and bench method - drift method - different methods of tunneling in soft soils including compressed air and shield tunneling - shafts in tunnels - ventilation of tunnel and various methods - lining of tunnels - drainage and lighting of tunnels, problems in tunnel constructions, boom tunnelling machines, full face tunnel boring machines; support of tunnels; adverse ground conditions; ground treatment and hazards in tunnelling.

Books Recommended

1. Godman, P.E."Introduction to Rock Mechanics", John Wiley, New York,1989.
2. Jager, G. "Rock Mechanics and Engineering", Cambridge University Press, 1972.
3. Stillborg, B. "Professional user handbook for racok bolting", Tran Tech publications, 1986.
4. Hock, E. and Brown, E.T. "Underground excavation in rock", Institute of Mining and Metallurgy,1980.
5. Hock, E. and Bray, J. "Rock slope Engineering", Institute of Mining and Metallurgy,1981.
6. Bickel, J.O., T.R. Kuesel, and E.H. King, "Tunnel Engineering Handbook", Chapman & Hall/ITP Publishing Company, 1996, 544 pp.

7. Parker, A. D."Planning and Estimating Underground Construction", McGraw-Hill, 1970.

CONSTRUCTION TECHNIQUES AND MANAGEMENT (Elective-IV)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-212	2	3	0	3

Construction planning-Construction facilities, Schedules, Layout of Plant utilities, Construction methods: Excavation and handling of Earth and Rock; Production and handling of Aggregartes and Concrete , cooling of concrete in dams, Drainage treatment of aquifers/sub-terrainean reservoirs; Tunneling, Tunneling in soft rocks-Grouting , chimney formation,etc ; Construction control and management-CPM/PERT, Human Factors, Organisation.

References:

1. Peurifoy, R.L. and Ledbetter, W.B.; Construction Planning ,Equipment and Methods, McGraw Hill Singapore, 1986.
2. Robertwade Brown; Practical Foundation Engineering Handbook, McGraw Hill Publications , 1995.
3. Joy, P.K.; Total Project Management- The Indian Context, New Delhi, MacMillan India Ltd., 1992.
4. Uliman, John.E, et al; Handbook of Engineering Management, Wiley, New York , 1986.
5. Neville, A.M.; Properties of Concerte, Pitman Publishing Ltd.,London, 1978.

FINITE ELEMENT ANALYSIS (ELECTIVE-IV)

SEMESTER: 2ND	L	T	P	C
COURSE NO. WRE-212	2	3	0	3

Introduction to Finite Element Method. Brief History of the Development. Advantages & Disadvantages of Finite Element Method. Finite Element Method-The Displacement Approach.

Foundations of the FEM- Energy Principles.

One Dimensional Finite Elements. Stiffness Matrix for the basic Bar & Beam Element Representation of Distributed Loading. The Assembly Process within the PMPE Approach. Element Stresses.

Shape Functions & Interpolation Polynomials. Refined One Dimensional Elements.

Finite Elements for Two Dimensional Planar Bodies. Triangular Elements for Plane Stress or Strain Conditions. Higher Order Triangular Elements. Rectangular Elements for Plane Stress or Strain Conditions. Higher Order Rectangular Elements : Lagrange Element Family.

Finite Elements for Three Dimensional Analysis. Tetrahedral Elements. Higher-Order Tetrahedra. Rectangular Hexahedral Elements. Higher-Order Rectangular Hexehedra: Lagrange Element Family.

Advanced Concepts In The Formulation of Two & Three Dimensional Elasticity Elements. Natural Co-ordinates. Area or Triangular Co-ordinates. Serendipity Rectangles & Hexahedra. The Isoparametric Concept. Properties of Isoparametric Elements. Numerical Integration.

Finite Elements For Plate Bending Analysis. A 12-Degree-Of-Freedom Rectangular Element (R1). Triangular Elements.

Books Recommended

Cook, R.D., Malkus, D.S. and Plesh, M.E."Concepts and Applications of finite element Analysis", John Wiley & Sons Inc. New York, 1989.

Bathe, K.J. " Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990.

Reddy, J.N. " An Introduction to Finite Element Method", McGraw Hill,1984.

Dawe, D.J. " Matrix and Finite Element Displacement Analysis of Structures", Clarinton Press, Oxford,1984.

Yang, T.Y. "Finite Element Structural Analysis"

Mukhopadhyay, M. "Matrix Finite Element Computer & Structural Analysis"

SYLLABUS FOR M.TECH (WATER RESOURCES ENGG.) 3RD SEMESTER

SOCIO-ECONOMIC AND ENVIRONMENTAL EVALUATION OF WATER RESOURCES PROJECTS

SEMESTER: 3RD	L	T	P	C
COURSE NO. WRE-301	2	3	0	3

Water Resources Projects:

Need and importance of Water Resources Projects, Types of projects.

2. Socio-Economic Analysis :

Social and Economic evaluation of population, standards of living, Community needs, Socio-Economic objectives.

3. Environment:

Eco systems, Habitat assessment, Environmental onjectives, study of available resources, Environmental monitoring, Environmental evaluation techniques.

4. Project Proposal and Implementation:

Project planning, selection of project, Public awareness programme, feasibility reports, Eco-friendly projects, Project funding and expenditure, Cost and benefits, Risk assessment.

5. Project Evaluation:

Evaluation and impact of projects like irrigation, Power Supply, Water Supply, Flood Control, Sewage, etc. Facilities generated, negative effects- inundation, migration, etc.

6. Case Studies:

Case studies and evaluation of some important water Resources Projects in India and abroad.

References :

Economic development and Environmental Issues by P.A. Modi
Water Resources and their Environmental Impacts by S.A. Abbasi.

HYDRAULIC STRUCTURES

SEMESTER: 3RD	L	T	P	C
COURSE NO. WRE-302	2	3	0	3

Design procedure for irrigation channels, Irrigation outlets, Canal masonary works, - principles of design, use of flow net, Khosla's theory , Regulation works - Falls, distributory head regulators, Cross regulators, Canal head Works, Earth Dams, Gravity Dams, Spillways and Energy dissipators , Escapes , Trench weirs , Supply channel and head regulator.

Highway Drainage: Importance, principles of surface drainage, roadside drains- cross-section; design, drains for hill roads, subsurface drains, capillary cut-off treatment.

Cross Drainage Works: Importance of cross drainage, causeways, culverts & bridges-types; estimation of design discharge, fixation of waterway, foundation depth and spans

References:

1. R.S. Varshney, S.C. Gupta and R.L. Gupta; Theory and Design of Irrigation Structures, Nemchand & Brothers ,Roorkee, 1992.
2. R.k. Sharma; Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Co., New Delhi, 1984.
3. Arora, K.R. " Irrigation water power and Water Resources Engineering", Standard Publishers Distributors, Delhi,2002.
4. L. R. Kadiyali and N. B. Lal; Principles and Practices of Highway Engineering, Khanna Publishers Delhi, 2005