DEPARTMENT OF CIVIL ENGINEERING

Scheme of Instruction and Syllabus of

M.E. (Civil Engineering)

Specialization: Water Resources Engineering

Full Time
(2017-2018)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous) Osmania University
Hyderabad – 500 007, TS, INDIA

(With effect from the Academic Year 2017-2018)

INSTITUTE

Vision

The Vision of the institute is to generate and disseminate knowledge through harmonious blending of science, engineering and technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate , disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services to the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT

Vision

To be as a leading academic department on pace with global standards and contribute to the development of economic, technically viable and useful to societal problems and challenges of civil engineering profession and also contribute to the regional and country's developmental activities.

Mission

- To train the human resources with knowledge base in the field of Civil Engineering so that they can face the challenges of civil and infrastructural engineering problems to provide viable solutions.
- To integrate their understanding and attainable knowledge on the specializations for effective functioning in their profession and useful to the welfare and safety of mankind.
- To enhance the technical knowledge and research aptitude in the domains of various Civil Engineering specializations to serve the society in highly professional manner.
- Produce highly competent and capable professionals and motivated young academicians to provide solutions to real life problems of Engineering and Technology and has apt for continuous learning and dedication towards societal issues.

Programme Educational Objectives (PEO):

1. Impart and enrich knowledge in the fields of Surface and Groundwater Engineering
2. Exposure to the state-of-art techniques / knowledge of modeling techniques in to be adopted for different Water Resources Engineering problems
3. Facilitate the policy makers and administrators to solve issues pertaining to regional Water Resources and Environmental Engineering
4. Provide continuing education as per the needs of practicing engineers and academician to enhance their technical knowledge

Programme Outcomes (PO):

1. Acquainted with the principles of Surface Water and Groundwater Hydrology
2. Familiar with the modeling techniques / state of art techniques for application to various Water Resources Engineering problems
3. Able to plan and design the wastewater treatment facilities and to conserve environmental systems
4. Proficient in design of various hydraulic structures and urban storm-water drainage systems
5. Advocate the policy makers and administrators to develop and operate regional water resources issues
6. Encourage the practicing engineers and academicians to enhance their technical knowledge

MAPPING OF PEO'S WITH PO'S

PROGRAMME EDUCATIONAL OBJECTIVES	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
PEO-1	YES	YES	--	--	YES	YES
PEO-2	YES	YES	--	--	YES	YES
PEO-3	--	--	YES	YES	YES	YES
PEO-4	--	YES	YES	YES	YES	YES

M. E. CIVIL (WATER RESOURCES ENGINEERING)

w. e. f. 2017-2018

Course Code	Course Title	Contact hours per week	Scheme of Examination		Credits
			CIE	SEE	
Core Subjects:					
CE1201	Advanced Fluid Mechanics	3	30	70	3
CE1202	Engineering Hydrology	3	30	70	3
CE1203	Groundwater Engineering	3	30	70	3
CE1204	Irrigation Engineering	3	30	70	3
CE1205	Open Channel Hydraulics	3	30	70	3
CE1206	Water Resources Systems	3	30	70	3
Elective Subjects:					
CE 1211	Applied Statistics in Water Resources Engineering	3	30	70	3
CE 1212	Environmental Impact Assessment	3	30	70	3
CE 1213	Flood Analysis and Control	3	30	70	3
CE 1214	Geo-Spatial Techniques	3	30	70	3
CE 1215	Groundwater contamination: Transport and Remediation	3	30	70	3
CE 1216	Hydraulic Structures	3	30	70	3
CE 1217	Impact of Climate changes in Water Resources Engineering	3	30	70	3
CE 1218	Models of Air and Water Quality	3	30	70	3

Course Code	Course Title	Contact hours per week	Scheme of Examination		Credits
			CIE	SEE	
CE 1219	Soft Computing Applications in Water Resources Engineering	3	30	70	3
CE 1220	Water Power Engineering	3	30	70	3
CE 1221	Watershed Management	3	30	70	3
CE 1222	Wastewater Treatment Systems	3	30	70	3
CE1116	Advanced Concrete Technology	3	30	70	3
CE 1118	Bridge Engineering	3	30	70	3
CE 0111	Engineering Research Methodology	3	30	70	3
CE 1312	Ground Improvement Techniques	3	30	70	3
Departmental Requirements:					
CE 1231	Water Resources Engineering Laboratory	3	50	-	2
CE 1232	Computer Applications Laboratory	3	50	-	2
CE 1233	Seminar-I	3	50	-	2
CE 1234	Seminar-II	3	50	-	2
CE 1235	Project Seminar	4	100	-	8
CE 1236	Dissertation	6	-	200	16

CIE : Continuous Internal Evaluation SEE : Semester End Examination

CE 1201 *w. e. f. 2017-2018*

ADVANCED FLUID MECHANICS

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to advanced concepts of fluid motion
- Knowledge about boundary layer concepts
- Description of ideal fluid flow theory and its application in real life problems

Course Outcomes:

- Comprehend the advanced concepts of fluid motion
- Application of boundary layer and ideal fluid flow theory concepts in water resources engineering problems

UNIT – I

Basic concepts: One, two and three dimensional flows, Lagrangian and Eulerian description of fluid flows, acceleration of fluid particles, general motion of a fluid element (Translation, Dilatation, Rotation, and Angular deformation), general stress-strain system, equations of motion, continuity equation, velocity potential, stream function, rotational and irrotational flows, circulation and vorticity.

UNIT – II

Dynamics of Flow: Navier-Stokes equations, simple exact solutions to NS equations (steady laminar flow between parallel plates and in a circular tube of constant diameter).

UNIT – III

Boundary layer flows: Concept of boundary layer, Prandtl's boundary layer equations, Von Karnan - Pohlhausen integral momentum equation, Blasius solution for laminar boundary layer flow over a flat plate, boundary layer separation.

UNIT – IV

Turbulent Boundary layer: Sources of turbulence, velocities, energies and continuity in turbulence, turbulent shear stresses, Reynolds equations for incompressible fluids, Prandtl's mixing length theory in shear flows, law of wall, velocity defect law, velocity distribution in turbulent flow through smooth and rough pipes.

UNIT – V

Standard Patterns of flow: Source, sink, vortex pair, spiral vortex, flow past a half body, flow past a cylinder with and without circulation, flow past a Rankine body.

Suggested Reading:

1. Schlichting Herman and Klaus Gersten, *'Boundary Layer Theory'*, Springer (India) Pvt Ltd., New Delhi, 2007
2. Yunus A Cengel and John M Cimbala, *'Fluid mechanics: Fundamentals and Applications'*, Tata McGraw-Hill Publishing Company, New Delhi, 2008
3. Som, S. K. and Biswas, G., *'Fluid Mechanics and Fluid Machines'*, Tata McGraw-Hill Publishing Company, New Delhi, 1998
4. Vijay Gupta and Santosh K. Gupta, *'Fluid Mechanics and its applications'*, Wiley Eastern Ltd., New Delhi,1984

CE 1202 *w.e.f. 2017-2018*

ENGINEERING HYDROLOGY

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- To provide the requisite knowledge of hydrologic principles
- To demonstrate how hydrologic principles can be applied to supplement decision support system for water and environmental management.
- To introduce the types and classes of hydrologic simulation models.

Course Outcomes:

- Water students and engineers will be able to deal with issues pertaining to design and operation of data retrieval and storage systems, forecasting and impact of climate change.
- Meet the needs of students who expect to become involved in programs concerned with the development, management and protection of water resources.

UNIT – I

*Atmospheric Water System***:** Hydrologic cycle, hydrologic budget, hydrologic models, solar and earth radiation, the general circulation, humidity, wind, hydrologic measurements and data sources, importance of hydrology and its applications in engineering.

UNIT – II

*Precipitation***:** Formation, measurement**,** interpretation and variation.
Infiltration: Measurement, models to calculate infiltration, SCS runoff curve number procedure.
Surface Water Hydrology: Rainfall-runoff process, quantitative measures of drainage basin characteristics, droughts and low stream flow, long term trends, hydrologic relations in droughts, drought frequency analysis, and low flow maintenance.

UNIT – III

*Hydrologic Simulation and Stream Flow Synthesis***:** Types of mathematical models, classification and components of hydrologic simulation models, single event rainfall-runoff models.

Conceptual Models of Unit Hydrograph: watershed response, linear channel, linear reservoir, cascade of linear channels and Nash model.

UNIT – IV

*Urban Hydrology***:** Urban runoff and climatic factors, environmental impacts of urban runoff, integrated framework for storm water management, ecological approaches to urban drainage system design, application of computer models.

UNIT – V

Reliability in Engineering: Brief theory of engineering reliability analysis, definitions of reliability and risk measures of reliability.

Uncertainty in Engineering: Definition of uncertainty, types of sources of uncertainty, analysis of errors, analysis of uncertainty.

Risk Analysis and Management: Classification of risks, sources of risk, estimation of risk.

Suggested Reading:

1. Ven Te Chow (1964), 'Hand book of Applied Hydrology' McGraw-Hill Book Company, New York.
2. Warren Viessman, Jr, Gary L. Lewis (2008), 'Introduction to Hydrology ', Prentice Hall of India, New Delhi.
3. Raghnath, H. M.(1985), 'Hydrology', New Age International Pvt. Ltd., New Delhi.
4. Ray K. Linsley, Jr, Max A. Kohler, Joseph L. H. Paulhus (1988), 'Hydrology for Engineers', McGraw-Hill Book Company, New Delhi.
5. Yeou Koung Tung, Benchie Yen, Charles Staven Melching (2005), 'Hydro systems Engineering Reliability Assessment and Risk Analysis', McGraw-Hill Book Company, New Delhi.
6. Yeou Koung Tung, Benchie Yen (2005), 'Hydro systems Engineering Reliability un certainity Analysis', McGraw-Hill Book Company, New Delhi.

CE 1203 *w. e. f. 2017-2018*

GROUNDWATER ENGINEERING

Instruction	**: 3 periods per week**
Duration of University Exam	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- A pathway to understand the basic physical principles of groundwater flow, differential equations, boundary condition and groundwater quality.
- Knowledge of various aspects of recharge of groundwater.
- Exposure to use the numerical solutions to solve problems with complex realistic situations.

Course Outcomes:

- Knowledge of groundwater hydrology and hydraulics of the movement of water in aquifers to manage groundwater resources.
- Use of knowledge and skill for the enhancement of human welfare.
- Ability to deal with more realistic situations to solve problems pertaining to groundwater quality.
- Conduct simulation studies for future state of groundwater systems, optimal protection and rehabilitation strategies

UNIT-I

Introduction: Ground water in hydrologic cycle, Distribution of subsurface water, ground water potential, occurrence of groundwater in hydro geologic formations, components of groundwater studies, Darcy's law and its validity.

Governing equations of groundwater flow in aquifers: 3-D Ground water flow equations in Cartesian and polar coordinates, equations for steady radial flow into a well in case of confined and unconfined aquifers,

equations for effect of uniform recharge in a fully penetrating unconfined aquifer, well flow near aquifer boundaries.

UNIT-II

Equations for unsteady radial flow into a well in case of confined aquifer, determination of Storage coefficient and Transmissibility (S and T) by Theis's graphical method, Cooper-Jacob's and Chow's method. Image well theory, partial penetration of wells, multiple well systems.

UNIT-III

Artificial recharge of aquifers: Introduction, current trends in artificial recharge, spreading methods, injection wells, technical feasibility and economic viability.

Geophysical methods in groundwater Exploration: surface geophysical methods: electrical resistivity method, seismic method, magnetic method, determination of aquifer thickness.

UNIT-IV

Quality of groundwater and seawater intrusion in coastal aquifers: Dissolved constituents in groundwater and their effects, fluctuations in groundwater, mechanism of salt water intrusion, Ghyben-Herzberg relation, slope and shape of the interface, prevention and control of seawater intrusion, case studies involving sea water intrusion.

UNIT-V

Models in ground water analysis: Major applications of ground water models, sand models, viscous fluid models, membrane models, thermal models, electric-Analog models, numerical modeling of ground water systems.

Suggested Reading:

1. Ven-Te-Chow, (1964) 'Hand book of Applied Hydrology', McGraw-Hill Book Company, New York.
2. Todd, D.K. (1980) 'Groundwater Hydrology', John Wiley and Sons, New York.
3. Karanth, K. R. (1987) 'Groundwater Assessment, development and Management', Tata Mc Graw – Hill publishing company New Delhi.

4. Raghunath H.M,(1982), ‘Ground water’ Wiley Eastern Ltd, New Delhi.
5. Wang Herbert. F. and Anderson Mary. P.(1995), ‘Introduction to groundwater modeling; FDM and FEM’, Academic Press, New York.
6. Rastogi, A.K. (2007) ‘Numerical Groundwater Hydrology’, Penram International publishing (India) Pvt Ltd.

CE 1204 *w. e. f. 2017-2018*

IRRIGATION ENGINEERING

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to concepts of soil-water-plant relationship
- Exposure to various water application techniques and their design principles
- Awareness relating to the drainage equations and its applications

Course Outcomes:

- Design of water application techniques
- Planning for Irrigation and drainage facilities

UNIT–I

Soil Agronomy – Soil moisture retention and movement, soil moisture tension, soil moisture stress, soil moisture constants (saturation capacity, field capacity, permanent witting point and available water), Measurement of soil moisture (Gravimetric, tensiometer, pressure membrane, electrical resistance and Neutron moisture meter methods), Soil-water-plant relationships, soil – water relationships, Soil – Crop relationships and fertility of soil.

UNIT–II

Estimation of evapotranspiration from direct and indirect/climatological data using Blanney–Criddle, Theronthwaite, Penmann, Modified Penman Method, Hargreaves radiation methods.

UNIT-III

Water Application methods – Details and design specifications for Border, Check basin, Furrow, sprinkler, and drip methods of applications of water. Irrigation requirements: gross, net, and frequency of application, Irrigation efficiencies.

UNIT-IV

Basics of Groundwater flow- Dupuit-Forchheimer's assumptions, water table subjected to recharge or capillary rise, steady flow towards a well, steady state drainage equations (Hooghoudt, and Ernst), unsteady state drainage equations (Glover-Dumm).

UNIT-V

Drainage criteria- Water table indices for drainage design, steady state versus unsteady state drainage equations, critical duration, storage capacity, and drainage design.

Drain spacings: principles of Hooghoudt, and Ernst equations.

Suggested Reading:

1. Ritzema, H.P. (1994), 'Drainage Principles and Applications', International Institute for Land Reclamation and Improvement, Publication no.16 (second edition), Netherlands (www.ilri.nl)
2. Beers Van W.F.J. (1976), 'Computing Drain Spacings', International Institute for Land Reclamation and Improvement, Bulletin no.15, Netherlands (www.ilri.nl)
3. Michael, A.M. (1978), 'Irrigation Theory & Practice', Vikas Publishing House, New Delhi.

CE 1205 *w. e. f. 2017-2018*

OPEN CHANNEL HYDRAULICS

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to the basic concepts of free surface flows
- Description of the equations of varied flows
- Basic concepts of Fluvial Hydraulics

Course Outcomes:

- Application of principles of free surface flows and fluvial Hydraulics
- Planning and application of the equations of varied flows

UNIT – I

Basic Concepts: Velocity and Pressure distribution, effect of slope on pressure distribution, energy and momentum principles, features of uniform flow, conveyance and section factor of a channel section, hydraulic exponent for uniform flow computation, flow computations in compound sections.

UNIT – II

Varied Flow: Application of specific energy and specific force concepts, Computation of flow profiles by Direct Integration and standard step method, profiles resulting from change in bed slope, jumps in non-rectangular channels, cross waves, design considerations for supercritical flow.

UNIT – III

Non Prismatic channels: Introduction, response to a disturbance, gradual change in boundary, flow at a corner, constrictions, super critical flow through constrictions, obstructions, flow between bridge piers, under flow gates, channel junctions.

UNIT – IV

Unsteady Flow: Continuity equation, momentum equation, uniformly progressive flow, positive and negative surges, SVF with increasing and decreasing discharges.

UNIT – V

Fluvial Hydraulics: Basic Characteristics of River Beds and Sediments, initiation of Motion, Regimes of Flow, Resistance to Flow in Alluvial Streams, Theories of Bed Load, Suspended and Total Load, Design of Stable Channels – Tractive Force Method.

Suggested Reading:

1. Chow Ven Te (1959), 'Open channel hydraulics', McGraw-Hill Book Company, New York.
2. French, R. H. (1986), 'Open channel hydraulics', McGraw-Hill Book Company, New York.
3. Hanif Chaudhry, M.(1993), 'Open-channel flow', Prentice-Hall of India Pvt. Ltd., New Delhi.
4. Subramanya, K. (1986), 'Flow through open channels', Tata McGraw-Hill Publishing Company, New Delhi.
5. Ranga Raju, K.G. (1983), 'Flow through open channels', Tata McGraw-Hill Publishing Company, New Delhi.
6. Henderson, F.M. (1967), 'Open Channel Flow', Mc Millan Publishing Company, NewYork
7. Bakhmeteff, B.A. (1932), Hydraulics of Open Channels', McGraw-Hill Book Company, New York.
8. Garde and Ranga Raju, K. G. (1980): "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wilsey Eastern, New Delhi.

CE 1206 *w. e. f. 2017-2018*

WATER RESOURCES SYSTEMS

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to various steps in water resources systems approach.
- Economic decision making in water resources.
- Identification of decision variables for linear and dynamic programming models and solution procedures for simple problems.

Course Outcomes:

- Ability to understand water resources systems concepts their stages and procedures.
- Application of Cash flow diagrams and solution to Water Resources problems based on economical aspects
- Ability to formulate WRE problems by L.P. and D.P models and solving simple problems.

UNIT – I

Introduction: Objectives of water resources development, plan formulation, planning models and solution procedures, basic steps involved in water resources systems approach, cash flow diagrams, annuities, discounting (Net Present Value, Internal Rate of Return, and Benefit Cost Ratio), and non-discounting techniques (urgency, payback, and average rate of return), cost comparison, determination of project benefits, economic and financial analysis of projects.

UNIT – II

Water Resources Planning: Concept of Water Resources Planning, Categories of Water Use, Stages and Flow Activities, Relationship among

stages, Data Collection and Processing, Estimation of Future Water Demands for Irrigation, Municipal Use, Industrial and Hydropower, Planning for Operation.

UNIT – III

Optimization techniques: Linear programming (introduction, geometrical approach and interpretation, basic concepts of simplex method), Dynamic Programming (basic concepts, general approach to recursive optimization, formulation of multistate problems), application to water resources engineering problems.

UNIT – IV

Stochastic optimization: Introduction to stochastic linear and stochastic dynamic programming, two stage linear programming, linear programming with chance constraints.

Simulation: Basic concepts and application to water resources engineering problems.

UNIT – V

River basin planning models: Irrigation planning model, resource inputs of irrigation, crop diversification, costs of inputs, formulation of linear programming models for single reservoir, multi reservoir cases with single and multiple objectives.

Suggested Reading:

1. Loucks, D. P., Stedinger, J. R., and Douglas, A.H. (1981), 'Water Resources Planning and Analysis', Prentice-Hall, New York.
2. Kuiper Edward (1965), 'Water Resources Project Economics', Butterworths and Company Ltd., London.
3. Jain, S.K. and Singh V.P. (2003), 'Water Resources Systems Planning and Management', Elsevier Science, B.V., Amsterdam.
4. Taha, H. A. (1982), 'Operations Research an introduction', Prentice-Hall of Indial, New Delhi.
5. Pramod. A. Bhave (2011) "Water Resources Systems" Narora Publishing House, 22, Medical Association Road, Dharyagunj, New Delhi – 110 002.

CE 1211 *w. e. f. 2017-2018*

APPLIED STATISTICS IN WATER RESOURCES ENGINEERING

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to frequency distribution and sampling
- Concepts of regression and correlation
- Knowledge about sampling distributions and tests of significance

Course Outcomes:

- Fitting of Probability distribution to data, modeling of the data in statistical domain especially in WR field
- Substantial knowledge in Regression and application to real problems.
- They are expected to check the significance tests especially in Hydrological applications.

UNIT-I

Introduction : Frequency Distribution - Measures of central tendency- measures of dispersion - Standard error - Skewness - kurtosis-moments - definitions and applications, Karl Pearson's, Bowley's, Kelly's, moment's methods - sampling- simple random sampling - stratified sampling - systematic sampling- sample size determination, and applications in Water Resources Engineering.

UNIT-II

Probability : axioms of probability - addition theorem on probability - conditional probability- independent events and multiplication theorem on probability - Baye's theorem - Random variables- discrete and Continuous random variables - probability distribution and density functions- Mathematical expectation - Moment generating function

Statistical Distribution: Binomial, Poisson, Normal distributions and fitting of these distribution -exponential distribution - gamma distribution -

uniform distribution - chi-square distribution ,and applications in Water Resource Engineering

UNIT-III

Regression and Correlation: Simple , multiple, total, partial linear and non-linear regressions-regression coefficients-regression equations - correlation - multiple correlation - multiple correlation coefficients - Standard error of estimate –curvilinear regression -analysis of variance - and applications in Water Resources Engineering.

UNIT-IV

Multivariate Data Distributions: Types of data - Base vectors and matrices - simple estimation of centroid, standard deviation, dispersion, variance and covariance - correlation matrices - Principal component analysis and Time series analysis .

UNIT-V

Exact Sampling Distributions and Tests of Significance : Chi-square distribution - student's t- distribution and F - distribution,-sampling and non-sampling errors - sampling fluctuations .sampling distribution of a statistic- standard error a statistic - Estimation theory - point estimation - interval estimation- confidence limits for population parameter - confidence interval of the mean - Testing hypothesis - Large sample and small sample tests - Tests of significance of single mean - difference between two means, difference between two variances -test of significance for single proportion (small samples and large samples) t-test, chi -square test - F-test, applications in Water Resources Engineering.

Suggested Reading:

1. Snedecor, G.W. and W.G. Cochran (1994), 'Statistical Methods', East West Press, New Delhi.
2. Alfredo, H.S. and Tang Wah (1975), 'Probability Concepts in Engineering Planning and Design: Vol-I (Basic Principles), John Wiley & Sons, New York.
3. Simpson and Kafks (1969), 'Basic Statistics', Oxford IBH, Calcutta.

CE 1212 *w.e.f. 2017-2018*

ENVIRONMENTAL IMPACT ASSESSMENT

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction of EIA concepts and methodologies.
- Importance of data collection of EIA assessment.
- Preparation of EIA reports and discussion about various environmental impact Laws pertaining to India.

Course Outcomes:

- Knowledge to assess environmental related projects.
- Understanding legislative acts to contribute towards clean environment
- Design of an efficient municipal solid waste management system

UNIT I

Environmental Impact Assessment: Definition, basic concepts and principles of EIA. Regulatory frame work in India. Environmental inventory, base line studies, over view of EIA studies.

UNIT II

Assessment and Methodologies: Physical, biological assessment, Socio economic and cultural environmental assessment, EIA methodologies– Adhoc, matrix, checklist approaches. Economic evaluation of impacts-cot benefits of EIA, Public participation in environmental decision making. Procedures for reviewing EIA analysis and statement.

UNIT III

Environmental Assessment: Introduction, process, Basic steps involved, Description of environmental setting – Base line data collection, possible impacts due to water resources projects. Impact prediction and assessment – methods of impact assessment, Matrix and check list method, Selection of proposed action. Preparation of environmental impact statement.

UNIT IV

Environmental Legislation and Regulations: Rationale, concerns, legislative data systems, safe drinking water act, clean water act, clean air act, noise control act, resource conservation and recovery act, comprehensive environmental response, compensation and liability act.

UNIT V

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/recycle, energy recovery, treatment and disposal).

Suggested Reading:

1. Canter, L.W. (1996), 'Environmental Impact Assessment', McGraw-Hill Book Company, New York.
2. Corbitt Robert A. (1999), Standard Hand Book of Environmental Engineering' McGraw-Hill Book Company, New York.
3. Marriott ( ), 'Environmental Impact Assessment: A Practical Guide', McGraw-Hill Book Company, New York.
4. Sabins F.F. Jr.(1978), 'Remote Sensing Principles and Interpretations' W.H. Freeman and Company, San Francisco
5. Jensen John R. (1986), 'Introductory Digital Image Processing', Prentice-Hall of India New York

CE 1213 *w.e. f. 2017-2018*

FLOOD ANALYSIS AND CONTROL

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Awareness about flood characteristics and flood forecasting systems
- Description of Flood mitigation, adjustment, and regulation
- Knowledge of Hydrological time series analysis

Course Outcomes:

- Ability to critically review and interpret scientific information on mathematics of flood forecasting and flood routing
- Advanced understanding of flood plain adjustment issues and the other technologies employed for flood management.

UNIT - I

Flood characteristics and forecasting : Measureable features of a flood (Elevation, discharge, volume, and duration), flood forecasting (unit hydrograph method, meteorological and snow data, and snow field air temperatures), operation of flood forecasting systems.

Space-time characteristics of rainfall: Policy criteria for design flood of a major and minor reservoir, spillways, diversion dams and barrages, design flood criteria for dams and other hydraulic structures (CWC recommendations).

UNIT - II

Flood routing: Mathematics of flood routing, various methods of flood routing, Hydrologic and Hydraulic routing.

UNIT - III

Flood mitigation : Flood mitigation reservoirs(purpose, location, size and operation) levees and flood walls (location, maintenance and flood fighting), flood ways, channel improvement, evacuation and flood proofing, land management, flood plain management, estimating benefits of flood mitigation.

UNIT - IV

Flood plain adjustments and regulations: Results of controlling floods, alternatives to controlling floods, range of possible adjustments, practical range of choice, critical characteristics of flood hazards, classification of flood plain land, and regulation of flood plain use, river training works (guide banks, approach and afflux embankments, spurs / groynes, artificial cut-offs, bank protection, pitched banks, and miscellaneous methods).

UNIT – V

Hydrologic Time Series Analysis: Independent and Auto-correlated data, structure of hydrologic time series, trend, jump, seasonality, stationarity, Auto-covariance and Auto-correlation Function, Correlogaram Analysis, spectral Analysis, Analysis of Multi-Variant Hydrologic series.

Suggested Reading:

1. Ven Te Chow (1964), 'Hand Book of Applied Hydrology', McGraw-Hill Publishers, New York.
2. Linsley, R. K. and Franzini A. W. (1992), 'Water Resource Engineering', McGraw-Hill Publishers, New York.
3. Varshney, R. S. (1979), 'Engineering Hydrology', Nem Chand Publishers, Roorkee.
4. Jaya Rami Reddy, P. (1987), 'A. Text Book of Hydrology', Lakshmi Publishers, New Delhi.
5. Daniel H. Hoggan (1989), 'Computer Assisted Flood Plain Hydrology and Hydraulics', McGraw-Hill Publishers, New York.

CE 1214 *w.e.f. 2017-2018*

GEOSPATIAL TECHNIQUES

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Description about various spatial and non-spatial data types, and data base management techniques
- Development of the concepts and professional skills in utility of geospatial techniques
- Enhancement of knowledge of geospatial techniques to field problems

Course Outcomes:

- Geospatial technology relating to the data acquiring and processing that is associated with geographic locations
- Application of Geospatial techniques in the decision support systems useful for decision makers and community services.
- Utility of Geospatial techniques in the fields of natural resource management, environment, urban planning and development, etc.

UNIT I

Introduction: Basic concepts, socioeconomic challenges, fundamentals of geographical information systems (GIS), history of geographical information system, components of geographical information systems.
Projections and Coordinate Systems: Map definitions, representations of point, line, polygon, common coordinate system, geographic coordinate system, map projections, transformations, map analysis.

UNIT II

Data Acquisition and Data Management: data types, spatial, non spatial (attribute) data, data structure and database management, data format, vector and raster data representation, object structural model filters and

files data in computer, key board entry, manual digitizing, scanner, aerial photographic data, remotely sensed data, digital data, cartographic database, digital elevation data, data compression, data storage and maintenance, data quality and standards, precision, accuracy, error and data uncertainty.

Data Processing: Geometric errors and corrections, types of systematic and non systematic errors, radiometric errors and corrections, internal and external errors.

UNIT III

Data Modeling: Spatial data analysis, data retrieval query, simple analysis, recode overlay, vector data model, raster data model, digital elevation model, cost and path analysis, knowledge based system.

GIS Analysis and Functions: Organizing data for analysis, analysis function, maintenance and analysis of spatial data, buffer analysis, overlay analysis, transformations, conflation, edge matching and editing, maintenance and analysis of spatial and non spatial data

UNIT IV

Applications of GIS: Environmental and natural resource management, soil and water resources, agriculture, land use planning, geology and municipal applications, urban planning and project management, GIS for decision making under uncertainty, software scenario functions, standard GIS packages, introduction to Global Positioning Systems (GPS) and its applications.

UNIT V

Introduction to Remote Sensing: General background of remote sensing technology, objectives and limitations of remote sensing, electro-magnetic radiation, characteristics, interaction with earth surface and atmosphere, remote sensing platforms and sensors, satellite characteristics, digital image processing, IRS series and high resolution satellites, software scenario functions, remote sensing applications to watershed modeling, environmental modeling, urban planning and management.

Suggested Reading:

1. Burrough, P. A., and McDonnell R. A. (1998), 'Principles of Geographical Information Systems', Oxford University Press, New York
2. Choudhury S., Chakrabarti, D., and Choudhury S. (2009), 'An Introduction to Geographic Information Technology', I.K. International Publishing House (P) Ltd, New Delhi
3. Kang-tsung Chang. (2006), 'Introduction to Geographical information Systems', Tata McGraw-Hill Publishing Company Ltd., Third Edition, New Delhi
4. Lilysand T.M., and Kiefer R.W. (2002), 'Remote Sensing and Image Interpretation', John Wiley and Sons, Fourth Edition, New York
5. Sabins F.F. Jr. (1978), 'Remote Sensing Principles and Interpretations', W.H. Freeman and Company, San Francisco
6. Tor Bernhardsen. (2002), 'Geographical Information System', Wiley India (P) Ltd., Third Edition, New Delhi
7. Hoffman-Wellenhof, B, et al. (1997), 'GPS Theory and Practice', Fourth Edition, Springer Wein, New York.

CE 1215 *w.e.f. 2017-2018*

GROUNDWATER CONTAMINATION: TRANSPORT AND REMEDIATION

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to the concepts of contaminant transport.
- Description of the NAPL impacts in source areas and plumes by modeling approaches.
- Illustration of the various evaluation schemes and emerging remediation techniques.

Course Outcomes:

- Solve problems of groundwater flow and solute transport
- Able to handle pollutants and treat them effectively
- Application of knowledge to solve problems of contaminant transport by modeling techniques

UNIT I

*Introduction to groundwater contamination***:** Hydrologic cycle, groundwater hydrology, groundwater contamination and transport, evolution of groundwater information, groundwater remediation, and groundwater movement, general flow equations and well mechanisms.

UNIT II

Sources and types of groundwater contamination: Introduction, under ground storage tanks, landfills, surface impoundments, waste disposal of injection wells, radioactive contaminants, classification of organic compounds, inorganic compounds in ground water. Non aqueous phase

liquids (NAPL'S): types, general processes, transport, fate of NAPL'S in subsurface.

UNIT III

Contaminant transport mechanisms: Introduction, advection process, diffusion and dispersion process, mass transport equation, governing flow and transport equations, analytical methods, tests for dispersivity.

UNIT IV

Flow and transport in the unsaturated zone: Capillary action, governing equations for unsaturated flow, transport process in unsaturated zone and its governing equations.

Remediation alternatives: introduction to remediation method and alternatives, containment methods for source control, hydraulic controls and pump and treat systems, bio-remediation, soil vapor extraction systems, emerging remediation technologies.

UNIT V

Numerical modeling of contaminant transport: Introduction, numerical methods, finite difference methods(FDM), finite element methods (FEM), methods of characteristics, numerical flow models, contaminant transport models, applying numerical model to field sites.

Suggested Reading:

1. Philip. B. Bedient, Hanadis. Rifai ,and Charles. J. Newell (1999), 'Groundwater Contamination: Transport and Remediation', Prentice-Hall, New Jersey.
2. Lakshmi.N.Reddi, Hilary, I.Inyang (2000) 'Geo-Environmental Engineering: Principles and Applications', CRC Press, Florida.
3. Zheng Zheng Chunmiao and Gordon. D. Bennett(1995), 'Applied Contaminant Transport Modeling (Theory and Practice)', John Wiley and Sons, New York.
4. Wang Herbert. F., and Anderson Mary.P.(1995), 'Introduction to Groundwater Modelling Finite Difference and Finite Element Methods', Academic Press, San Diego

CE 1216 *w.e.f. 2017-2018*

HYDRAULIC STRUCTURES

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Description of the design aspects of different types spillways
- Knowledge regarding the design of energy dissipation arrangements
- Awareness about urban storm drainage and concepts of dam safety

Course Outcomes:

- Application of design principles to different types spillways, energy dissipation arrangements and urban storm drainage systems

UNIT–I

Introduction – Functions of Spillways, Design flood, Hydraulic design steps for Side Channel spillway, Chute Spillway, and Shaft Spillway

UNIT–II

Roller Compacted Concrete (RCC) dams, Hydraulic design steps for Stepped spillway, and air regulated siphon spillway

Hydraulic design steps for Labyrinth weir and Duck bill spillway

UNIT – III

Energy Dissipaters – Factors governing the design, design criteria of energy dissipaters as per U.S.B.R. guide lines.

Cavitation and air entrainment in spillway as per BIS 2804-1989

UNIT – IV

Urban drainage: Quantity of storm water, design of storm water drainage system, SCS curve technique, design of culverts for submerged and partly submerged flow situations, airport drainage.

UNIT–V

Dam safety – Principles and concepts for new dams and existing dams, hazard classification of dams, spillway capacity criteria, safety of existing embankment dams and appurtenant structures.

Suggested Reading:

1. Water Resources Technical Publication (1974) 'Design of Small Dams (USBR)' Oxford and IBH Publication Company, New Delhi.
2. Vischer D.L. & W.H. Hager (1998) 'Dam Hydraulics' Wiely International Edition., New York
3. Novak P., A.I.B. Moffat, R. Nalluri & R. Narayanan(1990), 'Hydraulic Structures' Unwin Publishers, London
4. Larry-W-Mays (2006), 'Water Resources Engineering', John Wiley & Sons, Singapore
5. John E. Gribbin (1997), 'Hydraulics and Hydrology for Stormwater Management', Delmar Publishers, New York
6. Creager W.P., Joel D. Justin and Julion Hinds,(1961) 'Engineering for Dams' Volume I,II & III John Wiley and Sons Inc, New York

CE 1217 *w.e.f. 2017-2018*

IMPACTS OF CLIMATE CHANGE IN WATER RESOURCES ENGINEERING

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction to basic concepts of General Circulation Models and their importance.
- Features of Indian summer monsoon rainfall (ISMR) and their characteristics
- Downscaling principles of statistical downscaling and dynamical downscaling.

Course Outcomes:

- Analysis and synthesis on the causes of climate change on hydrology using General Circulation Models (GCMs)
- Modeling of climate variables using Statistical and Dynamic downscaling methodologies
- Applications SDSM and VIC models

UNIT–I

Climate System- Weather and Climate- Overview of earth-atmosphere- vertical structure of atmosphere- Radiation and Temperature- Temperature variation- vertical variation in Air temperature- temperature extremes

UNIT–II

Hydrological cycle- Introduction- Global water balance- cycling of water on land- simple water balance- climate variables affecting precipitation- forms and types of precipitation.

UNIT – III

Monsoon- wind patterns in India-Global wind circulation- clouds- Types of clouds-Indian summer monsoon Rainfall (ISMR) - characteristics- climate variability- Floods- droughts- drought Indicators - climate extremes.

UNIT – IV

Causes of climate change - Modeling of climate change-General circulation models (GCMs) –IPCC scenarios - IPCC Assessment Report (AR5) - physical science basis.

UNIT–V

Bias correction methods -Downscaling – Types of downscaling- Dynamical downscaling-Regional Climate Models - statistical downscaling - Types of statistical downscaling - climate predictors - data reduction techniques - principal component analysis- step wise regression- Lasso- - Kernel Regression - SDSM software - Hydrology models - Introduction on Soil and water assessment tool SWAT and VIC (variable Infiltration capacity models)

Suggested Reading:

1. Bonon G B (2008) - Ecological climatology- Cambridge University Press Edition- II - ISBN-1107268869, 9781107268869.
2. RL Wilby, SP charles, E Zoritaa, B Timbal, P WHetton, LO Mearns (2004) - Guide lines for use of climate science from Statistical Modeling models.
3. Physical science basis of AR 5 report of IPCC (2013)- working group I contribution to Assessment Report- https://ipcc.ch/report/ar5/wg1/
4. Soil and Water Assessment Tool (2005) SWAT- user Manual Report (2005) http://swat.tamu.edu/media/1294/swatuserman.pdf
5. VIC model Macro scale Hydrologic Model- http://www.hydro.washington.edu/Lettenmaier/Models/VIC/index.shtml
6. Rasmus E Benestad, Inger Hanson Baver, Delinag Chen (2008) Empirical Downscaling World Scientific Publishing Co. Ltd.

CE 1218 *w.e.f. 2017-2018*

MODELS OF AIR AND WATER QUALITY

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Description of the concepts of water and air pollution
- Exposure to the principles of modeling and their application to water bodies
- An overview regarding reservoir sedimentation

Course Outcomes:

- Capable of analyzing stream water and air quality issues along with the modeling techniques and standards
- Capable to estimate the reservoir sedimentation problems and apply various methods to control them

UNIT – I

Introduction: Water pollutants and their sources Stream sampling – hydrological factors affecting the stream self – purification. Steady state conservative system, steady state with non-conservative pollutants.

UNIT – II

Stream pollution modeling concepts: Measurement of BOD – Streeter Phelp's equation – Effect of temperature on BOD, Kinetic reaction rate – Stream re-aeration. Analysis of DO Sag curve by Streeter – Phelps equation method, statistical method.

UNIT – III

Water Quality of Lakes and Reservoirs: Mass balance model, Phosphorus model, Thermal stratification, Eutrophication of lakes.

Reservoir sedimentation: Determination of sediment yield, measurement of suspended load, Bed load estimation by empirical methods, control of sedimentation

UNIT – IV

Air Pollution: Sources and effects, scales of concentration, classification and properties of air pollutants effects of air pollution and air pollution standards, dispersion of air pollutants. Meteorological aspects of air pollution and atmospheric stability

UNIT -V

Plume behavior, modeling of air pollution: Gaussian plume model – determination of maximum ground level concentration due to elevated source pollutants. Limitations of Gaussian model, effective stack height concept and estimation of plume rise**.**

Suggested Reading:

1. Keily Gerard (1998), 'Environmental Engineering' McGraw-Hill International Publishers, London.
2. Fischer, H.B., E. John List, Robert C.Y. Koh, Jorg Imberger, and Norman H. Brooks(1979), 'Mixing in Inland and Coastal Waters' Academic Press Inc., New York.
3. Nelson Leonard Nemerow (1974), 'Scientific Stream Pollution Analysis' McGraw-Hill Publishers.
4. Wurbs, R. A. and James, W.P.(2002), 'Water Resources Engineering', Prentice-Hall of India, New Delhi.
5. Graf, W.H. (1971), 'Hydraulics of Sediment Transport', McGraw-Hill Book company, New York
6. Yalin, M.S. (1997), 'Mechanics of Sediment Transport', Pergaman Press, Oxford.

CE 1219 *w.e.f. 2017-2018*

SOFT COMPUTING APPLICATIONS IN WATER RESOURCES ENGINEERING

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Introduction of Soft computing concepts and terminology.
- Method of Solution and simple problem solving for Goal Programming problems.
- Various terminology and simple numerical problems for Neural Networks, Genetic Algorithm and Fuzzy based systems.

Course Outcomes:

- Ability to understand soft computing concepts, methods and technical terms
- Formulation of mathematical model using Goal programming and able solve simple problems
- Terminology and flow diagrams, terminology of NN model, Fuzzy Logic and G.A.s

UNIT – I

Goal Programming: Introduction, Concept of Goal Programming, Single Goal Models, Multiple Goal models, Multiple goals with priorities, Multiple goals with priorities and weights, Formulation of Goal programming, Methodology and solution of Goal programming by Simplex method for simple problems, Formulation of Goal Programming for Simple water resources problems.

UNIT – II

Multi Objective Optimization: Introduction, Plan generation, Weightage method, Constraint method, Methods of Estimation of weights by Weightage method, Constraint method, formulation of Multi-Objective problem by Goal Programming method, application of simple water resources multi-Objective problems.

UNIT –III

Neural Net works: Fundamental concepts, Biological Neural networks, Basic Models in Neural networks, Comparison of Biological Neuron and artificial neuron, terminology of Neural networks. Supervised learning networks and calculation of error. Back propagation networks (algorithm and architectures).

UNIT – IV

Fuzzy sets: Introduction to fuzzy sets and classical sets, fuzzy set operations and properties. Fuzzy relations, fuzzy membership functions, Fuzzy logic, fuzzy quantifiers and fuzzy inferences. fuzzy rule based methods and defuzzification methods. Application of fuzzy methods in water resources.

UNIT – V

Genetic Algorithms: Fundamentals of genetic algorithms, basic concepts, binary coding, fitness function, Reproduction, (Roulette wheel selection, Tournament selection). Cross over and mutation operations, convergence of algorithm. Simple applications in water resources.

Suggested Reading:

1. Raja Sekharan S. and Vijaya Laxmi Pai G. A. (2003), 'Neural Networks, Fuzzy Logic, and Genetic Algorithm', Prentice-Hall of India, New Delhi.
2. Jang J.S.R. , C.H. Tsai Sun, and Eiji Mizutsani (2004), 'Neuro-Fuzzy and Soft Computing', Pearson Education, New Delhi.
3. Ashok. D. Belegundu and Chandraputala T.R.(2002), 'Optimization concepts and Applications in Engineering', Pearson Education, New Delhi.
4. Vedula S. and. Mujumdar P.P. (2005), 'Water resources Systems', McGraw-Hill Publishing Company, New Delhi.

5. Srinivasa Raju K. and Nagesh Kumar D. (2010), 'Multi-Criterian Analysis in Engineering & Management', Prentice-Hall of India, New Delhi.
6. John Yen and Reza Langari (1999), 'Fuzzy Logic: Intelligence Control Information', Pearson Education, New Delhi.

CE 1220 *w.e.f. 2017-2018*

WATER POWER ENGINEERING

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- An overview of hydro power development
- Exposure to the principles involved in the design of surge tanks and penstocks
- Description regarding the concepts of speed and pressure regulation

Course Outcomes:

- Planning for hydro power development projects
- Application of principles involved in the design of surge tanks and penstocks

UNIT – I

General: Comparison with other methods of power generation, Site investigation and location of water power plant, Study of stream flow data for power estimation - Pondage and storage, and load prediction.
Development of power: Different types of layout, component parts of waterpower schemes.

UNIT – II

Water Conductor System: Intake – Various types, Hydraulics of Intakes, gates and their operations.

Powerhouse: General arrangements and criteria for fixing power house dimensions, including mechanical & electrical equipment details.

UNIT – III

Pipe networks : Analysis by Hardy Cross Method, and Newton Raphson Method, Joining and laying of pipes and pipe specials (Cast Iron, Ductile Iron, Pre stressed Concrete, and HDPE).

Penstocks and Pressure Shafts: Classification, Hydraulic design, Economical diameter of Steel Penstocks

UNIT – IV

Hydraulic transients and Surge Tanks: Introduction, effect of rapid valve closure, unsteady compressible flow, surge protection, and method of characteristics to water hammer.

Water Hammer theory – Joukowsky's method, and Allieve's method.

UNIT – V

Anchor Blocks: Various types and design of simple anchor blocks, Design of simple surge tanks, and method of characteristics to the design of surge tanks.

Pressure Regulation: General features, auxiliary devices, automatic and remote control devices, governor improvement methods, performance characteristics and speed regulation of different turbines.

Suggested Reading:

1. Creager W. P., and Justin J..D. (1959), 'Hydroelectric Hand Book', John Wiley and Sons Inc New York.
2. Barrows, H.K. (1980), 'Water Power Engineering', Tata McGraw-Hill Publishing Company, New Delhi.
3. EI-Wakil, M.M. (1984), 'Power Plant Technology', Mc.Graw-Hill Book Company, New York
4. Bhave, P.R., Gupta, R. (2006), 'Analysis of flow in water distribution networks', Narosa Publishing House, New Delhi.
5. Modi, P.N. (1988), 'Irrigation, water resource and Water Power Engineering', Standard Book House, New Delhi.

CE 1221 *w.e.f. 2017-2018*

WATERSHED MANAGEMENT

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Description about the concept of watershed and watershed management systems
- Introduction to the characteristics of watershed parameters
- Enhancing the working knowledge to create the data base of watershed using geospatial techniques

Course Outcomes:

- Application of Watershed Management practices in conservation vital natural resources like land and Water.
- Awareness on proper use of all available resources of a watershed for optimum production with minimum hazards

UNIT-I

Definition and concept of Watershed: Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management.

UNIT-II

Characteristics of Watershed: Size, shape, physiographic, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

UNIT-III

Principles of Erosion: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation.

Measures to Control Erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rock fill dams, brushwood dam, Gabion.

UNIT-IV

Water Harvesting: Rainwater harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds and percolation tanks.

Land Management: Land use and land capability classification, management of forest, agricultural, grassland and wild land, reclamation of saline and alkaline soils.

UNIT-V

Ecosystem Management: Role of Ecosystem, crop husbandry, soil enrichment, inter mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, silvi pasture, horticulture, social forestry and afforestation.

Applications: Planning of watershed management activities, peoples participation, preparation of action plan, administrative requirements. Social aspects of watershed management, community participation, private sector participation, industrial issues, socio-economy, integrated development, water legislation and implementations, case studies, applications of geospatial techniques in watershed management systems.

Suggested Reading:

1. Wurbs R. A. and James W. P.(2002), '*Water Resources Engineering'*, Prentice-Hall of India, New Delhi
2. Haan C.T., H.P. Johnson, D.L. Brakensiek (1982), '*Hydrologic Modeling of Small Watersheds'*, ASAE, Michigan.
3. Majumdar D.K. (2000), 'Irrigation and Water Management', Prentice-Hall of India, New Delhi.
4. Murthy, J.V.S. (1998), '*Watershed Management'*, New Age International Publishers, New Delhi

CE 1222 *w.e.f. 2017-2018*

WASTEWATER TREATMENT SYSTEMS

Instruction	**: 3 periods per week**
Duration of Semester End Examination	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- Description of different units of primary treatment and their relative importance
- Illustration about various techniques of natural and mechanical systems of sewage disposal
- Knowledge of disposal methods for conservation of water quality in lakes, rivers, and oceans

Course Outcomes:

- Planning for wastewater treatment facilities and conservation of ecological systems
- Selection of appropriate technologies for natural and mechanical systems of sewage disposal

UNIT – I

Planning in domestic wastewater treatment: Outline of unit processes, different types of treatment methods, primary treatment, screening, neutralization, equalization, flocculation, sedimentation, flotation, nitrification - dentitrification systems. Environmental impact and others considerations in planning treatment facilities.

UNIT – II

Aerated Lagoons: Design of facultative aerated, aerobic flow through dual powered aerated and extended aeration lagoons.

UNIT – III

Waste stabilization ponds: Types of ponds, factors affecting pond eco-system, design of aerobic and anaerobic stabilization ponds.

UNIT – IV

Design of wastewater irrigation systems: Rapid infiltration system, over land flow systems, vermiculture and sludge calculations.

UNIT – V

Effluent Disposal: Receiving water standards, disposal into lakes, rivers, mathematics of mass transport, diffusion-advection, and hydraulic models of physical systems. (Continuous flow stirred tank, reactor model, and plug flow reactor model) disposal into the ocean, outfall design.

Suggested Reading:

1. Metcalf and Eddy (1995), 'Wastewater Engg; treatment, disposal reuse', Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Soli J Arceivala(1998), 'Wastewater treatment for pollution control', Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Kiely Gerard (1998), 'Environmental Engineering', McGraw-Hill International Limited., London
4. Hammer, M.J. and Hammer, M.J. Jr.(1998), 'Water and Wastewater Technology', Prentice-Hall of India Pvt. Ltd., New Delhi.

ADVANCED CONCRETE TECHNOLOGY

No. of Credits	**: 3 Credits**
Instruction	**: 3 Periods per week**
Duration of University Examination	**: 3 Hours**
Semester End Evaluation	**: 70 Marks**
Continuous Internal Evaluation	**: 30 Marks**

Course Objectives:

- Learn the characterization of constituents of concrete.
- Design concrete mix by various methods as per different codes.
- Study the different types of admixtures, mix design, properties and applications of special concretes.

Course Outcomes:

- Learn hydration of cement and tests on properties of cement and aggregates.
- Comprehend the properties and testing of concrete in fresh and hardened state.
- Understand the shrinkage and creep mechanisms, curing and durability of concrete.
- Design concrete mixes by various methods.
- Familiarize with the types of admixtures, and applications of special concretes.

UNIT - I

Cement: Types of cement and their composition - Manufacture of Portland cement - Hydration of cement and hydration product - Structure of hydrated cement - Heat of hydration - Gel theories - Review of tests on properties of cement.

Aggregate: Classification of aggregates - Particle shape and texture - Bond and strength of aggregate and its influence on strength of concrete - Porosity - Absorption and moisture content and their influence - Soundness

of aggregate - Alkali aggregate reaction - Sieve analysis and grading of aggregate - Review of tests on properties of aggregate.

UNIT - II

Properties of Concrete: Mixing and batching - Workability - Factors affecting workability - Measurements of workability - Various tests and procedures - Segregation and bleeding - Vibration of concrete - Types of vibrators and their influence on composition - Analysis of fresh concrete - Strength of concrete - Water-cement ratio - Gel space ratio - Effective water in the mix - Mechanical properties of concrete - Tests and procedure - Influence of various parameters on strength of concrete - Relationship between various mechanical strengths of concrete.

UNIT - III

Shrinkage and creep of concrete: Types of shrinkage - Mechanism of shrinkage - Factors affecting shrinkage - Creep mechanism - Factors influencing creep - Rheological model - Effects of creep.

Curing of Concrete: Methods of curing - Maturity concept - Influence of temperature on strength of concrete.

Durability of Concrete: Permeability of concrete - Chemical attack of concrete - Tests on sulphate resistance - Effect of frost - Concreting in cold weather - Hot weather concreting and air entrained concrete.

UNIT - IV

Mix design of concrete: Basic considerations - Process of mix design - Factors in the choice of mix proportions and their influence - Quality control - Various methods of mix design - IS code method - British and ACI methods.

UNIT - V

Admixtures: Classification of admixtures - Chemical and mineral admixtures - Influence of various admixtures on properties of concrete and their applications.

Fly ash concrete: Mix design - Properties and its applications.

High strength concrete: Mix design - Properties and its applications. Fiber reinforced concrete: Mix design - Properties and its applications.

Ferro cement - Lightweight concrete - High-density concrete - Recycled aggregate concrete and their applications.

Suggested Reading:

1. A.M. Neville, “Properties of Concrete”, English Language Book Society-Longman Publications, 1988.
2. P.K. Mehta and J.M.M. Paulo, “Concrete – Microstructure – Properties and Material”, McGraw-Hill, New York, 1997.
3. N. Krishna Raju, “Design of Concrete Mix”, CBS Publications, New Delhi, 1985.

CE 1118 *w.e.f. 2017-2018*

BRIDGE ENGINEERING

No. of Credits	**: 3 Credits**
Instruction	**: 3 Periods per week**
Duration of University Examination	**: 3 Hours**
Semester End Evaluation	**: 70 Marks**
Continuous Internal Evaluation	**: 30 Marks**

Course Objectives:

1. Learn the hydraulic, geological and geo-technical aspects in bridge design.
2. Analyse, design and detail the bridge deck and box girder systems, steel and composite bridges.
3. Analyse and design the sub-structures, bridge bearings and various long span bridges.

Course Outcomes:

1. Understand the fundamentals and codes of practice of bridge design.
2. Design the bridge deck and box girder systems using appropriate method.
3. Devise the steel truss and composite steel-concrete bridges.
4. Propose the sub-structure components such as pier, abutments, etc. and bridge bearings.
5. Design the various types of long span bridges, curved and skew bridges.

UNIT –I

Introduction: Types of bridges - Materials of construction - Codes of practice (Railway and Highway Bridges) - Aesthetics - Loading standards (IRC, RDSO, AASHTO) - Recent developments box girder bridges - Historical bridges (in India and overseas).

Planning and layout of bridges: Hydraulic design - Geological and geo-technical considerations - Design aids - Computer softwares- Expert systems.

UNIT – II

Concrete bridges: Bridge deck and approach slabs - Slab design methods - Design of bridge deck systems - Slab-beam systems (Guyon-Massonet and Hendry Jaeger methods) - Box girder systems - Analysis and design - Detailing of box girder systems.

UNIT – III

Steel and composite bridges: Introduction to composite bridges - Advantages and disadvantages - Orthotropic decks - Box girders - Composite steel-concrete bridges - Analysis and design - Truss bridges.

UNIT-IV

Sub-structure: Piers - Columns and towers - Analysis and design - Shallow and deep foundations - Caissons - Abutments and retaining walls.

Bridge appurtenances: Expansion joints - Design of joints - Types and functions of bearings - Design of elastomeric bearings - Railings - Drainage system - Lighting.

UNIT-V

Long span bridges: Design principles of continuous box girders - Curved and skew bridges - Cable stayed and suspension bridges - Seismic resistant design - Seismic isolation and damping devices.

Construction techniques: Cast in-situ - Prefabricated - Incremental launching - Free cantilever construction - Inspection - Maintenance and rehabilitation - Current design and construction practices.

Suggested Reading:

1. Wai-Fah Chen Lian Duan, "Bridge Engineering Handbook", CRC Press, USA, 2000.
2. R.M. Barker and J.A. Puckett, “Design of Highway Bridges”, John Wiley & Sons, New York, 1997.
3. P.P. Xanthakos, "Theory and Design of Bridges", John Wiley & Sons, New York, 1994.

4. D.J. Victor, “Essentials of Bridge Engineening,” Oxford & IBH Publishing, New Delhi, 2001.
5. N. Krishna Raju, “Design of Bridges,” Oxford & IBH Publishing, New Delhi, 1998.
6. T.R. Jagadeesh and M.A. Jayaram, “Design of Bridge Structures,” Prentice-Hall of India, New Delhi, 2006.

CE 0111 *w.e.f. 2017-2018*

ENGINEERING RESEARCH METHODOLOGY

No. of Credits	**: 3 Credits**
Instruction	**: 3 Periods per week**
Duration of University Examination	**: 3 Hours**
Semester End Evaluation	**: 70 Marks**
Continuous Internal Evaluation	**: 30 Marks**

Course Objectives:

- Learn the research types, methodology and formulation.
- Know the sources of literature, survey, review and quality journals.
- Understand the research design for collection of research data.
- Understand the research data analysis, writing of research report and grant proposal.

Course Outcomes:

- Differentiate the research types and methodology.
- Able to do literature survey using quality journals.
- Able to collect research data.
- Process research data to write research report for grant proposal.

UNIT - I

Research methodology: Objectives and motivation of research - Types of research - Research approaches - Significance of research - Research methods verses methodology - Research and scientific method - Importance of research methodology - Research process - Criteria of good research - Problems encountered by researchers in India - Benefits to the society in general. Defining the research problem: Definition of research problem - Problem formulation - Necessity of defining the problem - Technique involved in defining a problem.

UNIT – II

Literature survey: Importance of literature survey - Sources of information - Assessment of quality of journals and articles - Information through internet.

Literature review: Need of review - Guidelines for review - Record of research review.

UNIT – III

Research design: Meaning of research design - Need of research design - Feature of a good design - Important concepts related to research design - Different research designs - Basic principles of experimental design - Developing a research plan - Design of experimental set-up - Use of standards and codes.

UNIT – IV

Data collection: Collection of primary data - Secondary data - Data organization - Methods of data grouping - Diagrammatic representation of data - Graphic representation of data - Sample design - Need for sampling - Some important sampling definitions - Estimation of population - Role of statistics for data analysis - Parametric vs. non parametric methods - Descriptive statistics - Measures of central tendency and dispersion - Hypothesis testing - Use of statistical softwares.

Data Analysis: Deterministic and random data - Uncertainty analysis - Tests for significance - Chi-square - Student's t-test - Regression modeling - Direct and interaction effects – ANOVA - F-test - Time series analysis - Autocorrelation and autoregressive modeling.

UNIT - V

Research report writing: Format of the research report – Synopsis – Dissertation - Thesis - Its differentiation – References – Bibliography – Webliography - Technical paper writing - Journal report writing - Making presentation - Use of visual aids.

Research proposal preparation: Writing a research proposal and research report - Writing research grant proposal.

Suggested Reading:

1. C.R Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, New Delhi, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, Chennai, 2011.
3. Ratan Khananabis and Suvasis Saha, "Research Methodology", Universities Press, Hyderabad, 2015.
4. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publishing Pvt. Ltd., New Delhi, 2004.
5. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
6. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.

CE 1312 *w.e.f. 2017-2018*

GROUND IMPROVEMENT TECHNIQUES

Pre-requisite : Soil Mechanics of BE / B.Tech-Civil Engg.
Instructions : (L/T/S/P) 3 theory periods per week (3/0/0/0)
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals through continuous evaluation:
(Two midterm assessments) 30 Marks

Course Objectives

- To understand the objectives, necessity and scope of ground improvement techniques
- To learn different methods of insitu densification of cohesive, cohesion less soils
- To learn the classification, functions and applications of Geosynthetics in ground improvement
- To learn the process of identification of necessity for ground improvement, finding alternative methods and recommendation of the ideal technique through case studies

Course Outcomes:

- Ability to understand the necessity of ground improvement and potential of a ground for improvement
- To gain comprehensive understanding about the improvement of in-situ cohesive soils as well as Cohesion less soils
- Competence to analyse an in-situ ground, identification of ground improvement techniques feasible, selection of the ideal method, its planning , design, implementation and evaluation of improvement level

UNIT – I

General : Formation of rock, soils and soil profiles, soil distribution in India and other countries - marine, black cotton soils (expansive)., lateritic, alluvial, desert soils peat etc., factors affecting the alteration of ground after formation – natural and man-made – reclaimed soils – methods of geotechnical processes.

UNIT – II

Compaction methods: moisture density relations – compactive efforts – field methods – surface compaction, deep compactions- vigor compaction methods, vibro-probes, stone columns, sand compaction, stone column piles, selection of methods – quality control – specifications for compaction process for solving field problems.

UNIT – III

Drainage methods: seepage, ground water seepage control – filter requirements methods of dewatering – well point methods of discharge computations – design of steps for dewatering – design of well screens – selection of pumps and accessories – deep bored wells.

Precompression methods: compressibility and consolidation properties of soils estimation of rate of consolidation settlements – accelerating methods – monitoring compressions – design of vertical drains – consolidation by electro osmosis and vacuum compression methods.

UNIT – IV

Grouting and injection methods: principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

UNIT – V

Stabilization methods: mechanical, cement, lime, chemical methods of stabilization of soils – use of admixtures – polymers – geosynthesis – reinforcements thermal slurry trenches, void filling – prewetting – improving rock stability methods – exercise quality control to achieve desired results.

Suggested Reading:

1. J.E. Bowles – Foundation Design & Analysis.McGraw-Hill Edition 1995.
2. Ground improvement techniques by P. Purushottam Raj, Laxmi Pub., 1999.
3. F. S. Fang Handbook of Foundation Engg. CBS Pub., 1985.

CE 1231 *w.e.f. 2017-2018*

WATER RESOURCES ENGINEERING LABORATORY

Instruction	**: 3 periods per week**
CIE	**: 50 marks**
Credits	**: 2**

Course Objectives:

- Application of Unit Hydrograph concept in model basin
- Estimation of saturated thickness of the aquifer
- Characterization of wastewater quality

Course Outcomes:

- Ability to determine infiltration parameters for any soil in watersheds
- Application of Unit hydrograph technique from the data for simple storms from data
- Synthesis of draw down and its use in Groundwater studies

Water Resources Laboratory

1. Measurement of infiltration rate of a soil
2. Verification of Darcy law through Hele-Shaw model
3. Measurement of Rainfall and Runoff for simple storm in model Basin
4. Measurement of Rainfall and Runoff for complex storm in model Basin
5. Effect on Runoff due to impermeable land use due to simple storm in model Basin
6. Effect on Runoff due to impermeable land use due to complex storm in model Basin
7. Verification of Sediment flow in Catch Basin due to Rainfall
8. Verification of Sediment flow in Catch Basin due to Rainfall and Runoff
9. Simulation of storm flow in Catch Basin and development of Unit Hydrograph
10. Study of Scour pattern and measurement around piers of different shapes
11. Resistivity survey for groundwater Potential
12. Verification of Drawdown curve experiment in Groundwater Model

13. Verification of Drawdown impact due to interference of wells in Groundwater Model

Environmental Engineering Laboratory

1. Determination of characteristics of wastewater viz.,
2. pH, Total Dissolved Solids, and Total Suspended Solids
3. Bio-chemical Oxygen Demand, and Chemical Oxygen Demand
4. Ammonia nitrogen
5. Oil content
6. Sulphates
7. Viscosity
8. Determination of break point chlorination

Suggested Reading:

1. Ven Te Chow (1964), 'Hand book of Applied Hydrology' McGraw-Hill Book Company, New York.
2. Warren Viessman, Jr, Gary L. Lewis (2008), 'Introduction to Hydrology ', Prentice Hall of India, New Delhi
3. Raghnath, H. M.(1985), 'Hydrology', New Age International Pvt. Ltd., New Delhi.
4. Karanth, K. R. (1987) 'Groundwater Assessment, development and Management', Tata Mc Graw – Hill publishing company New Delhi.
5. Raghunath H.M,(1982), 'Ground water' Wiley Eastern Ltd, New Delhi.

CE 1232 *w.e.f. 2017-2018*

COMPUTER APPLICATIONS LABORATORY

Instruction	**: 3 periods per week**
CIE	**: 50 marks**
Credits	**: 2**

Course Objectives:

- Introduction to soft computing tools: Matlab, ANN
- Applications of Statistics and Probability in Water Resources Engg

Course Outcomes:

- Students are expected to have gained knowledge on the programming concepts and applications to WRE problems.

1. Stability checking of Gravity Dams
2. Modified SCS curve Method
3. Measurement of Normal and critical depths
4. Frequency Analysis
5. Regression Analysis
6. Multiple Regression
7. Unit Hydrograph
8. Fitting of probability distributions to the Data
9. Rainfall- Runoff relationship using ANN
10. Flood routing by Muskingum method
11. Canal Design by Lacey Method
12. Gumbel Distribution of flood estimation

CE 1233 *w. e. f. 2017-2018*

SEMINAR-I

Instruction	**: 3 periods per week**
CIE	**: 50 marks**
Credits	**: 2**

Course Objectives:

- Prepare the student for a systematic and independent study
- Selection of topics in the state of art topics in his/her specialization

Course Outcomes:

- Literature collection and broad understanding of the concepts of domain area
- Effective preparation and presentation skills.

At least two faculty members will be associated with the seminar presentation to evaluate and award marks.

CE 1234 *w.e.f. 2017-2018*

SEMINAR-II

Instruction	**: 3 periods per week**
CIE	**: 50 marks**
Credits	**: 2**

Course Objectives:

- Problem definition
- Literature survey, familiarity with research journals
- Broad knowledge of the available techniques to solve the problem
- Technical writing skills
- Presentation skills

Course Outcomes:

- Selection of focused area for dissertation work.
- Understanding the methodology and enhancing presentation skills

The objective of the seminar is to prepare the student for a systematic and independent study of the state of art topics in his/her specialization. Seminar topics may be chosen by the students with the advice of the faculty members. Students are exposed to the following aspects:

Each student is required to submit a technical write-up, presentation of their study (about 20 minutes) followed by a discussion.

At least two faculty members will be associated with the seminar presentation to evaluate and award marks.

CE 1235 *w.e.f. 2017-18*

PROJECT SEMINAR

Instruction	**: 4 periods per week**
CIE	**: 100 marks**
Credits	**: 8**

Course Objectives:

- Define the statement of research problem.
- Update the literature in chosen area of research and establish scope of work.
- Develop the study methodology.
- Carryout basic theoretical study/experiment.

Course Outcomes:

- Detailed literature review and collection of relevant material
- Narrowing the suitable dissertation topic
- Framing the objectives

Each student will be attached to a faculty member who will monitor the progress of the dissertation. The student is required to submit a technical write-up, presentation of their study (about 20 minutes) followed by a discussion.

At least two faculty members will be associated with the seminar presentation to evaluate and award marks.

CE 1236 *w.e.f. 2017-2018*

Dissertation

Instruction	**: 6 periods per week**
SEE	**: 200 Marks**
Credits	**: 16**

Course Objectives:

- Expand on the defined research problem in dissertation.
- Conduct laboratory/analytical studies.
- Analyse data, develop models, offer solutions and give conclusions.

Course Outcomes:

- Comprehensive understanding and formulation of dissertation topic.
- Implementation and modeling for the selected problem.

Each student will be attached to a faculty member who will monitor the progress of the student. The student is required to submit a technical write-up, presentation of their study (about 20 minutes) followed by a discussion.

The dissertation shall be internally scrutinized by a Viva-Voce committee consisting of the Head of the Department, Chairman Board of Studies, Supervisor and Examiner.

The Dissertation will be scrutinized by an external examiner as per the institute guide lines applicable.