Government College of Engineering, Chhatrapati Sambhajinagar

(An Autonomous Institute of Government of Maharashtra)
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Curriculum for
M. Tech. Water Resources Engineering

(NEP Compliant)

(With Effect from Academic Year 2023-24)

Vision of the Institute

- In pursuit of global competitiveness, the institute is committed to excel in engineering education and research with concern for environment and society.

Mission of the Institute

- Provide conducive environment for academic excellence in engineering education.
- Enhance research and development along with promotion to sponsored projects and industrial consultancy.
- Foster development of students by creating awareness for needs of society, sustainable development and human values.

Motto of the Civil Engineering Department

To Build Strong Nation through Dedication

Vision of the Civil Engineering Department

To create, preserve and promulgate knowledge of civil engineering and thereby, contribute to the social, cultural, and economic well-being of the society.

Mission of the Civil Engineering Department

1. To maintain highest possible quality of civil engineering courses for developing competent, cultured, and responsible human resource.
2. To design, develop and direct activities of civil engineering discipline.
3. To extend civil engineering facilities to stakeholders.
4. To undertake Research & Development activities in civil engineering.
5. To develop entrepreneurship amongst the students.

Program Outcomes

After the successful completion of the Masters programme in Water Resources Engineering students will be able to:

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude
2. Identify, formulate and solve engineering problems in the domain of structural engineering field.
3. Use different software tools for Analysis and Design structural engineering domain.
4. Design and conduct experiments, analyse and interpret data, for development of simulation experiments.
5. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

M.Tech Programme components

Components		Total Credits
Programme Core Course (PCC)	Program Courses	22
Programme Elective Course (PEC)	Program Elective	14
Open Elective (OEC) Other than a particular program	Open Elective	06
Vocational and Skill Enhancement Course (VSE)	Skill Courses	04
Ability Enhancement Course (AEC) Technical Presentation	Humanities Social Science and Management (HSSM)	03
Entrepreneurship/Economics/Management Courses (EEM)		03
Research Methodology (RMC)	Experiential Learning Courses	04
Dissertation/Project/Internship (DIS/INT)		26
Co-curricular Courses (CCC)	Liberal Learning Courses	Audit
Total Credits		82

Government College of Engineering, Aurangabad

(An Autonomous Institute of Govt. of Maharashtra)

Teaching and Evaluation Scheme from year 2023-24 (NEP)

M. Tech. Water Resources Engineering

Semester -I											
			Teaching Scheme			Continuous Evaluation in terms of Marks					
	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
ELC	CERMC5001	Research Methodology	4	0	0	4	20	20		60	100
PCC	CEPCC5001	Computational and Statistical Methods	3	0	0	3	20	20		60	100
PCC	CEPCC5002	Engineering Hydrology and Hydrologic Systems	3	0	0	3	20	20		60	100
PEC	CEPEC5001 TO CEPEC5004	Program Elective Course -I	4	0	0	4	20	20		60	100
PEC	CEPEC5005 TO CEPEC5008	Program Elective Course -II	4	0	0	4	20	20		60	100
VSEC	CEVSE5001	Mini Project	0	0	4	2	-	25		25	50
PCC	CEPCC5003	Water Resources Software Laboratory	0	0	4	2	-	50		-	50
CC	INCCC5001	Audit Course (Stress Management by Yoga/Club Activity)	0	0	2	0	--	-	-	-	-
Total			18	0	10	22	100	175		325	600
Semester -II											
	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
PCC	CEPCC5004	Advanced Fluid Mechanics	3		-	3	20	20		60	100
PCC	CEPCC5005	Water Resources Systems Planning and Management	4	-	0	4	20	20		60	100
PCC	CEPCC5006	Hydraulic Structures	3	0	0	3	20	20		60	100
OE		Open Elective-I	3	0	0	3	20	20		60	100
PEC	CEPEC5009 TO CEPEC5012	Program Elective Course -III	3	0	0	3	20	20		60	100
PEC	CEPEC5013 TO CEPEC5015	Program Elective Course -IV	3	0	0	3	20	20		60	100
PCC	CEPCC5007	Lab- Water Technology Laboratory	0	0	2	1		25			25
PCC	CEPCC5008	Lab- Water Resources Systems Planning and Management	0	0	2	1		25			25
HSSM	EEAEC5001	Technical Presentation	3	0	0	3	20	20		60	100
VSEC	CEVSE5002	Mini Project	0	0	4	2		25		25	50
Total			22	0	08	26	140	215		445	800

Approved in XXVIIth Academic Council
Dated: 23rd Nov 2023

Government College of Engineering, Aurangabad

(An Autonomous Institute of Govt. of Maharashtra)

Teaching and Evaluation Scheme from year 2023-24 (NEP)

M. Tech. Water Resources Engineering

Semester -III											
			Teaching Scheme			Continuous Evaluation in terms of Marks					
	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
OE		Open Elective - 2	3	0	0	3	20	20		60	100
IKS	CEIKS6001	Ancient Water Management Practices	3	0	0	3	20	20		60	100
ELC	CEDIS6001	Dissertation-I	0	0	20	10	0	100		100	200
PCC	CEPCC5009	Engineering Hydrology Laboratory	0	0	4	2	0	25		25	50
Total			06	0	24	18	40	165		245	450
Semester -IV											
	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
ELC	CEDIS6002	Dissertation-II	0	0	32	16		150	0	150	300
Total			0	0	32	16		150	0	150	300

Note: The internship/Industrial Training of not less than 2 months duration should be completed by the students in vacations.

List of Program Elective Courses				
Sr No	PEC-I	PEC-II	PEC-III	PEC-IV
1	CEPEC5001:Groundwater Engineering	CEPEC5005:Planning and Design of Hydro Power Systems	CEPEC5009:Water Supply Systems	CEPEC5013:Integrated Watershed Management
2	CEPEC5002:Channel and River Hydraulic	CEPEC5006:Micro Irrigation	CEPEC5010:Environmental Impact Assessment	CEPEC5014:Land and Water Management
3	CEPEC5003:Urban Storm Water Management	CEPEC5007:GIS Applications in Water Resources Engineering	CEPEC5011:Climate Change and Water Resources	CEPEC5015:Water Quality Monitoring and Modeling
4	CEPEC5004:Rural and Urban Water Supply	CEPEC5008:River Basin Management	CEPEC5012:River Engineering and Flood Control	

List of Open Electives I to be offered in PG Semester II (First Year)

Sr. No	Course code	Open Elective Course	Course offering department
1	AMOEC5001	Basics of Finite Element Analysis	Applied Mechanics
2	CSOEC5002	Professional Ethics & Cyber Law	CSE
3	CEOEC5003	Engineering Optimization	Civil
4	MEOEC5004	Robotics (Not for Mechanical PG Students)	Mechanical
5	EEOEC5005	Electric Vehicles (Not for Electrical PG Students)	Electrical

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6	ECOEC5006	IoT for Smart Systems	E&TC

List of Open Electives II to be offered in PG Semester III (Second Year)

Sr. No.	Course code	Open Elective Course	Course offering Department
1	AMOEC6001	Indian Constitution	Applied Mechanics
2	CSOEC6002	Data Science (Not for CSE PG Students)	CSE
3	CEOEC6003	Disaster Management	Civil
4	MEOEC6004	Additive manufacturing	Mechanical
5	EEOEC6005	Smart Grid Systems	Electrical
6	ECOEC6006	Soft Computing	E&TC

List of Humanities I to be offered in PG Semester II (First Year)

Sr. No.	Course code	Humanities Course	Course offering Department
1	EEAEC5001	Technical Communication	Electrical

List of Humanities II to be offered in PG Semester III (Second Year)

Sr.No.	Course code	Humanities Course	Course offering Department
1	MEEEM6001	Entrepreneurship Development	Mechanical
2	ECEEM6002	Engineering Economics	E&TC
3	MEEEM6003	Industrial Management	Mechanical
4	CEIKS6001	Ancient Water Management Practices	Civil

MERMC5001: Research Methodology		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To guide students from understanding foundational research concepts to critically formulating research problems, culminating in the adept creation of comprehensive research plans and literature reviews.
2. To develop a comprehensive understanding of various research methods, both qualitative and quantitative
3. To facilitate students in analysing, evaluating, and creating research proposals.
4. To attain mastery in data collection methods, sampling, data analysis techniques, and result interpretation for robust research outcomes.
5. To equip students with the skills to proficiently create and present diverse research reports, encompassing various formats, oral delivery, technical writing, and ethical awareness regarding plagiarism.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Develop the ability to comprehend core research concepts, define key elements like variables and hypotheses, and critically evaluate literature to identify research
CO2	Justify their chosen research methods and explain their advantages and limitations.
CO3	Create well-structured research proposals that include clear research objectives, methods, and expected outcomes.
CO4	Proficient in using data analysis techniques relevant to their chosen research methods, such as statistical analysis for quantitative research or thematic analysis for qualitative research.
CO5	Create comprehensive research reports in diverse formats, such as academic papers, presentations, and technical reports.

Detailed Syllabus:

Unit 1	**Introduction to RM:** Meaning of Research, Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.
Unit 2	**Methods of Research:** Qualitative and quantitative methods of research like Historical, case study, ethnography, exposit facto, documentary and content analysis, survey (Normative, descriptive, evaluative etc.) field and laboratory experimental studies. Characteristics of methods and their implications in research area.
Unit 3	**Development of research proposal:** Research proposal and its elements Formulation of research problem-criteria of sources and definition Development of objectives and characteristics of objectives. Development hypotheses and applications.

Unit 4	**Methods of data collection:** Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications. Tools of data collections, their types, attributes and uses. Redesigning, research tools-like questionnaire, opinionnaire, observation, interviews, scales and tests etc. **Methods of data analysis:** Analysis of qualitative data based on various tools. Analysis of quantitative data and its presentation with tables, graphs etc. Statistical tools and techniques of data analysis-measures of central tendency, dispersion. Decision making with hypothesis testing through parametric and non-parametric tests. Validity and delimitations of research findings.
Unit 5	**Interpretation and Report Writing:** Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

Text and Reference Books

1. Garg B. L., Karadia R., Agarwal F. and Agarwal U. K., An introduction to Research Methodology, RBSA Publishers, 2002
2. Kothari C. R., Research Methodology: Methods and Techniques. New Age International, 1990.
3. Merriam S. B., Tisdell E. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley & Sons, 2016.
4. Creswell J. W., Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th edition, SAGE Publications, Inc, 2014.
5. Olsen C., Devore J., Peck R., Introduction to Statistics and Data Analysis, 5th edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	02	06
K2	Understand	10	08	24
K3	Apply	00	03	09
K4	Analyze	05	04	12
K5	Evaluate	00	03	09
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3		
CO2	2	2	2		
CO3	2		3	1	
CO4	1		3	1	
CO5	1	3	2		2

1 – Low, 2 – Medium, 3 – High

CEPCC5001: Computational and Statistical Methods

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to introduce the students to various methods of numerical solutions of ordinary differential equations such as Taylor's Series, Euler's Method, Runge Kutta Method. Course also develops the knowledge of Correlation and Regression Analysis, Skewness, Moments and Kurtosis. Students will gain an understanding of classification and presentation of data, probability theory and analysis. The course exposes students to the Finite difference methods, FEM, fuzzy and genetic algorithm and its applications to water resources engineering which are widely required to solve engineering problem.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Apply various differential equations methods to the water resources engineering.
2. Apply regression and correlation analysis.
3. Classify and present data. Apply the knowledge of probability and probability theory.
4. Develop FDM and FEM model and apply the knowledge of various soft computing tools such as fuzzy logic, neural network and genetic algorithm.

Detailed Syllabus:

Unit -1: Introduction Numerical Solution: 6 Hrs

Numerical Solution of Ordinary Differential Equations: Solution by Taylor's Series, Euler's Method, Runge Kutta Method, Newton Raphson Method, Bisection Me thod. Gauss-Jordan Method, Method of Leading Coefficient. Relaxation Method

Unit -2: Regression Analysis: 6 Hrs

Regression Analysis : Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypothesis – Multiple linear Regression – Correlation and Regression Analysis. Skewness, Moments and Kurtosis

Unit -3: Probability Techniques: 6 Hrs

Classification and Presentation of data, Basic Concepts of Probability, Probability Axioms, Analysis and Treatment of Data, Population and Samples, Measures of Dispersions, Measures of Symmetry Discrete and Continuous Probability Distribution Functions

Unit -4: Finite difference methods: 6 Hrs

Finite difference methods and its applications to water resources Engineering. Introduction to FEM and its applications to water resources Engineering

Unit -5: Fuzzy logic: 4 Hrs

Fuzzy logic, Fuzzy Mathematical Operations, Neural Networks, Mathematical Model of Neuron, Architecture. Introduction to genetic algorithm, Operators, Applications.

References:

1. Gupta. S.P., " Statistical Methods", S. Chand & Sons, New Delhi
2. Kothari C.R., "Research Methodology-Methods and Techniques", New Age International Publishers, New Delhi.
3. Gupta S.L. and Gupta Hitesh, “Research Methodology-Text and cases with SPSS applications” International Book House Pvt. Ltd., New Delhi.
4. Rao V and Rao H., “C++, Neural Networks and Fuzzy Logic”, BPB Publications,New Delhi.
5. Goldberg, D.E., “Genetic Algorithms in Search, Optimization & Machine Learning”, Addison Wesley Longman (Singapore) Pte. Ltd., Indian Branch, Delhi.
6. Klir George J. and Yuan Bo, “Fuzzy Sets and Fuzzy Logic”, PHI Learning Pvt. Ltd, New Delhi

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	3	3		2
CO3		3	3		3
CO4		3	3		3
3 – High		**2 – Medium**		**1 – Low**	

Teacher’s Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

a. Technical quizzes b. Application development
c. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher’s**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPCC5002: Engineering Hydrology and Hydrologic Systems

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to expose the students to system concept and hydrograph analysis. The rainfall-runoff analysis will be taught in the course, for un-gauged catchments. The hydrologic statistics will be studied for the determination of statistical parameters, frequency analysis and design flood. Geographical Information System and its applications to water resources engineering are included in the course. The climate change studies and Soil and Water Assessment Tool (SWAT) are also included in the course.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Develop unit hydrograph for a catchment
2. Do the rainfall-runoff analysis
3. Analyze the hydrologic statistics
4. Work with GIS and climate change effects on hydrology

Detailed Syllabus:

Unit -1: Introduction Hydrograph: 6 Hrs

Introduction: Systems Concept, Linear and Non Linear Systems, Lumped and Distributed Systems, Deterministic and Stochastic Systems, Time Invariant Systems, Unit Hydrograph Theory, S – Curve Hydrograph, Instantaneous Unit Hydrograph

Unit -2: Rainfall – Runoff Analysis: 6 Hrs

Rainfall – Runoff Analysis: Review of Rational Methods, Conceptual Model, Clarke and Nash Models, Derivation of Unit Hydrograph for un-gauged Catchments, Synthetic Unit Hydrograph.

Unit -3: Hydrologic Statistic: 6 Hrs

Hydrologic Statistic: Probabilistic Treatment of Hydrologic Data, Frequency and Probability Functions, Statistical Parameters, Frequency Analysis, Annual Maximum and Partial Duration Series Models, Regional Frequency Analysis, Design Flood

Unit -4: Hydrologic Flood Routing: 6 Hrs

Hydrologic Flood Routing: Reservoir Routing, Channel Routing, Estimation of Flood Routing Models, Flood Forecasting, Analog Models, Real Time Flood Forecasting. Applications of Remote Sensing and GIS in Hydrology: Land Use and Soil Mapping Using Remote Sensing, Watershed Management Using Remote Sensing Techniques, Concepts of Geographical information Systems (GIS) and its Application in Hydrologic Studies.

Unit -5: Climate Change: 4 Hrs

Climate Change: Global Circulation Model (GCM), Regional Circulation Model (RCM), Data collection and analysis, downscaling of climate parameters, uncertainty of regional climate projections, climate change impact, adaptation strategies, Risk and Vulnerability of Agriculture, climate forecasting, Soil and Water Assessment Tool (SWAT) Hydrological Model, Socioeconomic scenarios, Policy Initiatives for Climate Change Adaptation in India

References:

1. Chow, V.T., Maidment, D.R. and Mays, L.W. (1988), " Applied Hydrology", McGraw Hill Inc. N York
2. Singh, V.P. (1986), "Hydrologic Systems", Prentice Hall Inc., N York
3. Singh, V.P. (1992), "Elementary Hydrology", Prentice Hall of India, N Delhi
4. Haan C.T., (1995), "Statistical Methods in Hydrology", East West Press, New Delhi
5. Viessman, W., Lewis, G.L. and Knapp, J.W. (1989), "Introduction to Hydrology", Harper & Row Publications Inc., Singapore
6. Ponce, W.F. (1987), "Engineering Hydrology", Prentice Hall Inc. N York.
7. Lillesand, T.M. and Kiefer, R.H. (1994) "Remote sensing and Image Interpretation", John Wiley & Sons.
8. Subramanya, K. (2011), "Engineering Hydrology", Tata McGraw Hill Education Private Limited, New Delhi.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	3	3		2
CO3		3	3		3
CO4		3	3		3
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

b. Technical quizzes b. Application development

d. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5001: PEC-I Ground Water Engineering

Teaching Scheme		**Evaluation Scheme**	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course introduces different aspects of ground water engineering, determination of permeability and transmissibility by Theim and Dupuit's theory. It also evaluates aquifer properties for confined aquifer by Theis method, Jacob and Chow's method. Topics ranges from construction of well, water well design, drilling, components of ground water, ground water flow and ground water development and management.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Demonstrate the different terminologies related with groundwater hydrology
2. Identify suitable method of determination of aquifer parameters
3. Choose suitable ground water exploration techniques and assess ground water potential
4. Compare and contrast suitable ground water development and management methods

Detailed Syllabus:

Unit -1: Introduction Ground Water: 6 Hrs

Ground Water: porosity, retention of water in rocks, yield of rock, compressibility of rock, zone of aeration and saturation, fluctuation of water table and piezometric surfaces, storage coefficients of aquifers, specific yield, specific retention, unconfined and confined aquifer, ground water potential in India, geophysical methods for groundwater explorations.

Unit -2: Ground water flow: 6 Hrs

Ground water flow: Laminar and turbulent flow, Darcy's law, Reynolds number, permeability and transmissibility, Groundwater flow potential, Ground water theory for one, two and three dimensional problem, Differential equations governing groundwater flow for steady and unsteady state problems, Theim and Dupuit's theory for unconfined and confined aquifers, use of finite difference method to solve simple ground water flow problem.

Unit -3: Evaluation of Aquifer Properties: 6 Hrs

Aquifer tests, control well, observation well, Solution of aquifer parameters for confined aquifer by Theis method, Jacob and Chow's method, Theis' recovery method, bounded aquifer, interference among wells, aquifer properties for bounded aquifers by theory of images.

Unit -4: Ground Water Modeling: 6 Hrs

Construction of Wells and Ground Water Modeling: types of wells and method of construction, tube well design and well drilling: well screen, development and completion of wells, well performance test, well loss, Rotary drilling and Rotary percussion drilling, maintenance of wells. Groundwater Modeling: Groundwater flow, sand models, membrane model, thermal model, electric analog model and mathematical models

Unit -5: Groundwater Recharge, Development and Management: 4 Hrs

Components of ground water balance, estimation of recharge component, ground water storage changes, conjunctive use, artificial recharge of groundwater- different methods, subsurface dam, recharge by urban storm runoff, percolation from tanks, recharge from irrigated fields, groundwater quality, estimation of ground water discharge, ground water resource evaluation in India.

References:

1. Todd, D.K. "Ground Water Hydrology", John Wiley & Sons, Singapore.
2. Raghunath, H.M. "Ground Water" New Age International (P) Limited, New Delhi.
3. Karanth, K. R. "Ground Water Assessment Development and Management", Tata McGraw Hill Publishing Company Limited, New Delhi
4. Domenico "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc., NewYork
5. L. Harvil and F. G. Bell, Ground Water Resources and Development, Butterworth's, London.
6. Herbert F Wang and Mary P. Anderson "Introduction to Ground Water Modeling", W.H. Freeman and Company, NewYork

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	2			2
CO2	1	3	2		1
CO3	1		2		3
CO4	1	1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

a. Technical quizzes
b. Application development
c. Question & answer / Numerical solution
d. Group discussion
e. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test	Teacher's Assessment	End Semester Examination
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5002: PEC-I Channel and River Hydraulic

Teaching Scheme		Evaluation Scheme	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to explore the fundamentals of the specific energy, specific force, energy-depth relations and its computations. Course covers uniform flow calculations by using Chezy's and Manning's equations, computation of gradually varied flow and classification of flow profiles. The course provides detail knowledge of hydraulic jump and the energy dissipation including flow measurement. Course also includes the origin and properties of sediment and its analysis. At the end of this course, the basics of bed load, suspended load and channel design by Lane's theory, Kennedy's theory and Lacey's theory are included.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Calculate specific energy and describe energy-depth relationship.
2) Determine Chezy's and Mannings constant and GVF profiles.
3) Classify various types of hydraulic jumps and energy dissipation structures.
4) Design stable channels considering bed load and suspended loads.

Detailed Syllabus:

Unit -1: Introduction free surface flows: 6 Hrs

Basic concepts of free surface flows: flow regimes, velocity and pressure distribution, kinetic energy and momentum principles, energy-depth relationships, specific energy, critical depth, computation of

theoretical depth, section factors, hydraulic exponents, specific force diagram, theoretical concepts of channel bed roughness, transitions in channel sections.

Unit -2: Computation methods and analysis: 6 Hrs

Uniform flow, Chezy's equation, Manning's formula, roughness coefficients, equivalent roughness, uniform flow computations, gradually varied flow, dynamic equation, classification of flow profiles, GVF in different slopes, Computation methods and analysis: Direct integration, Breese's method, Chow's method, numerical methods: direct step method, standard step method

Unit -3: Rapidly varied flow: 6 Hrs

Rapidly varied flow, momentum equation for hydraulic jump, energy loss, classification of jumps, length and location of hydraulic jump in prismatic channel, rolling and ski jumps, energy dissipation works, Flow measurements: thin plate and sharp, broad, round crested weirs, critical depth flumes, Unsteady flows, equation of continuity, equation of motion, uniformly progressive waves, positive and negative surges, flood routing

Unit -4: Fluvial hydraulics: 6 Hrs

Fluvial hydraulics: Origin, ad properties of sediments, size, shape, fall velocity and its effects, orientation, grain size distribution, incipient motion of sediment particles, competency, lift force concept, critical tractive force approach, theoretical and sub theoretical analysis of Shield, White, and Iwagaki, regimes of flow, ripple and dune regime, characteristics,

Unit -5: Resistance to flow : 4 Hrs

Resistance to flow in alluvial streams, basic equations, theories of bed load suspended load, design of stable channels, Lane's theory, Kennedy's theory, Lacey's theory, tractive force methods of design of stable channels, design of stable channels in cohesive soils.

References:

1) Subramanya K. (1998) —Flow in Open Channels", Tata Mc Graw Hill Publishing Co.
2) Chow V.T. (1979) —Open Channel Hydraulics", Mc Graw Hill Inc., New York
3) Garde R, J.and Ranga Raju K.G. (1980) —Mechanics of Sediment Transportation and Alluvial Stream
4) French R.H. (1986) —Open Channel Hydraulics", Mc Graw Hill Publishing Co., New York
5) Chaudhary M. H., "Open Channel Flow. Prentice Hall of India, Eastern Economic Edition , . ISBN:81-203-08638,New Delhi. 1994.
6) French, R. H., "Open Channel Hydraulics McGraw Hill, New York NY 1985.
7) Srivastava R. Flow through Open Channels Oxford University Press New Delhi 2008.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

f. Technical quizzes
g. Application development
h. Question & answer / Numerical solution
i. Group discussion
j. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teacher's Assessment**	**End Semester Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5003: PEC-I Urban Storm Water Management

Teaching Scheme		**Evaluation Scheme**	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: Course focuses on water in an urban eco-system, its resources and problems. It also gives the knowledge of storm water management, its policies and feasibility. Course covers urban surface runoff model and quality model. Course also include structural and non structural management practices, hydraulic analysis and design guidelines. At the end, the planning and organizational aspects and general approach to operation and maintenance is covered.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Identify problems on urban eco-system and urban water resources.
2. Classify various types of models in urban water management.
3. Design flow and storage capacity of urban component.
4. Execute operation and management of urban water management system.

Detailed Syllabus:

Unit -1: urban eco-system: 6 Hrs

Water in the urban eco-system – Urban Water Resources – Major problems – Urban hydrological cycle – Storm water management objectives and limitations – Storm water policies – Feasibility consideration

Unit -2: Urban surface runoff models: 6 Hrs

Types of models – Physically based – conceptual or unit hydrograph based – Urban surface runoff models – Management models for flow rate and volume control rate – Quality models.

Unit -3: Storm water management practices: 6 Hrs

Storm water management practices (Structural and Non-structural Management measures) – Detention and retention concepts – Modelling concept – Types of storage – Magnitude of storage – Hydraulic analysis and design guidelines – Flow and storage capacity of urban components – Temple tanks.

Unit -4: Planning and organizational aspects : 6 Hrs

Planning and organizational aspects – Inter dependency of planning and implementation of goals and measures – Socio – economic financial aspects – Potential costs and benefit measures – Measures of urban drainage and flood control benefits – Effective urban water user organizations.

Unit -5: operations and maintenance: 4 Hrs

General approaches to operations and maintenance – Complexity of operations and need for diagnostic analysis – Operation and maintenance in urban water system – Maintenance Management System – Inventories and conditions assessment – Social awareness and involvement.

References:

1. Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), manual ondrainage in urbanized areas – Vol.1 and Vol.II, UNESCO, 1987. L T P C 3 0 0 3 30
2. Hengeveld, H. and C. De Voch.t (Ed)., Role of Water in Urban Ecology, 1982.
3. Martin, P. Wanelista and Yousef, A. Yousef., Storm Water Management, John Wiley and sons, 1993.
4. Neil S. Grigg., Urban Water Infrastructure Planning, Management and Operations, John Wiley and Sons, 1986.
5. Overtens D.E. and Meadows M.E., Storm Water Modelling, Academic Press, New York, 1976.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

k. Technical quizzes
l. Application development
m. Question & answer / Numerical solution
n. Group discussion
o. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teacher's Assessment**	**End Semester Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5004: PEC-I Rural and Urban Water Supply

Teaching Scheme		**Evaluation Scheme**	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: Address issues and various techniques for rural water supply, water quality monitoring, maintenance and operations. It also covers planning, collection, treatment and disposal of waste water. It provides knowledge of compact and simple waste water treatment units and septic tank. The disposal of solid waste, biogas plant, urban water supply, public health, pollution of urban water is also covered. At the end course covers collection, treatment, storage and handling of households' water and emergency water supply.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Identify techniques of rural water supply and rural water quality monitoring.
2. Plan waste water collection system, its disposal and treatment.
3. Decide suitable method of disposal of solid waste and rural sanitation.
4. Describe urban water supply, problems associated with it, monitoring water quality.

Detailed Syllabus:

Unit -1: Issues of rural water supply: 6 Hrs

Issues of rural water supply –Various techniques for rural water supply- merits- National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies, Introduction – Epidemiological aspects of water quality, methods for low cost water treatment – Specific contaminant removal systems

Unit -2: Introduction to rural sanitation: 6 Hrs

Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas stabilization ponds - septic tanks - Inhofe tank- soak pits- low cost excreta disposal systems Effluent disposal.

Unit -3: Disposal of Solid Wastes practices: 6 Hrs

Disposal of Solid Wastes- Composting- land filling incineration-Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.

Unit -4: Introduction to Urban Water Supply: 6 Hrs

Introduction to Urban Water Supply, urban Water and Public Health, problems associated with urban water supply, Water Sources and their Characteristics, urban Water Pollution, Water Treatment Technologies for Large-scale Water Supply, Distribution, Leakage and Illegal Connections, water meter system, MBR,ESR, Valves, Pressure relief valve

Unit -5: operations and maintenance: 4 Hrs

Water Safety Plans, Duties and Responsibilities of Water Utilities, Household Water Collection, Treatment, Storage and Handling, Efficient Use of Water, Monitoring Water Quality, Financing Urban Water Services, Water Emergencies and Emergency Water Supply, Public–Private Partnership and Other Commercial Opportunities

References:

1. Hengeveld, H. and C. De Voch.t (Ed)., Role of Water in Urban Ecology, 1982.
2. Neil S. Grigg., Urban Water Infrastructure Planning, Management and Operations, John Wiley and Sons, 1986.
3. Nathanson, Jerry A. (2009) Basic environmental technology: water supply, waste management and pollution control, 4th ed. New Delhi: PHI Learning.
4. Qasim, Syed R., Motley, Edward M., and Zhu, Guang (2000) Water works engineering: planning, design and operation. New Jersey: Prentice Hall.
5. Garg, S. K. (2007) Water supply engineering, 18th ed, Vol. I. New Delhi: Khanna Publisher
6. Handbook on Drinking Water Treatment Technologies, 2011, Ministry of Water and Sanitation, Government ofIndia, India
7. National Rural Drinking Water Program- Movement towards Ensuring i People's Drinking Water Security in Rural India, Framework for Implementation, Department of Drinking Water Supply, Ministry of Rural Development, Government of India, April, 2010 Source: http://swajal.uk.gov.in/files/pdENRDWP_GuidelineApril_10.pdf
8. Training Manual for Trainers of CSS,2007, Gujarat Jal Seva Training Institute, Vol. 1 &2
9. Water and Sanitation Program Report, 2011, Towards drinking water security in India-Lessons from the field, New Delhi, India

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

p. Technical quizzes
q. Application development
r. Question & answer / Numerical solution
s. Group discussion
t. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5005: PEC-II Planning and Design of Hydro Power Systems

Teaching Scheme		**Evaluation Scheme**	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course provides an overview of hydraulic engineering design of hydroelectric plants as well as it provides a detailed analysis for the optimization of related works and the parameters that influence the performance, safety and operation. The design of a hydroelectric plant begins with a hydrological analysis and hydraulic study, followed by an estimation of available water and eventual rated power to install including the overall quantity of energy to be produced. An understanding of the principles of the hydroelectric plant operation and the associated works is essential to efficiently perform the design and maximize uses of available water.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Analyze and design gravity dams.
2) Analyze and design Earth dams.
3) Design spillways and energy dissipation structures.
4) Design penstocks and surge shafts.

Detailed Syllabus:

Unit -1: Introduction to Power Plant Design: 6 Hrs

Introduction to Power Plant Design, Factors to Consider in Planning Hydrologic Analysis and Calculations Temporary Diversion Spillway & Riparian Flow Structures Composition of the power plant Energy production. Social Economic Research, Technical Survey, Outline of Hydropower Generation, Significance of Small Scale Hydropower Development.

Unit -2: Design of hydraulic structures: 6 Hrs

Design of hydraulic structures on permeable foundation including weir and barrage; determination of afflux and discharge intensity; waterway and looseness factor; stilling basin level and length; uplift pressures and exit gradient; floor thickness and protection works.

Unit -3: Earth dams: 6 Hrs

Earth dams- homogeneous and zoned sections; filter design and stability analysis. Gravity dams- general features; forces acting on gravity dam; galleries and their functions; stability analysis; roller compacted RCC dams

Unit -4: Spillways-layout and design: 6 Hrs

Spillways-layout and design of various types of spillways; design of energy dissipaters. Intake Structures-trash racks and their cleaning and handling devices; stop log arrangements; intake entrance; aeration vent; gate control. Tunnels-classification; rock cover; hydraulic design and supporting systems; concrete lining; portals and plugs; underground cavities.

Unit -5: Gates: 4 Hrs

Gates- various types of gates for barrages; spillways; intakes; sluices; structural design considerations for vertical lift and radial gates. Hydro power-function; classification and main components (penstocks, surge tanks, hydro turbines, etc.) of hydro power stations

References:

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. B.C. Punmia, Pande B.B. Lal “Irrigation and water power Engineering” Laxmi Publications Private Limited
4. Justinn, Creager and Hinds, “Engineering For Dams.Vol.I, II, III”
5. P.N.Modi. Irrigation and water powerengineering‘

6. Paulo C.F. Erbisti “design of hydraulic gates” A.A.Balkema publisher/Lisse/Abingdon/Exton (PA)/ Tokyo
7. E. Mosoni, “Water Power Development – Vol. I & II”
8. G. Brown, “Hydro-electric Engineering Practice Vol. I, II & III”
9. Varshney “Hydro Power Structures”
10. P. K. Bhattacharya, “Water Power Engineering” Khanna Pub., Delhi
11. M. M. Deshmukh, “Water Power Engineering” Dhanpat Rai and Sons

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher’s Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

u. Technical quizzes
v. Application development
w. Question & answer / Numerical solution
x. Group discussion
y. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teacher’s Assessment**	**End Semester Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5006: PEC-II Micro Irrigation

Teaching Scheme		Evaluation Scheme	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course emphasizes for understanding the importance of micro irrigation methods. Design and operation of sprinkler and drip irrigation methods is included in the curriculum. The course also emphasize on current developments in irrigation methods and the adoption of micro irrigation in the field.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Design the micro irrigation systems
2) Analyze the factors influencing the economics of micro irrigation
3) Understand the agricultural practices for enhancement of crop production and productivity
4) Understand planning, design and construction of sustainable small- scale micro irrigation schemes

Detailed Syllabus:

Unit -1: Introduction to irrigation methods: 6 Hrs

Importance, classification of irrigation methods – classification of micro-irrigation methods – principles and selection of micro- irrigation systems – low pressure mini spray systems – bubbler system – sprinkler and drip system – irrigation efficiencies.

Unit -2: Sprinkler irrigation systems : 6 Hrs

Development – Use – Types – Portable, Semi portable and Permanent systems – Components – pumping – Main line – Lateral line – Sprinkler heads – Moisture distribution pattern and uniformity of coverage – Testing of water distribution pattern – Design of Sprinkler irrigation systems – Types of system and layout - Selection and spacing – Capacity of sprinkler system – Hydraulic design – Design of laterals – Cost estimation – Operation and Maintenance – trouble shooting – Application of Fertilizers – Fertilizer injection methods and Devices.

Unit -3: Drip effect on water use: 6 Hrs

Drip effect on water use – description of drip irrigation system –types – various methods – manufacturing drip equipments – low and high density polythene – main pipe – submains – laterals – emitters – dripper with hole and socket – micro tube emitters – nozzles – self adjusting drippers – double wall pipe – leaky pipe. Principles for design of drip system – hydraulic formulae Darcy Weishbach equation – Hazen Williams formulae – factors to be consider to the design of the system – design procedure –design of emitters, laterals, submains and main lines – head works – drip layout for different crops – field crops – close spaced crops – orchard crops – drip irrigation design and layout – model design.

Unit -4: Effects of discharge rate: 6 Hrs

Effects of discharge rate of drip emitter – water movement under drip system – soil moisture distribution – soil water content – drainage flux – irrigation control by soil physical methods - Clogging – water quality and preventive measures – cleaning of clogged system – filtration problems and measures – gravel filters – vortex filters – other methods of filtering and prevention – clogging of outlets. Introduction and list of fertilizers – application of fertilizer – influence on general nutritional problems – fertilizers movement – fertilizing – existing

fertilizer practices – continuous fertilizers – methods of applying fertilizers – volume of fertilizer tank – dilution ratio.

Unit -5: drip system: 4 Hrs

drip system – engineering design – Agronomic manipulation –commercial production – factors influencing economics of drip system – cost estimates – optimum farm size – economics and financial analysis – present status and application – case studies.

References:

1. Michael, A.M., "Irrigation Theory and Practice", Vikas Publishers, New Delhi, 2000.
2. Dilip Kumar Majumdar., Irrigation Water Management, Prentice Hall Inc., 2004.
3. Dr. R. Suresh , "Principles of Micro-Irrigation Engineering", Standard Publishers Distributors, New Delhi, 2010.
4. R.K. Sivanappan, "Sprinkler Irrigation", Oxford and IBH Publishing Co, New Delhi,1987.
5. J.Keller and D. Karmeli, "Trickle Irrigation Design", Rainbird Sprinkler Irrigation Manufacturing Corporation, Glendora, California, USA.
6. Jack Keller and RondBelisher., "Sprinkler and Trickle Irrigation", Van nastrandReinhold,New York, 1990.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

- ✓ Technical quizzes
- ✓ Application development
- ✓ Question & answer / Numerical solution
- ✓ Group discussion
- ✓ Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teacher's Assessment**	**End Semester Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5007: PEC-II GIS Applications in Water Resources Engineering

Teaching Scheme		**Evaluation Scheme**	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: Course explores physics of remote sensing and various remote sensing platforms. It covers satellite data analysis, visual interpretation and image processing and data mining. The details of GIS, thematic mapping and application of GIS to water resources engineering are also covered at the end of the course.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Classify various remote sensing platforms
2. Analysis satellite data and apply image processing and image enhancement.
3. Modelling in GIS, thematic mapping obtain digital elevation modelling.
4. Apply GIS to various water resources problems.

Detailed Syllabus:

Unit -1: Introduction to remote sensing: 6 Hrs

Physics of remote sensing, electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation; Remote sensing platforms – Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS and others, Indian Space Programme.

Unit -2: Satellite Data analysis: 6 Hrs

Satellite Data analysis - Visual interpretation – Digital image processing – Image preprocessing – Image enhancement – Image classification – Data Merging.

Unit -3: Basic components of GIS: 6 Hrs

Definition – Basic components of GIS – Map projections and coordinate system – Spatial data structure: raster, vector – Spatial Relationship – Topology – Geodatabase models: hierarchical, network, relational, object oriented models – Integrated GIS database -common sources of error – Data quality: Macro, Micro and Usage level components - Meta data - Spatial data transfer standards.

Unit -4: Thematic mapping: 6 Hrs

Thematic mapping – Measurement in GIS: length, perimeter and areas – Query analysis – Reclassification – Buffering - Neighborhood functions - Map overlay: vector and raster overlay – Interpolation – Network analysis –

Digital elevation modelling. Analytical Hierarchy Process, – Object oriented GIS – AM/FM/GIS – Web Based GIS

Unit -5: Spatial data sources: 4 Hrs

Spatial data sources GIS approach water resources system –Thematic maps - Rainfall-runoff modelling – Groundwater modeling – Water quality modeling - Flood inundation mapping and Modelling – Drought monitoring – Cropping pattern change analysis –Performance evaluation of irrigation commands. Site selection for artificial recharge - Reservoir sedimentation.

References:

1. Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation" 3 rd Edition. John Wiley and Sons, New York. 1993.
2. Burrough P.A. and McDonnell R.A., "Principles of Geographical Information Systems",.Oxford University Press. New York. 1998.
3. Ian Heywood Sarah, Cornelius and Steve Carver "An Introduction to Geographical Information Systems". Pearson Education. New Delhi, 2002.
4. "Centre for Water Resources", Change in Cropping Pattern in Drought Prone Chittar Sub-basin, Project Report, Anna University, Chennai, 2002.
5. Mesfin Tadesse Bekalo “Landuse Change Detection Using GIS, Remote Sensing and Spatial Metrics”
6. Nigus Tadesse and Mazengia Mengist “Land Suitability Evaluation Using GIS and Remote Sensing Technology”

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher’s Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

c. Technical quizzes b. Application development
e. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher’s**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5008: PEC-II River Basin Management

Teaching Scheme		**Evaluation Scheme**	
Theory	4 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**4**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course links engineering science with social and economic science under the frame of sustainability with focus on water resource management at river basin level. Communication and conflict management, data and information management, system thinking and hydro social modelling is also included in the curriculum. Best and worst practices of land and water management are discussed.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Understand concept of sustainability.
2) Understand Hydrological and nutrient cycles.
3) Know water related diseases, source water protection.
4) Understand Climate change management option and tools to analyze hydrological change due to climate change

Detailed Syllabus:

Unit -1: Introduction : 6 Hrs

Sustainability indicators, resources depletion, growth models Planetary System Boundaries, footprints, prosperity Globalization, inter-connected world, Stakeholders in sustainability.

Unit -2: Climate change: 6 Hrs

Anthropocene, Climate change, climate variability, Hydrological cycle, water balance, catchment terminology, River basin management, Water availability, surplus, deficit, Water scarcity, water crisis, Stream morphology and land use, Nutrient cycles

Unit -3: Water and society: 6 Hrs

Water and society, poverty, demography, Water governance, integrity, accountability, Pollution, water related diseases, source water protection, Water and land use, wetlands, desertification, Dams, diversions, artificial rainfall, Economic and financial instruments in water management, Hydrological change due to climate change

Unit -4: Protecting water resources : 6 Hrs

Protecting water resources / improving water quality, Living standards, equity, education and technology transfer, Water conservation and efficiency, Improving monitoring and data management, decision support systems, Improving management and justice, Improving administrative (transnational) structures, Improving prediction and risk assessment

Unit -5: Sustainability sources: 4 Hrs

Sustainability criteria (ecological, economic, institutional, social) Multi-criteria decision support

References:

- ✓ Randhir, T.O., Watershed Management Issues and Approaches, IWA 2007
- ✓ Murty, J.V.S., Watershed management, New Age International 2009
- ✓ Majumdar, D.K., Irrigation Water Management, Prentice Hall 2000
- ✓ Allam, Gamal Ibrahim Y., Decision Support System for Integrated Watershed Management,< Colorado State University, 1994.American Socy. of Civil Engr., Watershed Management, American Soc. of Civil Engineers, New York, 1975.
- ✓ Black Peter E., Watershed Hydrology, Prentice Hall, London, 1991. Michael A.M., Irrigation Engineering, Vikas Publishing House, 1992. Purandare, A.P., Jaiswal A.K., Waterhed Development in India, NIRD, Hyderabad, 1995.
- ✓ Vir Singh, Raj , Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

- ✓ Technical quizzes
- ✓ Application development
- ✓ Question & answer / Numerical solution
- ✓ Group discussion
- ✓ Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teacher's Assessment**	**End Semester Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEVSE5001: Mini Project

Teaching Scheme		**Evaluation Scheme**	
Theory		Term Work / ISE-I	25 Marks
Tutorial	4 Hrs/Week	Viva-voce	25 Marks
Total Credits	**2**	Total	50 Marks

Prerequisite: Not applicable

Course Description: The student shall collect, review, compile, comprehend, present research literature and identify the problem for the dissertation.

Course Outcomes:

After successful completion of the course, students will be able to:

1. To search literature from different sources to appraise the state-of-the-art.
2. To compile and prepare a technical report from the collected literature.
3. To present the literature in a comprehensive manner and identify the problem for the dissertation

Detailed Syllabus:

Term Work:

The Mini Project with Seminar shall consist of collection of literature from a chosen field of Structural Engineering from various sources such as refereed journals, proceedings of national international conferences, PG/PhD theses etc. Based on the literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as necessary the candidate shall define the problem for the dissertation.

The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and at least one faculty member of the department.

Viva Voce Examination: It consists of two parts.

Part-I: Mid-Term Evaluation for 10 Marks: A mid-term evaluations for 10 marks out of 25 marks shall be done as per the schedule given in the institute academic calendar. Student should prepare a power point presentation and present before the panel of examiners and class students and should be able to answer questions asked by the panel of examiners and class students. Panel of examiner consists of guide as internal examiner and one faculty members appointed by the DCoE as external examiners. The panel of examiner will assess the contents and presentation and give the suggestions, if any and assigns the marks out of 10. In this phase student is expected to collect and present substantial literature.

Part-II: End Semester Evaluation for 15 Marks: Student should prepare technical report in prescribed format duly incorporating suggestions of Part-I and present power point presentation before the panel of examiners and class students. The student should be able to answer the questions asked. The panel of examiner will assess the seminar contents and seminar presentation and assigns the marks out of 15. In this phase the students is expected to define the problem for dissertation through further literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as necessary.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

- ✓ Technical quizzes
- ✓ Application development
- ✓ Question & answer / Numerical solution
- ✓ Group discussion
- ✓ Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Term Work**	**Viva-voce**
Pattern Level No.	**Level**	**Assessment**	**Examination**
K1	Remember	2	2
K2	Understand	8	5
K3	Apply	4	4
K4	Analyze	8	9
K5	Evaluate	3	4
K6	Create		1
	Total Marks	25	25

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Term Work (25 Marks)	8	7	10	
Vice-Viva (25 Marks)	5	5	15	

CEPCC5003: Water Resources Software Laboratory

Teaching Scheme		Evaluation Scheme	
Practical	4 Hrs/Week	Term Work	50 Marks
Total Credits	**2**	Total	50 Marks

Prerequisite: Not applicable

Course Description: Learning of software and solving examples is expected by the students during software laboratory work. Minimum six of the following are required to perform in the software laboratory. Student will have to work on software and do the mini project.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Learn different software related to water resources engineering.
2) Analyze optimization models using different softwares.
3) Solve real problems using these softwares.
4) Design the water distribution system network.

Detailed Syllabus:

1. Demonstration of QGIS Software [Georeferencing of Scanned images and Reference datasets, Creation of GIS Database (Digitization of point, line and polygon features), GIS database modification and editing (for point, line and polygon features)]
2. River modeling using HEC-RAS
3. Hydrologic modeling using HEC-HMS
4. Precipitation-runoff modeling using QSWAT
5. Study on Fluid Flow software
6. Study on the SWMM Software
7. Application of MATLAB and its toolboxes
8. Working in LINGO environment for water resources application
9. Working in SPSS for water resources application
10. Study on DAMBRK software
11. Study on River CAD model
12. Study on the BRANCH, EPANET, WATERGEMS, SEWERGEMS, etc. softwares

References:

Geographical Information Systems (QGIS) – QGIS is the most popular GIS tool with an impressive trajectory and a vibrant community. It also even has a particular ecosystem of complements called “plugins”. QGIS is a completely open source alternative that reduces the cost barriers since it does not need a paid license and can be executed in any operative system. (Web: www.qgis.org)

River modeling (HEC-RAS) – The numerical model HEC-RAS is developed by the U.S. Army Corps of Engineers. This model uses the gradient and topography to evaluate the flow depth, velocities and flooded zones. It is also useful to calculate sediment transport and water temperature. (Web: hec.usace.army.mil/software/hec-ras/)

iRIC (International River Interface Cooperative) – iRIC is a software developed with the purpose of offering a complete simulation environment of the riverbed and its results can be exported and used to analyze, mitigate and prevent disasters, through the visualization of the results of the river simulation. (Web: http://i-ric.org/en/)

Hydrologic modeling (HEC-HMS) – Hydrologic Modeling System (HEC-HMS) is designed to simulate the hydrologic processes in basins. The software includes traditional procedures of hydrologic analysis, such as infiltration events,

unit hydrograms and routing. HEC-HMS also includes modules for evapotranspiration, snow melting and calculus of soil humidity. (Web: www.hec.usace.army.mil/software/hec-hms)

PRMS – The modeling code PRMS (Precipitation Runoff Modeling System) is modular system of spatially distributed parameters, which represent physical processes of a basin. It was developed by the United States Geological Survey (USGS) to evaluate effects of several combinations of geomorphology, type of soil, soil use, vegetation and climatic parameters in hydrological response of a basin. (Web: wwwbrr.cr.usgs.gov/projects/SW_MoWS/PRMS.html)

QSWAT – SWAT is a tool to evaluate soil and water at a basin scale. It is focused in precipitation-runoff modeling and transport of water and solutes through surface flow. It predicts the impacts of soil management practices in water resources and sediments (Web: swat.tamu.edu)

Hydrogeological modeling (MODFLOW) – This code performs groundwater modeling based on finite differences developed by the United States Geological Survey (USGS). It is capable of simulating groundwater 2D and 3D flux and simulate the principal physical processes related to the groundwater regime such as recharge, evapotranspiration, pumping, drainage, etc. (Web: http://water.usgs.gov/ogw/modflow/)

Computational fluid dynamics modeling (OpenFOAM) – Pretty much any physical phenomenon associated to fluid dynamics can be represented with this software. The amount of packages incorporated and also its condition of an open source code make it useful to explore the possibilities of modeling several types of problems including the addition of a reactive model. (Web: www.openfoam.org)

Scientific tools – programming (Python) – This is the favorite code for scientific, water resources and environment analysis. It has several packages for different tools such as GIS, mathematical analysis and artificial intelligence. If a complete tool for manipulation, processing and plotting of data is needed, Python – Scipy is an effective, versatile and free code solution. (Webs: www.python.org, www.scipy.org)

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

CEPCC5004: Advanced Fluid Mechanics

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to introduce to students the concepts of fluid mechanics from both theoretical and applications perspective. There is a well-balanced coverage of physical concepts, mathematical operations along with example and exercise problems of practical importance. The course provides the platform for fundamental understanding of the basic principles of fluid mechanics and help to apply the basic principles to analyze fluid system.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Know and understand the basic concepts kinematics and Dynamics of fluid flow, Ideal flow, Laminar flow and Turbulent flow, Boundary layer theory, dimensional analysis and model analysis.
2. Apply the energy equations for practical problem related to fluid flow.
3. Analyze the effect of laminar and turbulent flow and boundary layer for fluid in motion.
4. Carry out dimensional analysis and model analysis for various practical problems.

Detailed Syllabus:

Unit -1: Properties of Fluids: 6 Hrs

Properties of Fluids: Role of fluid properties in fluid motion, types of fluids based on rheological diagram, Thermodynamic properties: Dimension of R, Isothermal process, Adiabatic Process, Universal Gas Constant kinematics of Fluid flow: Equation of continuity in Cartesian and cylindrical co-ordinate system, Lagrangian and Eulerian approach, stream tube, path lines, streak lines, stream lines and their equations, elements of particle motion, circulation, rotational and irrotational flows, vorticity, angular deformation, stream function, Velocity potential function, Laplace's equation, Flownets.

Unit -2: Dynamics of fluid flow: 6 Hrs

Dynamics of fluid flow: Equations of Motions, Euler's equation of motion in Cartesian and cylindrical coordinate system,energy equation from Euler's equation, practical applications of energy equation Ideal Flow: uniform flow parallel to x and y axis, source flow, sink flow, Free vortex flows, Superimposed flow: Source and Sink Pair, Doublet, A plane surface flow in a Uniform flow, Source and Sink Pair in Uniform flow, A doublet in a Uniform flow

Unit -3: Laminar Flow and Boundary layer theory: 6 Hrs

Laminar Flow: Navier-Stokes equation of motion, exact and approximate solutions to Navier-Stokes equation, Relationship between shear stress and Pressure Gradient, Flow of viscous fluid in Circular Pipes-Hagen Poiseuille Law, Flow of viscous fluid between two parallel plates: One plate is moving and other at rest-Couette flow and Both plates at rest

Boundary layer theory: boundary layer definitions and characteristics, displacement, momentum, and energy thickness, Momentum Equation for boundary layer by Von Karman, laminar boundary layer, boundary layer separation and its control

Unit -4: Turbulent flow: 6 Hrs

Turbulent flow: Charteristics of turbulent flow, Shear stress in turbulent flow: Boussinesq's theory, Reynolds theory, Prandtl's mixing lengththeory, Universal velocity distribution Hydrodynamically smooth and rough boundaries: velocity distribution for turbulent flow in smooth and rough pipes, Common equation for velocity distribution for both smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes

Unit -5: Dimensional analysis: 4 Hrs

Dimensional analysis: dimensions, dimensional homogeneity, Methods of dimensional analysis: Rayleigh's method and Buckingham's pi methods, limitations of dimensional analysis, Model analysis: Similitude, Forces influencing hydraulic phenomenon, dimensionless numbers and their significance, Model Laws, Types of models, Scale effect in models, Limitations of hydraulic similitude

References:

- ✓ R. K. Rajput, (2006) "Fluid Mechanics", S. Chand and Company Limited, New Delhi, Third Edition, ISBN:81-219-1667-4.
- ✓ S. Narsimhan (1973) "Engineering Fluid Mechanics", Orient Longman
- ✓ Douglas J.F, Gasiorek S, waffield J.A. (2003) "Fluid Mechanics", Pearson Education (Singapore) Pvt. Ltd. Indian office at 482 F.I.E. Patparganj, Delhi.
- ✓ Mohanthy A.K. (1994) "Fluid Mechanics, Prentice Hall of India, New Delhi

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

- ✓ Technical quizzes
- ✓ Application development
- ✓ Question & answer / Numerical solution
- ✓ Group discussion
- ✓ Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teacher's Assessment**	**End Semester Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPCC5005: Water Resources Systems Planning and Management

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to expose the students to engineering economy of water resources project for evaluation of benefit cost analysis. Optimization techniques such as linear programming and non-linear programming are included in the curriculum. Simulation and multi-objective optimization is also included in the curriculum. Student will be exposed to the water quantity and water quality management with different models.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Understand principles of engineering economy
2) Optimize the water resources systems
3) analyze the water quantity and quality management
4) Understand the legal aspects of water and environment systems.

Detailed Syllabus:

Unit -1: Introduction: 6 Hrs

Introduction: General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Systems, Economic Analysis of Water Resources Systems: Principles of Engineering Economy Capital, Interest and Interest rate, Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques Socio Economic Analysis.

Unit -2: Methods of Systems Analysis: 6 Hrs

Methods of Systems Analysis: Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models

Unit -3: Non-linear Programming: 6 Hrs

Non-linear Programming, Gradient Techniques, Stochastic Programming, Simulation,Multi Objective Optimization.

Unit -4: Water Quantity Management: 6 Hrs

Water Quantity Management: Surface Water Storage Requirements, Storage Capacity and Yield, Reservoir Design, Water Allocations for Water Supply, Irrigation, Hydropower and Flood Control,Reservoir Operations, Planning of an Irrigation System, Irrigation Scheduling, Groundwater Management, Conjunctive Use of Surface and Subsurface Water Resources

Unit -5: Water Quality Management: 4 Hrs

Water Quality Management: Water Quality Objectives and Standards, Water Quality Control Models, Flow Augmentation, Wastewater Transport Systems, River Water Quality Models. Legal Aspects of Water & Environment Systems: Principles of Law Applied to Water Rights and Water Allocation, Water Laws. Environmental Protection Law

References:

- ✓ Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1982) —Water Resources Systems Planning and
- ✓ Analysis“, Prentice Hall Inc. N York
- ✓ 3. Chaturvedi, M.C. (1987), —Water Resources Systems Planning and Management“, Tata McGraw Hill 4. Pub. Co., N Delhi
- ✓ Hall. W.A. and Dracup, J.A. (1975), —Water Resources Systems“, Tata McGraw Hill Pub. N Delhi
- ✓ James, L.D. and Lee (1975), —Economics of Water Resources Planning“,McGraw Hill Inc. N York
- ✓ 7. Kuiper, E. (1973) —Water Resources Development, Planning, Engineering and Economics“,8. Buttersworth, London.
- ✓ Biswas, A.K. (1976) —Systems Approach to Water Management“, McGraw Hill Inc, N York.
- ✓ Taha, H.A. (1996) —Operations Research“, Prentice Hall of India, N Delhi.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

d. Technical quizzes b. Application development

f. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPCC5006: Hydraulics Structures

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course introduces the different aspects of hydraulic structures. It deals with earthen dam, its types, design criteria and design of earthen dam. It also deals with seepage through dam and foundation and its control. Drainage of embankment and design of filter is also covered. Gravity dam with reference to forces acting, modes of failures, design and foundation treatment is included. Aspects such as strengthening and raising of gravity dam and repairs of concrete dam are also covered. Different aspects of arch dam and buttress dam are also included. Topics ranging from capacity of spillway, types of spillway, energy dissipation below spillway, different types of spillway gates and outlet through dams are also included.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Demonstrate the different terminologies related with hydraulic structures.
2. Decide suitability of individual hydraulic structures in different situation.
3. Design different hydraulic structures such as dams and spillways
4. Compare and contrast suitable hydraulic structure in a particular scenario

Detailed Syllabus:

Unit -1: Earthen Dams: 6 Hrs

Earthen Dams, types of earthen dams, choice of type of dam, causes of failure of earth dams, design criteria for earth dams, selecting a suitable preliminary section for an earth dam, design of earth dams; stability analysis of slopes: shape of slip surface, and method of slices..

Unit -2: Methods of Seepage Analysis: 6 Hrs

Seepage through Dam Section and its Control: fundamentals of seepage flow, Laplacian equation and flow net. Determination of top flow line and discharge through dam, seepage force and its effects, steady seepage. Drainage of Embankment: horizontal drain, chimney drain, design of filter, use of impervious core in seepage control. Control of seepage trough foundation, cut off trench, partial cutoff and upstream impervious blanket.

Unit -3: Gravity dams: 6 Hrs

Gravity dams, forces acting, modes of failure, elementary and practical profile, low and high gravity dam, design of gravity dam, drainage gallery, joints in a gravity dam, foundation treatment in a gravity dam, strengthening and

raising of gravity dams, deterioration and repairs of concrete dam, deformation measurement of dam body by plumb lines and off dam reference point.

Unit -4: Arch dams: 6 Hrs

Arch dams: types and its suitability, equations of cylindrical shells, general concepts about trial load method and elastic shell method. Hollow gravity dam, structural features, Buttress dam, types: flat slab type, massive head type, multiple arch type and prestressing of buttress dams.

Unit -5: Spillways: 4 Hrs

Spillways - Determination of capacity, types, ogee, side channel, chute, shaft and 6 Hr siphon. Basic principles of hydraulic design, energy dissipation arrangements below spillway. Spillway Gates: Types such as Tainter, drum, vertical lift, automatic gates. Outlets through dams: types, hydraulics of outlet works, river intakes and trash rack

References:

- ✓ William P. Creager, Joel Justin and Julian Hinds "Engineering for Dams" Vol. I, II and III, John Wiley and Sons, Inc. London
- ✓ Sharma, H.D. "Concrete Dams" Metropolitan Printers, Delhi 110153
- ✓ Garg, S.K. "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, Delhi.
- ✓ Novak, P., Moffat, A.I.B., Nalluri, C. and Narayanan, R. Hydraulic Structures Unwin Hyman Ltd.London 1989.
- ✓ USBR Design of Small Dams Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 1974.
- ✓ Varshney, R.S. Concrete Dams Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 1982.
- ✓ Varshney, R.S. Hydro Power Structures – Nem Chand Bros. Roorkee 1973 Guthrie, Brown J.
- ✓ Hydro Electric Engineering Practice Blackie and Son, Glasgow 1970.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	1	2			2
CO2		3	2		1
CO3		2	2		3
CO4		1	3		
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

e. Technical quizzes b. Application development

g. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPOC5001: Engineering Optimization

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to expose the engineering optimization technique such as linear and dynamic programming, Transportation Model, Assignment Model and Game Theory, Goal programming and Sequencing model, stochastic programming, Multi Objective Programming. With these techniques, it is possible to determine the ultimate goal to minimize the effort required or to maximize the desired benefit.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Understand optimization, concept of system and its application
2. Optimize a function using Linear and dynamic programming, sensitivity analysis,
3. Understand applications of the Transportation Model, Assignment Model and Game Theory
4. Optimize Goal programming and Sequencing model, stochastic programming, Multi Objective Programming

Detailed Syllabus:

Unit -1: Concept of System and Linear Programing: 6 Hrs

Concept of System, Types of System, Use of systems analysis in 6 Hrs Engineering, Introduction and Applications of Optimization Techniques in Engineering for Planning, design and Construction, Model and its Various types, Objective function and constraints, convex and concave functions, regions and sets. **Linear programming**: Formulation of Linear programming models for Civil engineering applications, Solution of LP Model by Graphical Method, The Simplex method and Special cases in simplex method, Artificial Variable Techniques: Method of Big M and Two phase method

Unit -2: Methods of programming: 6 Hrs

Linear programming: Duality and its Applications, Dual 6 Hrs Simplex Method, Sensitivity analysis, Post Optimality Analysis. **Deterministic Dynamic programming**: Multi stage decision processes, Principle of optimality, recursive equation, Applications and various models of D.P.

Unit -3: Non-Linear programming: 6 Hrs

Non-Linear programming: a) Single variable unconstrained optimization–Local & Global optima, unimodal function, Sequential Search Techniques- Dichotomous, Fibonacci, and Golden section. b) Multivariable

optimization without constraints-The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method. c) Multivariable optimization with equality constraints-Lagrange Multiplier Technique.

Unit -4: Transportation Model: 6 Hrs

The Transportation Model and its variants, Assignment Model and its variants, Game Theory and its variants

Unit -5: Goal Programming: 4 Hrs

Goal Programming, Sequencing model – n jobs through 2, 3 and m machines, Introduction to stochastic programming, Multi Objective Programming, Simulation

References:

- ✓ S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P)Ltd., New Delhi, 2000.
- ✓ G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
- ✓ H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
- ✓ K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
- ✓ K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	L	M			M
CO2		H	M		L
CO3		M	M		H
CO4		L	H		
H – High		**M – Medium**		**L – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

f. Technical quizzes b. Application development

h. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5009:Water Supply Systems

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: To educate the students in detailed design concepts related to water transmission mains, water distribution system with emphasis on computer application. Explain design concept of different water treatment units. Identify suitable method of treatment to be used for removal of impurity. Design conventional water treatment plant. Analyze water distribution system.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Get a basic knowledge of the design of pipe networks.
2) Analyze pipe network problems using different softwares and optimization technique
3) Familiar with the terminologies and designs of the water supply system.
4) Get a basic knowledge of water quality control techniques.

Detailed Syllabus:

Unit -1: Water requirement: 6 Hrs

Water requirement – sources of water – water demand – reservoir storage – nodal hydraulic gradient level values - water supply consideration, Types of water supply systems- piping system-distribution network- labeling- network components – Network models – design – optimization in practice

Unit -2: Conventional Treatment Processes: 6 Hrs

Conventional Treatment Processes: Sedimentation, Type of Sedimentation, Zone Setting, Filtration, Gravity Granular — Media Filtration, Head Losses, Back Washing and Media Filtration, Head Losses, Back Washing and Media Fluidization — Pressure Filters —Slow Sand Filters, Coagulation and Flocculation Coagulants, Theory of coagulation and flocculation process, coagulation kinetics, coagulant Aids, Rapid Mixing Devices, Disinfection, Disinfection Methods, Fluoridation, De-fluoridation.

Unit -3: Energy and hydraulic gradient lines: 6 Hrs

Energy and hydraulic gradient lines – head loss in links equivalent pipes – series – parallel pipes – path head loss and loop head loss – analysis of water distribution network- static node, dynamic node – network performance – flow analysis - Layout – in situ lining - pipes material – appurtenances – minimization of water losses – leak detection.

Unit -4: Water distribution systems: 6 Hrs

Water distribution systems, major and minor losses, head discharge relationships, formulation of equations, pipe network analysis, Hardy cross method, Newton Raphson method, linear theory method, and finite element method. Uncertainty and reliability – affecting events- assessment – reliability parameters-configurations. Design methodology - strengthening and expansion

Unit -5: Node flow analysis: 4 Hrs

Node flow analysis, optimization techniques in pipe networks, hydraulic design of water supply systems, pumping systems, distribution Reservoirs and Service Storage

References:

- ✓ Viessman Jr., Mark 3. Hammer (1990) Water Supply and Pollution Control. McGraw Hill International Edition.
- ✓ Fair, Geyer, Okun (1990) Water Supply Engineering. John Wiley.
- ✓ Turbuit T H Y (1998) "Principles of Water Quality Control" Pergamon Press.Bhave P. R, Optimal design of water distribution networks, Narosa publishing House, New Delhi,2003
- ✓ Bajwa. G. S, Practical handbook on Public Health Engineering, Deep publishers, Shimla 2003
- ✓ Manual on water supply and treatment, CPHEEO, Ministry of Urban Development, GOI, NewDelhi, 1999
- ✓ B.A. Hauser, practical hydraulics Hand Book, Lewis Publishers, New York, 1991
- ✓ Moser A. P, Buried pipe Design, 3rd Edition, American Water Works Association
- ✓ Robert van Bentum and Lan K. Smout, Buried Pipe lines for surface Irrigation, The Water,Engineering and Development Centre, Intermediate Technology Publications,UK,1994
- ✓ Wurbs R.A., and James W.P. Water Resources Engineering. Prentice Hall of India, Eastern Economic Edition. ISBN: 81-203-2151-0, New Delhi, 2007

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	L	M			M
CO2		H	M		L
CO3		M	M		H
CO4		L	H		
H – High		**M – Medium**		**L – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

g. Technical quizzes b. Application development

i. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5010:Environmental Impact Assessment

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course emphasizes in the curriculum for the practical means by which organizations minimize their impacts on the environment. In this course student will learn how to assess impacts at different scales, and design, implement and monitor mitigation measures. This knowledge will assist you to critically evaluate complex environmental issues and assist in the development of Environmental Impact Statements (EIA's) and the preparation, maintenance and implementation Environmental Management Systems (EMS) in accordance with relevant environmental legislation and international standards.

Course Outcomes:

After successful completion of the course, students will be able to:

- Understand the ecological stability and ecological systems concept.
- Real problem due to manmade developmental activities, Select Environmental, Economic and social indicators, collect data and conduct analysis.
- Selecting the appropriate technique and methodology to carry out Environmental Impact Assessment.
- Carry out Environmental Impact Assessment of the water resources components.

Detailed Syllabus:

Unit -1: Water: 6 Hrs

Water resources development and environmental issues –Environment in water resources project planning – Environmental regulations and requirements – The EIA (Environmental Impact Assessment) notification

Unit -2: EIA: 6 Hrs

Environmental Impact Assessment (EIA) – EIA in Project Cycle –Legal and Regulatory aspects in India according to Ministry of Environment and Forests – Types and limitations of EIA – Cross sectorial issues and terms of reference in EIA –Participation of Public and Non-Governmental Organizations in environmental decision making

Unit -3: water quality impacts : 6 Hrs

Hydrological and water quality impacts – Ecological and biological impacts – Social and cultural impacts – Soil and landscape changes – Agro economic issues – Human health impacts – Ecosystem changes.

Unit -4: Environmental Impact Statement: 6 Hrs

Team formation – Development of scope, mandate and study design – Base line survey – Check lists – Ad hoc procedures – Network and matrix methods – Semi-quantitative methods – ICID checklist – Economic approaches – Environmental Impact Statement (EIS) preparation.

Unit -5: ecological water requirements: 4 Hrs

In-stream ecological water requirements - Public participation in environmental decision making – Sustainable water resources development – Eco restoration – Hydrology and global climate change – Human ecology – Ecosystem services – Environmental monitoring programs.

References:

- ✓ Canter, L.W., Environmental Impact Assessment. McGraw Hill International Edition, New York. 1995.
- ✓ Barathwal, R.R., Environmental Impact Assessment. New Age International Publishers, New Delhi. 2002.
- ✓ Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science London. 1999.
- ✓ Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Inter Science, New Jersey. 2003.
- ✓ Arnel, N., Hydrology and global environmental change. Prentice Hall, Harlow. 2002.
- ✓ Chari. B., Richa Sharma and S.A. Abbasi, Comprehensive Environmental Impact Assessment of Water Resources Projects : With Special Reference to Sathanur Reservoir Project (Tamil Nadu)/K. Discovery Pub., New Delhi, 2005.
- ✓ UNEP's Environmental Impact Assessment Training Resource Manual -2 nd Edition, 2002.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	L	M			M
CO2		H	M		L
CO3		M	M		H
CO4		L	H		
H – High		**M – Medium**		**L – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

h. Technical quizzes b. Application development

j. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5011:Climate Change and Water Resources

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to expose the students to understand about climate change and to explore possible solutions. There is action that can be taken to prepare for a more variable climate. Improved understanding of our water resource will allow more efficient and flexible allocation system and better investment in infrastructure, both to improve access to water and reduce risks from climate change.

Course Outcomes:

After successful completion of the course, students will be able to:

- ✓ Understand the climate system, being aware of the impact of climate change on society, adaptation in relation to water and climate change.
- ✓ Describe the possible impacts, adaptations and remedies in relation to water resources and climate change.
- ✓ To orient towards the global climate change and its impact on water resources.
- ✓ To understand the climate change phenomenon and its related issues on water, irrigation and its social implications.

Detailed Syllabus:

Unit -1: Global climate: 6 Hrs

Introduction to global climate; Global climatic models; Methods of reconstructing climate; Quaternary climates, sea level changes.

Unit -2: Glacial / interglacial cycles: 6 Hrs

Glacial / interglacial cycles; Geological records of climate change, sediment logy, stable isotopes, geochemistry; Geochronology –relative and numerical methods.

Unit -3: geological time: 6 Hrs

Vegetation dynamics, migration history, response of vegetation to climatic reversals, Pre-quaternary climates, evolution of climate through geological time.

Unit -4: Indian Climatology: 6 Hrs

Indian Climatology - Different seasons, Distribution of Means Sea level pressure/temperature in different seasons, Wind circulation and temperature distribution over India in lower, middle and upper troposphere in different seasons, Indian rainfall in different seasons, Indian summer monsoon, onset, withdrawal, rainfall distribution,

inter annual variability of monsoon. Main synoptic pressure systems causing weather over India in different seasons.

Unit -5: Climate Change & Variability: 4 Hrs

Climate Change & Variability -Overview of the climatic history of the earth. Long term changes (Climate of Past century, past millennium, past glacial period), Methods of determining past climate. Possible causes of climate change- External (Milankovitch variation and Solar activity) and Internal (natural and anthropogenic). General idea of internal dynamical processes of the atmosphere, oceanic processes, Cryospheric processes, land processes. Man's impact on climate, Greenhouse gases and global warming, basic radiation processes, Climate feedback mechanism, Climate predictability, future climate, potential consequences, International efforts to minimize climate change and their effects on Indian scenario

References:

- ✓ R.J. Barry and R.G. Chorley "Atmosphere, Weather and Climate" (Methuen Publication)
- ✓ Y.P. Rao "South West Monsoon" (IMD Publication) .
- ✓ S. Pettersen "An Introduction to Meteorology"
- ✓ Miller, Thompson and Paterson "Elements of meteorology"
- ✓ H.R. Byer "General Meteorology"
- ✓ P.K. Das "Monsoon"
- ✓ IPCC Report Technical Paper VI – Climate change and water , 2008.
- ✓ UNFCC Technologies for Adaptation to climate change, 2006.
- ✓ P R Shukla, Subobh K Sarma, NH Ravindranath, Amit Garg and Sumana Bhattacharya,"Climate Change and India: Vulnerability assessment and adaptation" University Press(India) Pvt Ltd, Hyderabad.
- ✓ Preliminary consolidated Report on Effect of climate change on Water Resources, GOI, CWC, MOWR, 2008.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	L	M			M
CO2		H	M		L
CO3		M	M		H
CO4		L	H		
H – High		**M – Medium**		**L – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

i. Technical quizzes b. Application development
k. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5012:River Engineering and Flood Control

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course emphasizes in the curriculum to get knowledge of fluvial geomorphology and understand concept of analysis of river flow hydraulics so that they are able to analyze hydraulic geometry and to design stable alluvial channels. So the students will able to do fluvial design for river bank protection and flood control.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Understand theoretical concepts of water and sediment movements in rivers.
2) Inculcate the benefits of fluvial system to the society.
3) Appreciate the complex behavior of rivers.
4) Gain the skills to take up research activities in river flood management.

Detailed Syllabus:

Unit -1: river: 6 Hrs

Primary function of a river – River uses and measures – Water and Sediment loads of river – Rivers in India, Himalaya and Peninsular.\

Unit -2: flood: 6 Hrs

Physical Properties and Equations – Steady flow in rivers –uniform and non uniform – Turbulence and velocity profiles – resistance coefficients – Boundary conditions and back waters – Transitions – Rating Curve – Unsteady flow in rivers : Preoperative of surface waves – Characteristics, flood waves – kinematic and diffusion analogy – velocity of propagation of flood waves – Flood wave –Maximum

Unit -3: River Equilibrium: 6 Hrs

River Equilibrium : Stability of Channel – regime relations – river bend equilibrium – hydraulic geometry of downstream - Bars and meandering - River dynamics – degradation and aggradation of river bed – Confluences and branches – River Data base.

Unit -4: Mapping: 6 Hrs

Mapping – Stage and Discharge Measurements – Sediments – Bed and suspended load Physical hydraulic Similitude – Rigid and mobile bed – Mathematical – Finite one dimensional – multi – dimensional – Water Quality and ecological model

Unit -5: River training works: 4 Hrs

River training works and river regulation works-Flood forecasting – Flood plain management – waves and tides in Estuaries - Interlinking of rivers – River Stabilization

References:

- ✓ Janson PL.Ph.,LvanBendegamJvanden Berg, Mdevries A. Zanen (Editors), "Principles of River Engineering – The non tidal alluvial rivers" – Pitman, 1979.
- ✓ Pierre Y. Julien ., "River Mechanics" ,Cambridge University Press, 2002.
- ✓ K.L Rao , "INDIA‟s WATER WEALTH" – Orient Longman Ltd., 1979.
- ✓ River Behaviour and Management and Training,-CBIP publication.
- ✓ Anderson, M.C., Burt, T.P. , 'Manual on flood forecasting', New Delhi, 1985.
- ✓ Central Water Commission, 'Hydrological forecasting', John Willy and Sons, 1989.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	L	M			M
CO2		H	M		L
CO3		M	M		H
CO4		L	H		
H – High		**M – Medium**		**L – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

- ✓ Technical quizzes
- ✓ Application development
- ✓ Question & answer / Numerical solution
- ✓ Group discussion
- ✓ Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5013: Integrated Watershed Management

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The objective of this course is to solve water resources problems which include watershed management and erosion estimation such as USLE equation and modified USLE equation are included in the curriculum. Also the GIS technique and remote sensing is included in the curriculum. Student will be exposed to the watershed development and management with different models.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Understand Applications of GIS and remote sensing in water resources engineering.
2) Understand the aspects of watershed management.
3) Analyze the water quality monitoring.
4) Understand the watershed management practices and to know the sustainable use of the watershed.

Detailed Syllabus:

Unit -1: Watershed : 6 Hrs

Watershed - Definition and delineation, Watershed approach, Hydrologic cycle, Watershed components, Water budget, Watershed assessment, Watershed planning, Watershed as a management unit, Total maximum daily load. Characteristics of watershed - Size, Shape, Physiography, Slope, Climate, Drainage, Land use, Vegetation, Geology and Soils, Hydrology and hydrogeology, Socio-economic characteristics, Basicdataon watersheds.

Unit -2: Land use : 6 Hrs

Land use and water quality issues - Land use impacts on watersheds, Residential activities, Municipal Construction, Mining operations, Agriculture, Forestry practices, Recreation. Water quality monitoring – Temperature, pH, Dissolved Oxygen and Biological Oxygen demand, Nutrients, Pathogens, Turbidity, Biological monitoring methods, Species indicators, Biological integrity, Habitat index, Land use index,
Water resource assessment, Water yield.

Unit -3: Erosion: 6 Hrs

Erosion - Factors affecting erosion, Effects of erosion on land fertility and land capability, Soil Erosion Modelling, Erosivity and erodibility, Processes, USLE and modified/ revised USLE models for erosion processes. Land

Management - Survey, Preparation and development, Soil and soil moisture conservation, Conservation measures, Ploughing, Furrowing, Trenching, Bunding, Terracing, Gully control, Rockfill dams, Brushwood dam, Gabion, Rain water management, Reclamation of saline soils.

Unit -4: Rainwater harvesting: 6 Hrs

Water Harvesting: Rainwater harvesting, Catchment harvesting, 6 Hrs Harvesting structures, Soil moisture conservation, Check dams, Artificial recharge, Farm ponds, Percolation tanks. 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. Model watershed – Government and NGO Projects

Unit -5: Sustainable Watershed: 4 Hrs

Sustainable Watershed Approach & Watershed Management 6 Hrs Practices Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation; Watershed Management Practices in Arid and Semiarid Regions, Case studies, short term and long term strategic planning. Social Aspects of Watershed Management: Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies. Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management. Perspective on recycle and reuse, Waste water reclamation.

References:

- ✓ Murty, J.V.S., Watershed management, New Age International 2009
- ✓ Majumdar, D.K., Irrigation Water Management, Prentice Hall 2000
- ✓ Allam, Gamal Ibrahim Y., Decision Support System for Integrated Watershed Management,Colorado State University, 1994.
- ✓ American Society of Civil Engineers, Watershed Management, American Soc. of Civil Engineers, New York, 1975.
- ✓ Black Peter E., Watershed Hydrology, Prentice Hall, London, 1991.
- ✓ Michael A.M., Irrigation Engineering, Vikas Publishing House, 1992.
- ✓ Purandare, A.P., Jaiswal A.K., Waterhed Development in India, NIRD, Hyderabad, 1995.
- ✓ Vir Singh, Raj , Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1		3	3		3
CO2	3	3	3		2
CO3	3	3	2		3
CO4	3	3	3		3
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

j. Technical quizzes b. Application development

l. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test	Teacher's Assessment	End Semester Examination
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5014:Land and Water Management

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The aim of this course is to provide an understanding of issues and methods in water resources management, and is set especially within the framework of total, or integrated, catchment management. The course gives an introduction to the unique hydrology of India, major issues of water resource management, the implications of past water management practices, the principles of integrated catchment management and sustainability, and current management tools and strategies.

Course Outcomes:

After successful completion of the course, students will be able to:

- ✓ Understand the economic development in water resource management in India
- ✓ Explain how the changing balance over time in water availability, demand for water and value of water, institutional arrangements, policy and management.
- ✓ Demonstrate familiarity with a range of water and land management issues, including origins, impacts and management interventions in both rural and urban areas
- ✓ Understand the irrigation methods, types, problems associated with the land degradation

Detailed Syllabus:

Unit -1: Basic: 6 Hrs

Basic concepts of soil erosion; control of soil erosion; Mechanics of wind and water erosion, water and wind erosion control practices; concept of runoff and its estimation, evapotranspiration, methods of evapotranspiration estimation, Design, construction and maintenance of vegetated waterways; Planning, Design, Construction and maintenance of terraces contours and bunds; irrigation and drainage systems for efficient soil and water conservation; cost analysis.

Unit -2: surface irrigation: 6 Hrs

Physics of surface irrigation; Design and evaluation procedure for border, check basin and furrow irrigation; Guidelines for operation and maintenance of surface irrigation methods. Description of Quick coupling, dragline and movable sprinkler irrigation systems and center Pivot system; Design installation, operation and maintenance of sprinkler irrigation systems; spray losses and drop size distribution in sprinkler irrigation systems and efficiency evaluation. Suitability of drip irrigation system under Indian conditions; Types of drip irrigation systems; Emitter types; Emitter construction; Discharge principles for emitters; Design of drip irrigation systems; water and salt distribution; Emitter clogging; water treatment; Automation; Field performance and evaluation. Irrigated crops- Irrigated agriculture in relation to crop production; irrigated crops around the world; Soil and climatic condition; selection of irrigation methods for irrigated field condition vegetable and fruit crops; Agronomical practices for major irrigated crops in India, Drainage requirement for irrigated crops, Economic analysis of major irrigated crops, field visit.

Unit -3: Management Concept: 6 Hrs

Watershed Development and Management Concept of watershed development and management; collection of hydrological data; watershed characteristics and hydrologic cycle; problems of land degradation; Land use capability classification and topographical characteristics of watershed; Appropriate soil and water conservation measures for agricultural and non-agricultural lands; Grassland development and management, Legal aspects in water sharing and management – PC-CP - case studies.

Unit -4: Techniques : 6 Hrs

Techniques for dry land farming based on watershed characteristics; water harvesting techniques for hilly and arid regions; Hydrological and sediment monitoring of watershed; Estimation of peak design runoff rate; Planning, management and economic evaluation of watershed development projects; case studies.

Unit -5: Land suitability: 4 Hrs

Land suitability classification according to USBR; Land suitability categories according to FAO framework; Land evaluation; Mapping of degraded soil through soil survey; Land degradation in arid and semi-arid regions, Land degradation due to erosion, Land degradation management by conservation practices; Causes, reclamation and management of water logged and salt affected soils; Rehabilitation and management of ravine lands; Selection, Design and management of irrigation and drainage systems in wastelands; Economic evaluation of wasteland development projects..

References:

- ✓ Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2004
- ✓ Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998
- ✓ Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998
- ✓ Majumdar, D.K., Irrigation Water Management, Prentice Hall of India, New Delhi, 2000
- ✓ Michael, B.A.M., Irrigation, Vikas Publishing House Pvt. Ltd. New Delhi, 1990
- ✓ Scwabe, G.O., Fangmeir, D.D., and Elliot W.J., Soil and Water Management Systems, John Wiley and Sons, N York, 1996
- ✓ Asawa, G.L. (1996) —Irrigation Engineering“, New Age International Pub. Co. N Delhi.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1		3	3		3
CO2	3	3	3		2
CO3	3	3	2		3
CO4	3	3	3		3
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

k. Technical quizzes b. Application development
m. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPEC5015:Water Quality Monitoring and Modeling

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: These courses introduce water quality concepts, its evaluation for irrigation purposes, besides relevant environmental problems and recycle and reuse concepts. Also understand the importance of water quality for irrigation and major uses of water and the role environmental issues.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Understand the water quality and its dependence on sources of water
2) Understand and interpret water quality data for its use in water quality models
3) Solve the water quality problems.
4) Design low cost waste water treatment plant.

Detailed Syllabus:

Unit -1: properties of water : 6 Hrs

Physical and chemical properties of water – Suspended and dissolved solids – EC and pH – major ions –. Water quality investigation – Sampling design - Samplers and automatic samplers - Data collection platforms – Field kits – Water quality data storage, analysis and inference – Software packages

Unit -2: Water quality: 6 Hrs

Water quality for irrigation – Salinity and permeability problem – Root zone salinity - Irrigation practices for poor quality water – Saline water irrigation – Future strategies

Unit -3: Water treatment technologies: 6 Hrs

Sources and Types of pollution – Organic and inorganic pollutants - BOD – DO relationships – impacts on water resources – NPS pollution and its control – Eutrophication control - Water treatment technologies - Constructed wetland.

Unit -4: Multiple uses of water: 6 Hrs

Multiple uses of water – Reuse of water in agriculture – Low cost waste water treatment technologies - Economic and social dimensions - Packaged treatment units – Reverse osmosis and desalination in water reclamation.

Unit -5: Principles of water quality: 4 Hrs

Principles of water quality – Water quality classification – Water quality standards - Water quality indices – TMDL Concepts – Water quality models.

References:

- ✓ George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, "Wastewater Engineering: Treatment and Reuse", McGraw-Hill, 2002.
- ✓ Vladimir Novonty, "Water Quality: Diffuse pollution and watershed Management", 2nd edition, John Wiley &

Sons, , 2003
- ✓ Mackenzie L Davis, David A Cornwell, "Introduction to Environmental Engineering", McGrawHill 2006.
- ✓ Stum, M and Morgan, A., "Aquatic Chemistry", Plenum Publishing company, USA, 1985.
- ✓ Lloyd, J.W. and Heathcote, J.A., "Natural inorganic chemistry" in relation to groundwater resources, Oxford University Press, Oxford, 1988

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	3	3		2
CO3	3	3	2		3
CO4		3	3		3
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

l. Technical quizzes b. Application development
n. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEPCC5007: Lab- Water Technology Laboratory

Teaching Scheme		Evaluation Scheme	
Practical	2 Hrs/Week	Term Work	25 Marks
Tutorial			
Total Credits	**1**	Total	25 Marks

Prerequisite: Not applicable

Course Description: There are opportunities in the field of analysis, analytical research, fundamental research, quality control departments, governmental and non-governmental organizations etc. for the technical laboratory personnel.

Course Outcomes:

After successful completion of the course, students will be able to:

1. To acquire skills for Laboratory Management and routine analysis of soil, water and food.
2. To improve working ability in analytical laboratory.

Detailed Syllabus:

- ✓ Collection and preservation of samples from open well, tap, bore well, river, water treatment plants, waste water treatment plants.
- ✓ Determination of PH and Electrical Conductivity of water.
- ✓ Determination of Alkalinity and Hardness (Total, Permanent & Temporary)
- ✓ Determination of calcium and Magnesium.
- ✓ Determination of Carbonates & Bi-carbonates.
- ✓ Determination of Chemical Oxygen demand (C.O.D.) and Biochemical Oxygen Demand (B.O.D.)
- ✓ Determination of M.P.N. of water.

Industrial Visit

1. Visit to Sewage Treatment Plant and Water Treatment Plant
2. Visit to CWPRS / MERI / NERI /WALMI

References:

- ✓ Standard Methods for Examination of water & waste wate APHA- AWWA- WPCE
- ✓ Manual of water & waste water analysis, NEERI, Nagpur.
- ✓ Text book of water and waste water engineering by H. K. Hussen.
- ✓ Water supply & sanitary engineering by Birdie.
- ✓ Practical methods in ecology & Environmental science by R. K. Trivedi, P. K. Goel,C. L. Trisal.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	PO1	PO2	PO3	PO4	PO5
Outcome					
CO1	2	3			1
CO2			2		
CO3		2			
CO4	2				1
3 – High		**2 – Medium**		**1 – Low**	

CEPCC5008 - Lab- Water Resources Systems Planning and Management

Teaching Scheme		**Evaluation Scheme**	
Practical	2 Hrs/Week	Term Work	25 Marks
Tutorial			
Total Credits	**1**	Total	25 Marks

Prerequisite: Not applicable

Course Description: This laboratory course introduces on applications and performance of different methods in economic analysis and operations research. Also the students should learn the water rights and environmental protection laws. Students have to do all the assignments mentioned below.

Course Outcomes:

After successful completion of the course, students will be able to:

1) Carry out the economic analysis of hydraulic structures
2) Solve the optimization problems in water resources engineering
3) Analyze the reservoir operation problems
4) Understand the water rights and environmental protection law

Detailed Syllabus:

- ✓ Carry out the cost economic analysis of any existing hydraulic structure using its data (student should work individually)
- ✓ Solve Linear programming problems using Simplex method, dual programming
- ✓ Solve Non Linear programming using gradient technique, Stochastic programming
- ✓ Write the mathematical model for Multi objective reservoir operation and solve it by LINGO
- ✓ Prepare a draft for the water rights and protection laws, Conflicts over water, environmental protection law, legal aspect
- ✓ Redesign any small reservoir by considering requirement, future population growth for upcoming next 35 years
- ✓ Assessment of the water quality of the any area using institutes laboratory and draft report for the implications (Group Task)

Candidates are required to submit the duly completed journals before the end of semester.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1		3		3	3
CO2	3	1	2	3	2
CO3		2	2	3	2
CO4				3	1
3 – High		**2 – Medium**		**1 – Low**	

EEAEC5001- Technical Presentation

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This workshop is designed to help participants develop effective technical presentation skills. Whether you are an engineer, scientist, or a technical professional, the ability to communicate complex ideas clearly and persuasively is essential. Through a combination of theory and practical exercises, you will learn to create and deliver compelling technical presentations.

Course Outcomes:

After successful completion of the course, students will be able to:

- ✓ Understand the principles of effective technical presentations.
- ✓ Develop and structure technical content for presentations.
- ✓ Enhance speaking and delivery skills.
- ✓ Use visual aids and technology effectively.
- ✓ Manage Q&A sessions and handle audience questions.
- ✓ Gain confidence in presenting technical information.

Detailed Syllabus:

Session 1: Introduction to Technical Presentations
Course overview and expectations
Importance of technical presentations
Elements of a successful presentation

Session 2: Audience Analysis
Understanding your audience
Tailoring your content to the audience
Identifying audience needs and interests

Session 3: Content Development
Creating clear objectives
Organizing technical content
Using effective transitions

Session 4: Visual Aids and Technology
Designing effective slides
Using multimedia and visuals
Avoiding common design mistakes

Session 5: Speaking and Delivery Skills
Techniques for effective speaking
Body language and non-verbal communication
Managing nerves and anxiety

Session 6: Rehearsal and Feedback

The importance of practice
Peer and self-assessment
Receiving constructive feedback

Session 7: Handling Q&A Sessions
Preparing for questions
Strategies for answering questions
Dealing with challenging questions

Session 8: Final Presentations
Each participant delivers a technical presentation
Peer and instructor feedback
Reflection and improvement plans
Session 9-16: Repeat Sessions 1-8 with in-depth practice, refining skills, and incorporating feedback.

Assessment and Grading:

Attendance and participation: 20%
Presentation content and structure: 20%
Delivery and speaking skills: 20%
Visual aids and technology usage: 15%
Handling Q&A sessions: 15%
Improvement over the course: 10%

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	1	2		2
CO3	3	2	2		2
CO4			3		1
3 – High		**2 – Medium**		**1 – Low**	

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of the following

m. Technical quizzes b. Application development
o. Question & answer / Numerical solution d. Group discussion e. Other if any

Table 2: Recommended Assessment Pattern

Assessment	**Knowledge**	**Class**	**Teacher's**	**End Semester**
Pattern Level No.	**Level**	**Test**	**Assessment**	**Examination**
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

CEVSE5002: Mini Project

Teaching Scheme		Evaluation Scheme	
Theory		Term Work / ISE-I	25 Marks
Tutorial	4 Hrs/Week	Viva-voce	25 Marks
Total Credits	**2**	Total	50 Marks

Prerequisite: Not applicable

Course Description: The student shall collect, review, compile, comprehend, present research literature and identify the problem for the dissertation.

Course Outcomes:

After successful completion of the course, students will be able to:

1. To search literature from different sources to appraise the state-of-the-art.
2. To compile and prepare a technical report from the collected literature.
3. To present the literature in a comprehensive manner and identify the problem for the dissertation

Detailed Syllabus:

Term Work:

The Mini Project with Seminar shall consist of collection of literature from a chosen field of Water Resources Engineering from various sources such as refereed journals, proceedings of national international conferences, PG/PhD theses etc. Based on the literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as necessary the candidate shall define the problem for the dissertation.

The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and at least one faculty member of the department.

Viva Voce Examination: It consists of two parts.

Part-I: Mid-Term Evaluation for 10 Marks: A mid-term evaluations for 10 marks out of 25 marks shall be done as per the schedule given in the institute academic calendar. Student should prepare a power point presentation and present before the panel of examiners and class students and should be able to answer questions asked by the panel of examiners and class students. Panel of examiner consists of guide as internal examiner and one faculty members appointed by the DCoE as external examiners. The panel of examiner will assess the contents and presentation and give the suggestions, if any and assigns the marks out of 10. In this phase student is expected to collect and present substantial literature.

Part-II: End Semester Evaluation for 15 Marks: Student should prepare technical report in prescribed format duly incorporating suggestions of Part-I and present power point presentation before the panel of examiners and class students. The student should be able to answer the questions asked. The panel of examiner will assess the seminar contents and seminar presentation and assigns the marks out of 15. In this phase the students is expected to define the problem for dissertation through further literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as necessary.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	1	2		2
CO3	3	2	2		2
CO4			3		1
3 – High		**2 – Medium**		**1 – Low**	

CEDIS6001: Dissertation-I

Teaching Scheme		**Evaluation Scheme**	
Practical	4 Hrs/Week	Term Work / ISE-I	100 Marks
Total Hours	20	Viva-voce	100 Marks
Total Credits	**10**	Total	200 Marks

Prerequisite: Not applicable

Course Description: The dissertation work is one of the key areas of post graduate education incorporating the research component in the curriculum. The student is required to study the existing literature from various sources such as referred journals, proceedings of National/International seminar/conferences, post graduate dissertation, PhD thesis, reference book etc. of Civil-Water Resources Engineering. The student would identify the problem and provide solution/s through experimental/comparative study as partial fulfillment of post graduate degree in Civil-Water resources engineering.

The dissertation-I mainly focuses on literature survey, identification of problem and action plan with possible outcomes for the completion of Dissertation-II

Course Outcomes: After successful completion of the course, students will be able:

1. To carry out exhaustive literature survey on chosen field of study.
2. To formulate/define the problem for dissertation
3. To compile and prepare a technical report of the collected literature and present.
4. To understand the methodology case study.

Term Work:

The Dissertation-I shall consist of collection of literature from a chosen field of Civil-Water resources engineering from various sources. The candidate shall formulate/define analytical and/or experimental problem for carrying out dissertation work. The candidate shall prepare a technical report in a prescribed format. The evaluation of the term work shall be through submission of report of the student in prescribed format.

Viva Voce Examination: It consists of two parts.

Part-I: Mid-Term Evaluation for 25 Marks: A mid-term evaluations for 25 marks out of 50 marks shall be done as per the schedule given in the institute academic calendar. Students should prepare a power point presentation and

present before the panel of examiners and class students and should be able to answer questions asked by the panel of examiners and class students. Panel of examiner consists of guide as internal examiner and at least one faculty member appointed by the Head of the Department as external examiner. The panel of examiner will assess the contents and presentation and gives the suggestions, if any and assigns the marks out of 25marks.

Part-II: End Semester Evaluation for 25 Marks: Students shall prepare a comprehensive report incorporating the suggestions of part-I, if any and make a power point presentation before the panel of examiners as above and class students and should be able to answer questions asked by the panel of examiners and class students. The panel of examiner will assess the contents and presentation and assigns the marks out of 25 marks.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	1	2		2
CO3	3	2	2		2
CO4			3		1
3 – High		**2 – Medium**		**1 – Low**	

CEPCC5009: Engineering Hydrology Laboratory

Teaching Scheme		**Evaluation Scheme**	
Theory		Term Work / ISE-I	25 Marks
Tutorial	4 Hrs/Week	Viva-voce	25 Marks
Total Credits	**2**	Total	50 Marks

Prerequisite: Not applicable

Course Objectives: To teach the principles, applications and Performance of unit and synthetic hydrographs. Also the students will learn the flood frequency studies and storage capacity of reservoirs. Students have to do all the assignments mentioned below.

Course Outcome: After successful completion of the course student will be able to:

1) Determine flood discharge for different return periods

2) Analyze reservoir routing and channel routing

3) Determine unit hydrograph and synthetic unit hydrograph

4) Decide the storage capacity of reservoir

List of Assignments:

1. Determine the flood discharge for the 100 year return period using real data

2. Route any inflow hydrograph through the river reach

3. Geographical distribution and finding average precipitation over an area

4. Solve Examples based on unit hydrograph method

5. Develop S-curve hydrograph and synthetic unit hydrograph for given data

6. Flood frequency study using Gumbel's distribution.

7. Analysis of Rainfall data (double mass curve technique)

8. Determination of storage capacity of a reservoir

9. Site visit to the nearest metrological station Candidates are required to submit the duly completed journals before the end of semester.

Candidates are required to submit the duly completed journals before the end of semester.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	2	2	3	3
CO2		1	2	3	2
CO3		2		3	2
CO4		2	2	3	3
3 – High		**2 – Medium**		**1 – Low**	

CEDIS6002: Dissertation-II

Teaching Scheme		**Evaluation Scheme**	
Practical	8 Hrs/Week	Term Work / ISE-I	150 Marks
Total Hours	32	Viva-voce	150 Marks
Total Credits	**16**	Total	300 Marks

Prerequisite: Not applicable

Course Description:

The dissertation-II is a continuation of Dissertation-I and mainly focuses on solution of the defined problem through experimental/analytical/comparative study as planned.

Course Outcomes: After successful completion of the course, students will be able:

1. To appraise the additional literature in the chosen field of water resources engineering.
2. To refine the formulated problem in the chosen field of water resources engineering.
3. To find solution to the identified problem using appropriate methodology.
4. To interpret, discuss, debate the solution and draw conclusions.
5. To write the dissertation report and present before panel of examiner and peers.

Term Work:

The Dissertation-II shall consist of a complete analytical and/or experimental work in water resources engineering containing literature survey, problem formulation, solution, results, interpretations, discussions and conclusions certified by guide and an internal evaluation committee. The candidate shall prepare a technical report in a

prescribed format and submit soft bound 3-hard copies signed by the guide and submit it to the CoE for viva-voce examination. After the viva-voce examination, student shall submit 3-hard bound copies after the corrections, if any, suggested by the panel of examiners along with program exit survey in prescribed format. The evaluation of the term work shall be based on continuous assessment of the student and final submission.

Paper Publications:

A proof of publication or uploading paper to SCI, Web of Science, Scopus, Indian Citation Index journal or filling patent is mandatory requirement for submission of dissertation. However, if the dissertation work is in collaboration with industry/organization/research agency, the uploading of paper/filling a patent shall not be mandatory but desirable.

Pre submission presentation:

There shall be a pre submission presentation before a panel of experts/faculty consisting of guide and faculty/experts and PG students of the concerned class.

Viva Voce Examination:

Students should prepare a power point presentation and present it before the panel of examiners consisting of guide and the external examiner appointed by the Controller of Examination. The candidate should be able to defend his work in front of the panel of examiners and peers. The panel of examiners will assess the dissertation contents and presentation and assigns the marks out of 150.

Table 1: Mapping of Course Outcome with Program Outcomes

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
Outcome					
CO1	3	3	3		3
CO2	3	1	2		2
CO3	3	2	2		2
CO4			3		1
3 – High		**2 – Medium**		**1 – Low**	

CEIKS6001: Ancient Water Management Practices

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Course Description

This course will explore various dimensions of knowledge on water resources - local, indigenous, traditional, and scientific and its criticality as a resource for development. The course explores how strategies have been evolved by mankind to create knowledge systems and societies for sustainable

development of water resources. Particular emphasis of this course is on traditional knowledge for water management.

Course objectives

1. To explore various dimensions of knowledge and its impact on water management.
2. To gain understanding of necessity of emphasis on traditional knowledge for water management.
3. To impart skills of exploration and debate on knowledge societies and adaptive water Management.

Course Outcomes:

By the end of the course, students will:

- Understand the importance of various dimensions of knowledge and its relevance for water management.
- Appreciate the need to go beyond binaries and articulate the need for greater synergies between two knowledge systems and bridging the science-management divide.
- Be familiar with the concept and need for use of traditional knowledge for adaptive water management.
- Be aware of traditional practices of water management in India , especially in Maharashtra and also understand why these practices did not sustain, i.e. an insight into the institutional processes that are key to understanding management issues and explore avenues of reviving these practices using current technology.

Course content

UNIT I : Introduction Knowledge for development : Definition and aspects of knowledge (traditional, social, technical), Understanding of knowledge (static, processesual, past), meaning of traditional knowledge, Utility of various aspects of knowledge for water management.

UNIT II : Knowledge gap: Introduction, the science-management divide, Local and global/scientific knowledge, Need for greater synergies. Traditional knowledge and adaptive management :((I) Integration of traditional and western / contemporary knowledge for adaptive management, (II) Traditional knowledge and conflict resolution (III) Knowledge management & Knowledge networks, Hydraulic Societies.

UNIT III : **Knowledge for water management** : Human and Water, Ancient Civilizations, Harappan (or Indus Valley) civilization (~3000–1500 BCE), Vedic Period in the Indian subcontinent, Mauryan dynasty and other dynasties. Knowledge of hydrological processes in ancient Indian Vedas, epics and literarture, Measurement of precipitation in ancient India and data storage, Hydraulic interlinkages between the ancient Indian and nearby cultures, Decline of Harappan civilization – role of climate and natural disasters. various (traditional) knowledge systems for water management in different ecological (global, in India and local) Hydraulic Societies, zones – *(Note : discussion not to focus on only simple empirical design of structures but also on untangling the complex socio-political and economic realities that led to demise/or sustenance of these knowledge systems through case studies of different knowledge systems in different ecological zones*).

UNIT IV : **Water management technology in ancient India**: Traditional Methods of harnessing water and water conservation in India, Concepts, Thumb rules & empirical Hydrological, Hydraulic Design and Construction of Talab/Bandhi, Jhalaras, Baoli, Kund (Gujarat and Rajasthan), Bawari (Rajasthan),Taanka (Thar desert region in Rajasthan), Nadi, Bamboo drip irrigation system (Northeastern India), Zings (Ladakh),

Kuhls (Himachal Pradesh). Jackwells (Great Nicobar Islands), Water harvesting structures of Ramtek (Maharashtra) etc, Contemporary Water distribution and water use practices at various regions in India, Wastewater management practices in ancient India, evolution of institutions and ideas with respect to traditional knowledge on water management and how this influences response of various stakeholders at present.

UNIT V: **Traditional water conservation and management practices of Maharashtra** :

Introduction. Contributions of Rulers namely Rashtrakut, Satwahan, Yadavas, Chatrapati Shivaji Maharaj, Rani Ahilhyadevi Holkar, Chatrapati Shahu Maharaj for water resources development in the public interest. Concepts, Thumb rules and empirical Hydrological and Hydraulic Design and Construction and Use of Kunds and Tanks near caves, forts and temples for rainwater harvesting and conservation, Jalatung lake and structures around for water supply and irrigation, Traditional water storing structures namely, Open wells, Badis, Baravs, Khajana wells, Jal Mahals, earthen dams,Kolhapur type Bandharas etc.. Community driven Water distribution policies Phad Irrigation system, Warabandi, Malgujari Talav system etc. as Contemporary Water distribution and water use practices at various regions of Maharashtra. Participative water management system.

References :

Hydrology and water resources management in ancient India by Pushpendra Kumar Singh, Pankaj Dey, Sharad Kumar Jain, and Pradeep P. Mujumdar, EGU publication Hydrology and Earth System Sciences Vol 24, Issue 10 year 2020 https://doi.org/10.5194/hess-24-4691-2020

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Mosse, D. (1999). Colonial and Contemporary Ideologies of 'Community Management': The Case of Tank Irrigation Development in South India. Modern Asian Studies, 33(02), 303-338

Traditional water management practices of Maharashtra by Dr. D.M. More

Evers, H. D. (2008). Knowledge Hubs and Knowledge Clusters: Designing a Knowledge Architecture for Development, ZEF Working Paper Series 27. Bonn: Centre for Development Research.

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World Bank. (1998). WDR 1998/1999: Knowledge for Development: World Bank and Oxford University Press.

Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. Development and Change, 26(3), 413-439.

Koul, D. N., Singh, S., Neelam, G., & Shukla, G. (2012). Traditional water management systems-An overview of Ahar-pyne system in South Bihar plains of India and need for its revival. Indian Journal of Traditional Knowledge, 11(2), 266-272.

Mosse, D. (1999). Colonial and Contemporary Ideologies of 'Community Management': The Case of Tank Irrigation Development in South India. Modern Asian Studies, 33(02), 303-338

Websites:

Development Gateway http://knowledge.developmentgateway.org
United Nations University Traditional Knowledge Initiative http://www.unutki.org
World intellectual property organization http://www.wipo.int/tk/en/indigenous/customary_law

Journals

1. Journal of environmental management
2. Ecology and society
3. Water resource management