INTEGRAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING

PROGRAMME: M.TECH HYDRAULICS AND WATER RESOURCES ENGINEERING
PROGRAM SPECIFIC OUTCOMES (PSO):

PSO-1: To develop the knowledge based on Hydraulics and water resources engineering and water resources management and research based on water resources engineering.
PSO-2: To use the knowledge and Experience gained from the course in uplifting the social living standards at economical cost with modern technology and new inventions for making a great Society, State and Country.

PROGRAM EDUCATIONAL OBJECTIVES (PEO):
PEO-1: Students will have sound knowledge to identify and formulate challenging in Water Resources Engineering problems and apply appropriate research methodologies to provide technical solutions that are economically feasible and sustainable.
PEO-2: Students will possess analytical and lateral thinking ability to engage in lifelong learning for professional advancement to cope up with the rapidly evolving Water Resource Engineering profession which is multi-disciplinary.
PEO-3: Students will become socially responsible and work efficiently and accept leadership roles in their profession, public services and community.

PROGRAM OUTCOMES (PO):
PO1- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE: MATHEMATICS AND STATISTICS FOR HYDRAULIC ENGINEERING
COURSE CODE: CE555/CEE555

COURSE OBJECTIVES:

- To understand the application of Multiple Integration, Differential Equation and Conformal Mapping in Hydraulic and Water Resources Engineering
- To learn about the application of Distributions, Measures of central tendency, Fractals and application to hydraulic engineering.
- To learn about the application of Distributions, Measures of central tendency, Fractals and application to hydraulic engineering.
- To learn about the applications of Furrier transform and Integrals in hydraulic and water resources engineering
- To learn about the Mathematical modeling in hydraulic and water resources engineering

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To understand the basic concept of Multiple Integration, Differential Equation and Conformal Mapping
CO2	To understand the application of Eigen Value and Eigen Vectors and Algorithm in Hydraulic and Water Resources Engineering
CO3	To learn about the application of Distributions, CDF and PDF, Measures of central tendency, Fractals and application to hydraulic engineering.
CO4	To learn about the applications of Furrier transform and Integrals in water resources engineering
CO5	To understand the basic concept of Mathematical modeling in water resources engineering

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To understand the basic concept of Multiple Integration, Differential Equation and Conformal Mapping	3	3	2	2	1	1	2	1	2	1	2	1
CO2	To understand the application of Eigen Value and Eigen Vectors and Algorithm in Hydraulic and Water Resources Engineering	2	1	2	1	1	1	1	1	1	1	2	2
CO3	To learn about the application of Distributions, CDF and PDF, Measures of central tendency, Fractals and application to hydraulic engineering.	1	3	2	2	2	1	2	1	1	2	0	2
CO4	To learn about the applications of Furrier transform and Integrals in water resources engineering	3	2	0	2	1	2	2	1	1	2	2	1
CO5	To understand the basic concept of Mathematical modeling in water resources engineering	2	2	2	2	2	2	1	1	2	1	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: WATER RESOURCES SYSTEMS PLANNING AND MANAGEMENT
COURSE CODE: CE556/CEE556

COURSE OBJECTIVES:

- To understand Principles of Systems Analysis in Water Resources Engineering, Resources Planning and Development, Nature of Water Resources Systems and Socio Economic Characteristics
- To understand the Principles of Engineering Economy, Capital, Economic and Financial Evaluation and Socio-Economic Analysis
- To understand Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Optimization Techniques, Simulation and Multi Objective Optimization.
- To understand the Surface Water Storage Requirements, Storage Capacity, Hydropower and Flood Control, Reservoir Operations, Irrigation and Planning of an Irrigation System.
- To understand concept of Groundwater management, Conjunctive Use of Water Resources and Design of Water Conveyance and Distribution Systems

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will be able to explain the principles of system analysis and nature of water resources system
CO2	Students will be able to understand the engineering economy and able to understand the financial evaluation
CO3	Students will be able to understand Linear Programming Models and methods of analysis
CO4	Students will be able to understand the Requirements of Surface Water Storage ,Hydropower and flood control
CO5	Students will be able to understand Groundwater management, Conjunctive Use of Water Resources and design of water conveyance and distribution systems.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will be able to explain the principles of system analysis and nature of water resources system	2	1	0	0	0	0	1	0	2	1	0	0
CO2	Students will be able to understand the engineering economy and able to understand the financial evaluation	2	1	0	0	1	0	0	0	0	0	3	1
CO3	Students will be able to understand Linear Programming Models and methods of analysis	1	1	3	2	0	0	0	0	1	0	2	0
CO4	Students will be able to understand the Requirements of Surface Water Storage ,Hydropower and flood control	2	2	0	0	0	0	2	0	2	0	0	2
CO5	Students will be able to understand Groundwater management, Conjunctive Use of Water Resources and design of water conveyance and distribution systems.	2	2	3	1	0	0	2	0	1	0	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: ADVANCED HYDRAULIC ENGINEERING
COURSE CODE: CE557/CEE557

COURSE OBJECTIVES:

- To understand basic concept of fluid properties and relationship between them, buoyancy and flow measurement
- To learn the fundamentals of Non-Uniform flow (Gradually Varied Flow) and channel contraction in open channels.
- To understand Dimensional analysis, Buckingham pi theorem, Navier Stokes Equation, Bernaulli's and Eulers equation.
- To learn Finite element method and its applications to transient problems.
- To understand the basic concept of Flow dynamics and its application in hydraulics.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students are able to understand basic concept of properties of fluid and its application.
CO2	Students will learn about basic principle of Gradually Varied flow (GVF), Channel Contractions and its applications
CO3	To apply dimensional analysis to predict physical parameters of model and prototype. To learn the Navies Stokes Equation, Bernoulli's and Euler's equation and its applications.
CO4	To understand the Finite element method, application to potential flow problems, and application to transient problems.
CO5	To understand the concept of Stream function, velocity potential, and Flow dynamics.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students are able to understand basic concept of properties of fluid and its application.	2	3	2	3	2	2	1	3	2	3	2	1
CO2	Students will learn about basic principle of Gradually Varied flow (GVF), Channel Contractions and its applications	2	2	2	2	3	2	3	2	2	2	1	1
CO3	To apply dimensional analysis to predict physical parameters of model and prototype. To learn the Navies Stokes Equation, Bernoulli's and Euler's equation and its applications.	2	3	1	3	2	3	3	2	3	1	2	2
CO4	To understand the Finite element method, application to potential flow problems, and application to transient problems.	3	2	2	2	1	2	3	2	2	2	1	1
CO5	To understand the concept of Stream function, velocity potential, and Flow dynamics.	1	2	2	2	2	2	2	2	1	2	1	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: MODELING SIMULATION AND OPTIMIZATION
COURSE CODE: CE558/CEE558

COURSE OBJECTIVES:

- To understand the system and types of system, optimization, functions of variable and constrained optimization
- To understand the linear programming: Graphics method, simplex method, multiple solutions, unbounded and infeasible problems.
- To understand the dynamic programming: Water allocation problem, reservoir operation problem, capacity and expansion and shortest route problem.
- To understand the Simulation, Multi objective planning, Fuzzy optimization for water quality control and reservoir operation
- To understand Conjunctive use of ground and surface water, hydropower optimization, crop yield optimization, multi-basin and multi –reservoir system

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will learn about the system and types of system, optimization, functions of variable and constrained optimization
CO2	Students will learn about the linear programming and Graphics method, simplex method, multiple solutions, unbounded and infeasible problems.
CO3	Students will learn about the dynamic programming and different types of problems (Water allocation problem, reservoir operation problem, capacity and expansion and shortest route problem.
CO4	Students will learn about the Simulation, Multi objective planning, Fuzzy optimization for water quality control and reservoir operation
CO5	Students will learn about the Conjunctive use of ground and surface water, hydropower optimization, crop yield optimization, multi-basin and multi –reservoir system

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will learn about the system and types of system, optimization, functions of variable and constrained optimization.	2	1	1	1	0	0	0	0	1	0	1	1
CO2	Students will learn about the linear programming and Graphics method, simplex method, multiple solutions, unbounded and infeasible problems.	2	3	2	2	0	1	0	0	1	1	1	1
CO3	Students will learn about the dynamic programming and different types of problems (Water allocation problem, reservoir operation problem, capacity and expansion and shortest route problem.	2	3	2	2	0	1	0	0	1	1	1	1
CO4	Students will learn about the Simulation, Multi objective planning, Fuzzy optimization for water quality control and reservoir operation.	2	3	1	2	0	1	0	0	1	1	0	1
CO5	Students will learn about the Conjunctive use of ground and surface water, hydropower optimization, crop yield optimization, multi-basin and multi –reservoir system.	2	1	0	1	0	1	1	0	1	1	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: ADVANCE NUMERICAL ANALYSIS
COURSE CODE: CE560/CEE560

COURSE OBJECTIVES:

- To enable the students to Know and understand Numerical Methods,
- To Distinguish between Numerical differences, integration and classical difference & Integration and
- To learn & Integration and Apply the knowledge Extensively in Engineering and Statistics
- method of calculation of differ
- To solve the various types of simultaneous Linear Systems of Equations
- To solve value problems in differential equations using numerical methods.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To enable the student to learn various types of curve fitting methods.
CO2	To enable the students to Solve initial and boundary value problems in differential equations using numerical methods
CO3	To give the knowledge to Integrate the function using General Quadrature formula on errors
CO4	To learn the numerical solutions of system of linear equations and check the accuracy of the solutions
CO5	To learn the solutions of simultaneous Linear Systems of Equations

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To enable the student to learn various types of curve fitting methods.	1	1	3	3	3	1	0	0	1	0	0	2
CO2	To enable the students to Solve initial and boundary value problems in differential equations using numerical methods	1	2	2	2	2	1	0	0	1	0	0	1
CO3	To give the knowledge to Integrate the function using General Quadrature formula on errors	1	2	3	3	3	2	0	0	1	0	0	1
CO4	To learn the numerical solutions of system of linear equations and check the accuracy of the solutions	1	1	2	2	3	2	0	0	1	0	0	1
CO5	To learn the solutions of simultaneous Linear Systems of Equations	1	1	2	2	3	3	0	0	1	0	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: FLOOD AND DROUGHT
COURSE CODE: CE561/CEE561

COURSE OBJECTIVES:

- To introduce the term flood, runoff and Hydrograph and factors which affecting the flood, Runoff and Hydrograph
- To introduce the methods of estimation of flood and probable maximum flood, risk, reliability and safety factor.
- To introduce the basic concept of flood routing, hydrological channel routing and flood control
- To introduce the basic concept of drought and their type and Couse of drought and their effects on water resources.
- To introduce the flood management measures and prevention from drought.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To understand the basic concept of flood, factor affecting flood, Runoff, factors affecting runoff, estimation of runoff, Flood Hydrograph, , factors affecting Hydrograph, Unit Hydrograph
CO2	To understand the basic concept of methods of Estimation of flood, Probable Maximum Flood (PMF) Risk, reliability and safety factor.
CO3	To understand the basic concept of Flood Routing**,** and hydrologic channel routing, Hydraulic method of flood routing and Flood control.
CO4	To understand the basic concept of Drought and their types, Cause of drought, Drought in India, Effects on water resources
CO5	To understand the basic Flood management measures, structural measures for flood management, Non-structural measures for flood management, prevention from drought.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To understand the basic concept of Flood, factor affecting flood, Runoff, factors affecting runoff, estimation of runoff, Flood Hydrograph, factors affecting Hydrograph, Unit Hydrograph	3	2	1	1	0	2	2	0	0	0	0	0
CO2	To understand the basic concept of methods of Estimation of flood, Probable Maximum Flood (PMF) Risk, reliability and safety factor.	2	2	1	2	0	3	1	0	2	0	1	2
CO3	To understand the basic concept of Flood Routing**,** and hydrologic channel routing, Hydraulic method of flood routing and Flood control.	2	2	1	2	0	3	2	0	2	0	1	2
CO4	To understand the basic concept of Drought and their types, Cause of drought, Drought in India, Effects on water resources	2	1	1	1	0	2	3	0	0	0	1	1
CO5	To understand the basic Flood management measures, structural measures for flood management, Non-structural measures for flood management, prevention from drought	2	2	1	1	0	2	2	0	2	0	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: EXPERIMENTAL METHOD IN WATER RESOURCES ENGINEERING
COURSE CODE: CE563/CEE563

COURSE OBJECTIVES:

- Student will learn about the site selection and installation of the equipment in the field.
- Student will learn how to take the reading from the respective equipment's for hydrological analysis.
- Student will learn about the factors which affects the hydrological parameters.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Student will be able to understand about the site selection and installation of the equipment in the field.
CO2	Student will be able to understand how to take the reading from the respective equipment's for hydrological analysis.
CO3	Student will be able to understand about the factors which affects the hydrological parameters.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Student will be able to understand about the site selection and installation of the equipment in the field.	0	0	0	0	3	1	0	1	2	3	2	0
CO2	Student will be able to understand how to take the reading from the respective equipment's for hydrological analysis.	0	0	0	0	1	1	0	1	2	2	2	0
CO3	Student will be able to understand about the factors which affects the hydrological parameters.	0	0	0	0	1	1	0	1	2	2	2	0
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: APPLIED HYDROLOGY
COURSE CODE: CE565/CEE565

COURSE OBJECTIVES:

- 'To understand 'Hydrologic cycle, systems concept, hydrologic model classification; Reynold's Transport
- To understand the concept of Thunderstorm Cell model, IDF relationships and measurement of evaporation, energy balance method, ,
- To understand the concept of Hortonian and saturation overland flow, stream flow hydrographs and UH
- To understand the concept of convolution equation; definition and limitations of a UH;
- To understand the basic concept of infiltration and its equation, Groundwater Hydrology, Darcy's law,

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	'To understand 'Hydrologic cycle, systems concept, hydrologic model classification; Reynold's Transport Theorem.
CO2	To understand the concept of Thunderstorm Cell model, IDF relationships and measurement of evaporation, energy balance method, ,
CO3	To understand the concept of Hortonian and saturation overland flow, stream flow hydrographs and Unit Hydrograph concept
CO4	To understand the concept of convolution equation; definition and limitations of a UH;
CO5	To understand the basic concept of infiltration and its equation, Groundwater Hydrology, Darcy's law,

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	'To understand 'Hydrologic cycle, systems concept, hydrologic model classification; Reynold's Transport Theorem.	1	3	2	2	1	1	2	1	1	1	2	1
CO2	To understand the concept of Thunderstorm Cell model, IDF relationships and measurement of evaporation, energy balance method, ,	2	1	2	1	3	1	1	2	1	2	2	2
CO3	To understand the concept of Hortonian and saturation overland flow, stream flow hydrographs and Unit Hydrograph concept	3	1	3	1	2	1	2	1	2	2	1	2
CO4	To understand the concept of convolution equation; definition and limitations of a UH;	2	2	1	2	1	2	2	1	0	1	2	1
CO5	To understand the basic concept of infiltration and its equation, Groundwater Hydrology, Darcy's law,	2	2	2	2	2	2	1	1	2	1	3	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: OPEN CHANNEL HYDRAULICS
COURSE CODE: CE566/CEE566

COURSE OBJECTIVES:

- To study about the type of flow, Different types of equation, Types of Channel and Discharge Calculation
- To study about the gradually varied flow function and GVF profiles and GVF computations
- To study about the various type of jump in sloping and rectangular channels and effect on hydraulic structures
- To study about SPH simulations, unsteady flow, surge tank, water hammer, St. Venant equations, Hydraulic flood routi
- To study about Design of canals, Theories of design, apron design, design of spillway, design of labyrinth spillway.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will learn the type of flow, Different types of equation, Types of Channel and Discharge Calculation.
CO2	Students will learn about the gradually varied flow function and GVF profiles and GVF computations.
CO3	Students will learn about the various type of jump in sloping and rectangular channels and effect on hydraulic structures
CO4	The learner will learn about SPH simulations, unsteady flow, surges, surge tank, water hammer, St. Venant equations, Hydraulic flood routi.
CO5	To learn the Design of canals, Theories of design, apron design, design of spillway, design of labyrinth spillway.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will learn the type of flow, Different types of equation, Types of Channel and Discharge Calculation	2	1	2	1	1	2	2	1	1	1	2	1
CO2	Students will learn about the gradually varied flow function and GVF profiles and GVF computations	2	1	2	2	1	1	2	1	1	2	2	1
CO3	Students will learn about the various type of jump in sloping and rectangular channels and effect on hydraulic structures	1	1	1	2	2	2	1	1	2	2	1	1
CO4	The learner will learn about SPH simulations, unsteady flow, surges, surge tank, water hammer, St. Venant equations, Hydraulic flood routi.	1	2	2	1	1	1	2	1	1	1	2	1
CO5	To learn the Design of canals, Theories of design, apron design, design of spillway, design of labyrinth spillway.	1	1	1	1	2	2	1	1	2	1	2	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: CLIMATE CHANGE IMPACTS IN WATER RESOURCES ENGINEERING
COURSE CODE: CE568/CEE568

COURSE OBJECTIVES:

- To understand the Climate, Climate system, climate change, Characteristics of climate system, Greenhouse effect and Carbon cycle.
- To understand the Precipitation, water vapor, Sea level , Evapotranspiration, Runoff and river discharge, Influences of hydrological changes on climate and Projected changes in climate
- To understand the climate change impacts, Future changes in water availability and demand due to climate change and Impacts of climate change on costs and other socio-economic aspects of freshwater.
- To understand the climate change in the fields of Ecosystems and biodiversity, water supply and sanitation, infrastructure and Economy Adaptation, vulnerability and sustainable development
- To understand Sector-specific mitigation Hydropower, Geothermal energy, Energy use in buildings, Afforestation and Reforestation, Effects of water management policies and measures on GHG emissions and mitigation.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students are able to understand the climate change and greenhouse gases and carbon cycle.
CO2	Students have ability to understand the precipitation, Evapotranspiration and influences of hydrological changes on climate and Projected changes in climate.
CO3	Students have ability to understand the impact of climate change and Future changes in water availability and demand due to climate change.
CO4	Students are able to understand the impact of climate change in the field of ecosystem and biodiversity.
CO5	Students are able to understand the Sector-specific mitigation, Effects of water management policies, measures on GHG emissions and mitigation.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students are able to understand the climate change and greenhouse gases and carbon cycle.	2	0	0	0	0	2	2	0	2	0	0	0
CO2	Students have ability to understand the precipitation, Evapotranspiration and influences of hydrological changes on climate and Projected changes in climate.	2	1	0	1	0	0	3	0	0	2	0	2
CO3	Students have ability to understand the impact of climate change and Future changes in water availability and demand due to climate change.	2	2	0	2	2	2	3	0	1	2	0	0
CO4	Students are able to understand the impact of climate change in the field of ecosystem and biodiversity.	2	2	2	2	0	2	3	1	2	0	0	0
CO5	Students are able to understand the Sector-specific mitigation, Effects of water management policies, measures on GHG emissions and mitigation.	2	1	0	2	0	2	2	1	1	2	1	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: RESEARCH PAPER PRESENTATION AND DISCUSSION/SEMINAR
COURSE CODE: CE572/CEE572

COURSE OBJECTIVES:

- To understand organization of topic for presentation and research.
- To learn the skill set required to perform research.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Skill to search on any topic to extract the information.
CO2	Ability to organize – deliver presentation and report on any topic.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Skill to search on any topic to extract the information.	0	0	0	3	3	1	2	1	3	3	0	3
CO2	Ability to organize – deliver presentation and report on any topic.	0	0	0	0	3	1	2	1	3	3	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: COMPUTER METHODS IN HYDRAULICS AND HYDROLOGY
COURSE CODE: CE567/CEE567

COURSE OBJECTIVES:

- Students will learn about the computer programming and computation with MATLAB.
- Students will learn about the Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics parameter estimation.
- Students will learn about the Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will be able to understand about the application of MATLABin Open channel flow for the Estimation of normal and critical depth etc.
CO2	Students will be able to learn about the Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics parameter estimation.
CO3	Students will be able to learn about the Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will be able to understand about the application of MATLABin Open channel flow for the Estimation of normal and critical depth etc.	2	0	3	0	3	0	0	0	0	2	0	0
CO2	Students will be able to learn about the Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics parameter estimation.	2	0	3	0	3	0	0	0	0	2	0	0
CO3	Students will be able to learn about the Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.	2	0	3	0	3	0	0	0	0	2	0	0
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: RESEARCH METHODOLOGY
COURSE CODE: CE552/CEE552

COURSE OBJECTIVES:

- Think critically and understand the concept of gap identification for research
- Identify appropriate research methods for a specific research problem
- Write a professional research report.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.
CO2	Develop student's understanding of sampling techniques for research.
CO3	Develop student's understanding of different data collection methods and their suitability.
CO4	Students will gain understanding of analysing the quantitative data.
CO5	Students will gain understanding of analysing the qualitative data and will learn how to write a professional research report.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.	2	2	3	1	3	3	3	3	1	2	3	3
CO2	Develop student's understanding of sampling techniques for research.	3	3	2	3	2	2	2	3	1	3	2	3
CO3	Develop student's understanding of different data collection methods and their suitability.	3	3	2	3	2	2	2	3	1	3	2	3
CO4	Students will gain understanding of analysing the quantitative data.	3	3	2	3	3	2	3	3	1	3	2	3
CO5	Students will gain understanding of analysing the qualitative data and will learn how to write a professional research report.	2	2	3	1	3	3	3	3	1	2	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: REMOTE SENSING AND GIS IN WATER RESOURCES ENGINEERING
COURSE CODE: CE660/CEE660

COURSE OBJECTIVES:

- To understand Remote Sensing, Types and Principles of remote sensing, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interactions with earth surface features.
- To understand the Satellites and orbits, Spatial and spectral resolutions, Multispectral, Features of the remote sensing satellites.
- To understand **GIS,** Maps and map scales, Data model and data structures, **spatial data input & editing** Interpolation, Methods of interpolation**.**
- To understand the DEM, Types of DEM, Sources of digital elevation data, Radar interferometer, Drainage pattern and catchment area delineation.
- To understand the Applications of remote sensing in watershed management, Rainfall-runoff modelling, Irrigation management, Flood mapping and Drought assessment.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students have ability to understand Remote Sensing, Principles of remote sensing, Energy interactions in the atmosphere and Energy interactions with earth surface features
CO2	Students have ability to understand the Satellites and orbits, Spatial and spectral resolutions, Multispectral, Features of the remote sensing satellites
CO3	Students have ability to understand the GIS , Data model and data structure, editing of data and method of interpolation
CO4	Students will learn about the DEM, Sources of digital elevation data, Drainage pattern and catchment area delineation
CO5	Students will learn about the application of remote sensing in watershed management and rainfall –runoff modelling

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students have ability to understand Remote Sensing, Principles of remote sensing, Energy interactions in the atmosphere and Energy interactions with earth surface features	2	1	0	1	1	0	2	0	1	1	0	0
CO2	Students have ability to understand the Satellites and orbits, Spatial and spectral resolutions, Multispectral, Features of the remote sensing satellites	2	1	0	1	1	0	1	0	1	0	1	2
CO3	Students have ability to understand the GIS , Data model and data structure, editing of data and method of interpolation	3	1	2	2	2	0	1	0	1	0	1	1
CO4	Students will learn about the DEM, Sources of digital elevation data, Drainage pattern and catchment area delineation	3	1	2	2	1	0	0	0	1	0	1	2
CO5	Students will learn about the application of remote sensing in watershed management and rainfall –runoff modelling	3	1	3	1	2	1	1	0	1	0	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: HYDRO POWER ENGINEERING
COURSE CODE: CE661/CEE661

COURSE OBJECTIVES:

- To understand the Hydropower energy, hydropower development in India, Hydropower plants, Surface and underground power stations, Low medium-high head plants-layout and pumped storage plants.
- To understand the Classification of penstocks, Design of Penstocks, surges in canals design criteria of power canals, Location, function and types of intakes, energy losses at intake trash rock and design of intakes
- To understand Rigid and elastic water column theories, water hammer pressure. Behavior of surge tanks, types of surge tanks and hydraulic design of tank.
- To understand the Hydraulic turbines and types and classification, constructional features, hydraulic analysis, characteristic curves, governing of turbine, drafts tubes-types, hydraulic principles and design. Gates and valves- types. Design of air vent
- To understand Power house structures, Power house substructure and Power house superstructure Layout and dimensions, deign considerations.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will learn about the hydropower energy, hydropower development in India, Hydropower plants, Surface and underground power stations, Low medium-high head plants-layout and pumped storage plants
CO2	Students will learn about the penstocks, Design of Penstocks, design criteria of power canals, Location, function and types of intakes and design of intakes
CO3	Students will learn about the Rigid and elastic water column theories, water hammer pressure. Behavior of surge tanks, types of surge tanks and hydraulic design of tank.
CO4	Students will learn about the Hydraulic turbines and types and classification, constructional features, hydraulic analysis, characteristic curves, governing of turbine, hydraulic principles and design.
CO5	Students will learn about the Power house structures, Power house substructure and Power house superstructure, Layout dimensions and deign considerations

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will learn about the hydropower energy, hydropower development in India, Hydropower plants, Surface and underground power stations, Low medium-high head plants-layout and pumped storage plants	2	2	2	1	0	1	2	0	2	1	0	1
CO2	Students will learn about the penstocks, Design of Penstocks, design criteria of power canals, Location, function and types of intakes and design of intakes	2	1	3	2	0	1	0	0	2	1	1	2
CO3	Students will learn about the Rigid and elastic water column theories, water hammer pressure. Behavior of surge tanks, types of surge tanks and hydraulic design of tank.	2	1	3	2	0	1	0	0	1	0	1	0
CO4	Students will learn about the Hydraulic turbines and types and classification, constructional features, hydraulic analysis, characteristic curves, governing of turbine, hydraulic principles and design.	2	2	3	1	0	1	1	0	2	1	1	2
CO5	Students will learn about the Power house structures, Power house substructure and Power house superstructure, Layout dimensions and deign considerations	2	0	3	2	0	1	0	0	0	1	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: ADVANCED IRRIGATION ENGINEERING
COURSE CODE: CE662/CEE662

COURSE OBJECTIVES:

- To introduce the water resources in India, need of irrigation, advantages and Criteria for good Irrigation management.
- To learn about the classification of soil water, soil water plant relationship and soil moisture measurement.
- To introduce the basic Water requirement of crops, Evapotranspiration and consumptive use of water
- To introduce the Surface irrigation methods, types and canal design
- To learn the sprinkler and drip irrigation and components design.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To understand the water resources in India and their needs and criteria for good irrigation management.
CO2	To understand the basic concept of soil water and plant relationship and soil moisture measurement.
CO3	To understand the basic concept of requirement of water for a crops and consumptive use of water.
CO4	To understand the methods of surface irrigation, types and canal design.
CO5	To understand the sprinkler and drip irrigation and criteria of adopting the method of irrigation and design of the components

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To understand the water resources in India and their needs and criteria for good irrigation management.	3	1	0	0	0	1	2	0	0	0	2	0
CO2	To understand the basic concept of soil water and plant relationship and soil moisture measurement.	3	1	1	0	0	1	2	0	0	0	0	0
CO3	To understand the basic concept of requirement of water for a crops and consumptive use of water.	2	2	1	0	0	2	2	0	0	0	0	0
CO4	To understand the methods of surface irrigation, types and canal design.	2	0	3	0	0	2	1	1	1	2	1	1
CO5	To understand the sprinkler and drip irrigation and criteria of adopting the method of irrigation and design of the components	2	1	3	0	0	2	2	1	1	2	1	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: FLUVIAL HYDRAULICS
COURSE CODE: CE664/CEE664

COURSE OBJECTIVES:

- To understand the behavior of sediment transport in alluvial channels.
- To design the stable alluvial channel and solve various civil engineering problems encountered in fluvial hydraulics.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will understand about the Reservoir sedimentation, site selection, critical tractive force of cohesion less and cohesive materials, regimes of flow, importance and prediction of regimes of flow.
CO2	Students will understand about the Resistance to flow and velocity distribution in alluvial streams, Bed load equations, suspended load, and general considerations about sediment distribution equation.
CO3	Students will have ability to understand about the Total load transport, microscopic and macroscopic methods based on a single size and fraction wise size calculations.
CO4	Students have ability to Design of stable channels in alluvium: variables in channel design, general comments on regime and tractive force methods of channel design.
CO5	Students will understand the Bed level variation in alluvial streams, local scour, degradation, aggradations, silting of reservoir, estimation of silt, distribution of sediment in reservoir, life of reservoir, and sediment flow through pipes.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will understand about the Reservoir sedimentation, site selection, critical tractive force of cohesion less and cohesive materials, regimes of flow, importance and prediction of regimes of flow.	2	2	0	2	0	1	0	0	1	2	0	1
CO2	Students will understand about the Resistance to flow and velocity distribution in alluvial streams, Bed load equations, suspended load, and general considerations about sediment distribution equation.	2	1	0	0	2	1	0	0	2	1	0	1
CO3	Students will have ability to understand about the total load transport, microscopic and macroscopic methods based on a single size and fraction wise size calculations.	2	1	2	1	1	0	1	0	2	1	0	0
CO4	Students have ability to Design of stable channels in alluvium: variables in channel design, general comments on regime and tractive force methods of channel design.	2	2	3	2	0	0	1	0	1	2	1	0
CO5	Students will understand the Bed level variation in alluvial streams, local scour, degradation, aggradation, silting of reservoir, estimation of silt, distribution of sediment in reservoir, life of reservoir, and sediment flow through pipes.	2	2	3	2	0	0	1	0	2	1	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: APPLICATION OF SOFT COMPUTING TECHNIQUE IN HYDROLOGY
COURSE CODE: CE665/CEE665

COURSE OBJECTIVES:

- To learn the basic concepts of Soft Computing and become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will be able to understand the Fuzzy computing, neural computing, genetic algorithms, application in water resources engineering and Model of artificial neuron
CO2	Students will be able to understand the back propagation learning, back propagation algorithm, associate memory: description and Auto-associate memory
CO3	Students will be able to understand Recap –supervise, unsupervised, back prop algorithm, competitive learning and unsupervised ART Clustering.
CO4	Students will be able to understand the fuzzy set membership, operations, properties Fuzzy relations, fuzzy logic, fuzzy inference and fuzzy rule based system.
CO5	Students will be able to understand the operators of genetic algorithm, basic genetic algorithm. integration of neural networks, Fuzzy back propagation networks and Fuzzy associative memories

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will be able to understand the Fuzzy computing, neural computing, genetic algorithms, application in water resources engineering and Model of artificial neuron	2	2	3	2	3	0	0	0	1	0	2	1
CO2	Students will be able to understand the back propagation learning, back propagation algorithm, associate memory: description and Auto-associate memory	1	2	0	2	2	0	1	0	1	1	2	0
CO3	Students will be able to understand Recap – supervise, unsupervised, back prop algorithm, competitive learning and unsupervised ART Clustering.	2	2	1	0	2	0	0	0	1	1	1	0
CO4	Students will be able to understand the fuzzy set membership,operations, properties Fuzzy relations, fuzzy logic,fuzzy inference and fuzzy rule based system.	2	2	0	0	2	0	0	0	1	0	1	1
CO5	Students will be able to understand the operators of genetic algorithm, basic genetic algorithm. integration of neural networks,Fuzzy back propagation networks and Fuzzy associative memories	2	2	1	0	3	0	1	0	1	0	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: RIVER ENGINEERING
COURSE CODE: CE666/CEE666

COURSE OBJECTIVES:

- To introduce the Primary function of River, Water and Sediment loads of river, Rivers in India.
- To introduce the Physical Properties and Equations of flow in rivers, velocity profile, uniform and non-uniform, turbulence, Diffusion and Dispersion.
- To give the idea about the Stability of Channel, hydraulic geometry of downstream, meandering, River dynamics, degradation and aggradations of river bed.
- To give the idea about Mapping, Stage, Discharge Measurements, Sediments, Bed and suspended load, Rigid and mobile bed, Water Quality and ecological model.
- To introduce about the river training work and river regulation work flood plain measurement and river stabilization

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To understand the Primary function of River, Water and Sediment loads of river, Rivers in India.
CO2	To understand the Physical Properties of river and Equations of different types of flow in rivers, velocity profile, uniform and non-uniform, turbulence, Diffusion and Dispersion
CO3	To understand about the Stability of Channel, hydraulic geometry of downstream, meandering, River dynamics, degradation and aggradations of river bed.
CO4	To understand about Mapping, Stage, Discharge Measurements in river, Sediments, Bed and suspended load, Rigid and mobile bed, Water Quality and ecological model
CO5	To understand the river training work and river regulation work, flood plain measurement and river stabilization.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To understand the Primary function of River, Water and Sediment loads of river, Rivers in India.	3	1	0	0	0	2	2	0	0	1	1	0
CO2	To understand the Physical Properties of river and Equations of different types of flow in rivers, velocity profile, uniform and non-uniform, turbulence, Diffusion and Dispersion	2	2	1	2	0	2	2	0	0	0	1	1
CO3	To understand about the Stability of Channel, hydraulic geometry of downstream, meandering, River dynamics, degradation and aggradations of river bed.	3	2	3	1	0	1	1	0	0	0	1	1
CO4	To understand about Mapping, Stage, Discharge Measurements in river, Sediments, Bed and suspended load, Rigid and mobile bed, Water Quality and ecological model	3	2	1	1	0	1	3	0	0	0	1	0
CO5	To understand the river training work and river regulation work, flood plain measurement and river stabilization.	2	3	2	1	0	1	1	0	0	2	1	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: HYDRAULIC STRUCTURE
COURSE CODE: CE668/CEE668

COURSE OBJECTIVES:

- To understand the basic concept of site selection of dam and Types of dam,
- To understand the Design criteria, Elementary profile of gravity dam and stability of dam
- To know the safety criteria, force acting on the gravity dam, function of spillway and energy dissipaters

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will be able to understand the criteria of site Selection of dam, Forces acting on darns, Elementary profile of a gravity dam, Stability analysis and methods of determination of shear stress.
CO2	Students will be able to understand the Arch dam, Types of arch dams, Design of arch dam, Valleys suited for arch darns, Thin cylinder theory, Most economical central angle and Effects of foundation elasticity on arch dam.
CO3	Students will be able to understand the Buttress dam, Types of buttress darn, Design principles, Buttress design by Unit column theory and Basic shape of buttress.
CO4	Students will be able to understand the Spillways, Types of spillways, Design principles of spillway, Hydraulic design of spillways and Energy dissipation below spillways.
CO5	Students will be able to understand Theory of similarity, dimensional analysis, Basic concepts, Froude law, Reynolds law, Mach law, Cavitations number and Modeling technique.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will be able to understand the criteria of site Selection of dam, Forces acting on darns, Elementary profile of a gravity dam, Stability analysis and methods of determination of shear stress.	2	1	1	1	0	0	1	0	2	2	0	1
CO2	Students will be able to understand the Arch dam, Types of arch dams, Design of arch dam, Valleys suited for arch darns, Thin cylinder theory, Most economical central angle and Effects of foundation elasticity on arch dam.	2	1	3	1	0	0	2	0	1	0	2	1
CO3	Students will be able to understand the Buttress dam, Types of buttress darn, Design principles, Buttress design by Unit column theory and Basic shape of buttress.	2	1	3	0	0	0	2	0	1	1	2	0
CO4	Students will be able to understand the Spillways, Types of spillways, Design principles of spillway, Hydraulic design of spillways and Energy dissipation below spillways.	2	0	3	0	0	0	2	0	2	0	1	2
CO5	Students will be able to understand Theory of similarity, dimensional analysis, Basic concepts, Froude law, Reynolds law, Mach law, Cavitation number and Modeling technique.	2	1	3	2	0	0	2	0	0	0	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: WATERSHED MANAGEMENT
COURSE CODE: CE669/CEE669

COURSE OBJECTIVES:

- To know the basic principle of watershed management, environmental guidelines for water quality.
- To know the factors of soil erosion, soil conservation practices and social aspects of watershed management.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Students will be able to understand the Watershed, characteristics, watershed management, Typical watershed problems, Principles of watershed management, Watershed management policies and National water policy
CO2	Students will be able to understand the Water quality, pollution, Types and sources of pollution, water quality modeling and Environmental guidelines for water quality
CO3	Students will be able to understand Sustainable watershed management, Principles, Natural resources management, Sustainable land management practices, Soil erosion: causes, processes, erosion factors, Water erosion, Types, Estimation of soil loss Wind erosion and Soil conservation practices.
CO4	Students will be able to understand the Social aspects of watershed management: Community participation, Private sector participation, Socio-economy Integrated development, Water legislation and implementations.
CO5	Students will be able to understand Standard modeling approaches, system concept for watershed modeling, modeling of rainfall, runoff process, subsurface flows and groundwater flow.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Students will be able to understand the Watershed, characteristics, watershed management, Typical watershed problems, Principles of watershed management, Watershed management policies and National water policy	3	2	0	2	3	2	3	0	1	2	2	0
CO2	Students will be able to understand the Water quality, pollution, Types and sources of pollution, water quality modeling and Environmental guidelines for water quality	2	2	2	2	0	2	3	0	0	2	0	1
CO3	Students will be able to understand Sustainable watershed management, Principles, Natural resources management, Sustainable land management practices, Soil erosion: causes, processes, erosion factors, Water erosion, Types, Estimation of soil loss Wind erosion and Soil conservation practices.	2	2	1	2	1	2	3	0	1	0	2	0
CO4	Students will be able to understand the Social aspects of watershed management: Community participation, Private sector participation, Socio-economy Integrated development, Water legislation and implementations.	2	1	2	1	0	3	2	1	2	2	2	0
CO5	Students will be able to understand Standard modeling approaches, system concept for watershed modeling, modeling of rainfall, runoff process, subsurface flows and groundwater flow.	2	1	3	1	2	1	1	0	1	0	1	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: EARTH AND ROCK FILL DAMS
COURSE CODE: CE670/CEE670

COURSE OBJECTIVES:

- To introduce about the earthen dam, Types of earthen dam, Methods of construction, Cause of failure, Pore-Water Pressure and its Significance in the Design of Earth Dams.
- To introduce about the Seepage Discharge through the Soil, Phreatic line and Determination of Phreatic Line for Homogeneous section with a Horizontal Filter and without Filter.
- To introduce how to control the Seepage through embankments, Seepage Control through foundations, Design of Filters, protection of upstream and downstream Slope.
- To introduce about the Stress relationship and shear parameters, Location of Centre of Slip Circle, Stability of Slope during Steady Seepage, Sudden Drawdown and Stability of the foundation against Shear.
- To introduce about the Rockfill Dams, Design of Foundation and Embankment of Rockfill Dams, Placement ofRockfill Materials, Compaction and Membrane Design for Rockfill Dams.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To understand the basic concept of earthen dam their types cause of failure, Methods of construction,Pore-Water Pressure and its Significance in the Design of Earth Dams
CO2	To understand about the Seepage Discharge through the Soil, Phreatic line and Determination of Phreatic Line for Homogeneous section with a Horizontal Filter and without Filter.
CO3	To understand how to control seepage through the embankment and foundation of the earthen dam and how to design the filter and protection of slop.
CO4	To understand about the location of slip circle and stability of slope during the sudden drawdown and steady seepage.
CO5	To understand about the fockfill dams, placement of material and compaction and design of rockfill dams

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To understand the basic concept of earthen dam their types cause of failure, Methods of construction, Pore-Water Pressure and its Significance in the Design of Earth Dams	3	3	3	1	0	2	3	0	0	0	2	2
CO2	To understand about the Seepage Discharge through the Soil, Phreatic line and Determination of Phreatic Line for Homogeneous section with a Horizontal Filter and without Filter.	3	3	1	2	0	2	0	0	1	0	1	1
CO3	To understand how to control seepage through the embankment and foundation of the earthen dam and how to design the filter and protection of slop.	2	3	1	1	0	2	0	0	0	0	1	1
CO4	To understand about the location of slip circle and stability of slope during the sudden drawdown and steady seepage.	2	1	1	3	0	2	0	0	0	0	1	1
CO5	To understand about the fockfill dams, placement of material and compaction and design of rockfill dams	3	1	3	1	0	2	1	0	1	0	2	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: DIRECTED STUDY
COURSE CODE: CE675/CEE675

COURSE OBJECTIVES:

- To make learner aware about the latest technology and engineering practices in industries.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Awareness regarding the latest technology, engineering methodology and practices being used in industries.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Awareness regarding the latest technology, engineering methodology and practices being used in industries.	3	0	0	2	3	3	0	0	3	3	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: M TECH DISSERTATION
COURSE CODE: CE699/CEE699

COURSE OBJECTIVES:

- To develop individuality and problem analysis skill.
- To nurture ability to perform literature review.
- To improve critical thinking ability for formulation of plan.
- To develop skill to use various engineering and technological tools.
- To develop skill to think critically on research results.
- To enhance the writing skill for research paper and dissertation.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to work independently on a research-based problem.
CO2	Skill to perform review of available literature effectively to present research gap.
CO3	Aptitude to plan methodology for the attainment of various research objectives.
CO4	Competency to apply of various engineering and technological tools to carry research.
CO5	Ability to conclude work using critical thinking.
CO6	Proficiency in preparing presentation and report.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to work independently on a research-based problem.	0	0	0	3	3	0	0	3	3	3	0	3
CO2	Skill to perform review of available literature effectively to present research gap.	0	0	0	3	3	0	0	3	3	3	0	3
CO3	Aptitude to plan methodology for the attainment of various research objectives.	0	0	0	0	3	0	0	0	3	3	0	3
CO4	Competency to apply of various engineering and technological tools to carry research.	0	0	0	3	3	0	0	0	3	0	0	3
CO5	Ability to conclude work using critical thinking.	0	0	0	3	3	0	0	3	3	3	0	3
CO6	Proficiency in preparing presentation and report.	0	0	0	0	3	0	0	3	3	3	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													