INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**WATER RESOURCES ENGINEERING**				
Course Code	ACE014				
Programme	B.Tech				
Semester	VI	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Ms. B.Bhavani, Assistant Professor				
Course Faculty	Ms. B.Bhavani, Assistant Professor Ms. N.Sri Ramya , Assistant Professor				

I. COURSE OVERVIEW:

This course addresses the concept of present science of the practice of irrigation engineering which comprising partially all the modern developments which occurs in irrigation purpose. In this mainly the units are taken as metric unit which covers the total area which need for irrigation. In this we can know about water requirement of crops by hydrology, ground water, reservoir water and rain water storing. By this water recourses engineering we can know about design of irrigation structures and planning of reservoir as for flood control.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE005	IV	Fluid Mechanics	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Water Resources Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✔	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE):

The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

	Program Outcomes (POs)	Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Assignments/ Exams
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	1	Seminars
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Mini Project
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Seminars
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	1	Assignments
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Seminars/ Mini Project

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication	2	Assignments
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	-	-
PSO 3	**Self-learning and Service:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	1	Seminars

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Enrich the knowledge of hydrology that deals with the occurrence, distribution and movement of water on the earth.
II	Design unlined and lined irrigation canals; mitigate sediment problems associated with canal.
III	Identifying, formulating and management of water resource related issues.
IV	Discuss the limitations and applications of hydrograph flood analysis

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcomes
CO 1	Understand the basic knowledge of hydrology, hydrological cycle, precipitation and movement of water on earth and below the earth surface in addition to importance and estimation of runoff	CLO 1	Understand the basic concepts of Hydrology and its applications. And also understand different forms and types of precipitation.
		CLO 2	Understand the Rainfall measurement methods and different types of Rain gauges
		CLO 3	Compute the average rainfall over a basin, processing of rainfall data, and adjustment of rainfall record and usage of double mass curve.
		CLO 4	Understand the concepts of runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae.
		CLO 5	Understand the abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration,penman and Blaney-Criddle methods and infilteration

COs	Course Outcome	CLOs	Course Learning Outcomes
CO 2	Determining the importance of different types of hydrographs.	CLO 6	Understand the concept of Hydrograph, effective rainfall, and base flow separation
		CLO 7	Analyze the concept of direct runoff hydrograph
		CLO 8	Analyze the importance of unit hydrograph, definition, and limitations applications of unit hydrograph.
		CLO 9	Understand the derivation of unit hydrograph from direct runoff hydrograph and runoff hydrograph to unit hydrograph
		CLO 10	Understand the concept of synthetic unit hydrograph and its applications.
CO 3	Importance and occurrence of Ground water, estimation of discharge through various types of aquifers, wells development	CLO 11	Understand the Ground water Occurrence and types of aquifers
		CLO 12	Define and understand the different terminology of water resource engineering like aquifer parameters, porosity, specific yield, permeability, and Transmissivity.
		CLO 13	Determine the radial flow to wells in confined and unconfined aquifers and
		CLO 14	Understand the concept of Darcy's law in aquifiers
		CLO 15	Understand the Types of wells, well construction, and well development.
CO 4	Analyze the importance of irrigation and their types, methods of application of irrigation water, duty and delta, irrigation efficiencies, water logging.	CLO 16	Understand the work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation
		CLO 17	Explain the methods of application of irrigation water and understand the India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation
		CLO 18	Understand the standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants.
		CLO 19	Calculate the soil moisture tension, consumptive use, duty and delta and understand the factors affecting duty.
		CLO 20	Determination of design discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging
CO 5	Understand the classification of canals, design of irrigation canals, IS standards for a canal design canal lining, SCS curve number method, flood frequency analysis of stream flow.	CLO 21	Understand the mechanical classification of canals
		CLO 22	Design of irrigation canals by Kennedy,,s and Lacey,,s theories, balancing depth of cutting
		CLO 23	Calculate by using IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula.
		CLO 24	Understand the SCS curve number method and flood frequency analysis of stream flow

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE014.01	CLO 1	Understand the basic concepts of Hydrology and its applications. And also understand different forms and types of precipitation.	PO 1, PO 3, PO4, PO7, PO9	2
ACE014.02	CLO 2	Understand the Rainfall measurement methods and different types of Rain gauges	PO1,PO2, PO4	1
ACE014.03	CLO 3	Compute the average rainfall over a basin, processing of rainfall data, and adjustment of rainfall record and usage of double mass curve.	PO3	1
ACE014.04	CLO 4	Understand the concepts of runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae.	PO3	1
ACE014.05	CLO 5	Understand the abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration,penman and Blaney-Criddle methods and infilteration	PO1,PO3, PO4, PO7, PO9	1
ACE014.06	CLO 6	Understand the concept of Hydrograph, effective rainfall, and base flow separation	PO3,PO4, PO9	1
ACE014.07	CLO 7	Analyze the concept of direct runoff hydrograph	PO4	1
ACE014.08	CLO 8	Analyze the importance of unit hydrograph, definition, and limitations applications of unit hydrograph.	PO4,PO7, PO9	2
ACE014.09	CLO 9	Understand the derivation of unit hydrograph from direct runoff hydrograph and runoff hydrograph to unit hydrograph	PO1,PO2, PO3	1
ACE014.10	CLO 10	Understand the concept of synthetic unit hydrograph and its applications.	PO1,PO2, PO4,PO7	1
ACE014.11	CLO 11	Understand the Ground water Occurrence and types of aquifers	PO1,PO2, PO4	1
ACE014.12	CLO 12	Define and understand the different terminology of water resource engineering like aquifer parameters, \porosity, specific yield, permeability, and Transmissivity.	PO1,PO2, PO3,PO4,	1
ACE014.13	CLO 13	Determine the radial flow to wells in confined and unconfined aquifers	PO1,PO2, PO3,PO4	1
ACE014.14	CLO 14	Understand the concept of Darcy's law in aquifiers	PO4	1
ACE014.15	CLO 15	Understand the Types of wells, well construction, and well development.	PO1,PO2, PO3,PO4	1
ACE014.16	CLO 16	Understand the work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation	PO1,PO2, PO4	1
ACE014.17	CLO 17	Explain the methods of application of irrigation water and understand the India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation	PO1,PO2, PO3,PO4	1
ACE014.18	CLO 18	Understand the standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants.	PO1,PO2, PO3,PO4, PO9	1
ACE014.19	CLO 19	Calculate the soil moisture tension, consumptive use, duty and delta and understand the factors affecting duty.	PO1,PO2, PO3,PO4	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE014.20	CLO 20	Determination of design discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging	PO1,PO2, PO3,PO4	1
ACE014.21	CLO 21	Understand the mechanical classification of canals	PO1,PO2	1
ACE014.22	CLO 22	Design of irrigation canals by Kennedy,,s and Lacey's theories, balancing depth of cutting	PO1,PO2, PO3	2
ACE014.23	CLO 23	Calculate by using IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula.	PO1,PO2, PO3,PO9	2
ACE014.24	CLO 24	Understand the SCS curve number method and flood frequency analysis of stream flow	PO1,PO2, PO3,PO4, PO7	1

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)						Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 7	PO 9	PSO1	PSO3
CO 1	2	2	2	2	2	2	2	2
CO 2	2	1	2	2	1	1	1	2
CO 3	2	2	2	2			2	1
CO 4	2	2	2	2		2	2	2
CO 5	2	2	1	2	1	1	1	2

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X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2		2	1			1		1				2		
CLO 2	2	2		1									1		
CLO 3			2												1
CLO 4			2										2		
CLO 5	2		1	1			2		2				2		
CLO 6			2	1			1						2		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 7				2									2		
CLO 8				2			1						1		
CLO 9	2	2	1						2				2		1
CLO 10	2	2		1			1						2		1
CLO 11	2	2		1									1		1
CLO 12	2	1	1	1									1		
CLO 13	2	2	1	1									2		1
CLO 14				2									1		2
CLO 15	2	2		1									2		1
CLO 16	2	2	1	1									2		1
CLO 17	2	1	1	2					2						1
CLO 18	2	2	1	1											1
CLO 19	2	2	1	1									2		1
CLO 20	1	2	2												
CLO 21	2	2													
CLO 22	2	2	1						2						
CLO 23	2	1	1	1			1						1		
CLO 24	1	1	1	1			1								
CLO 25	2	2	2	2			1								1

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XII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1,PO2, PO3, PO4, PO7, PO9, PSO1, PSO3	SEE Exams	PO 1,PO2, PO3, PO4, PO7, PO9, PSO1, PSO3	Assignments	PO 1, PO2, PO3	Seminars	PO 9
Laboratory Practices	PO 4	Student Viva	PO 1, PO2, PO3, PO4, PO7, PO 9	Mini Project	PO3, PO7, PO9	Certification	-
Term Paper	-						

XIII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT-I	INTRODUCTION TO ENGINEERING HYDROLOGY AND ITS APPLICATIONS
Introduction to engineering hydrology and its applications, hydrologic cycle, types and forms of participation, rainfall measurement, types of rain gauges, computation of average rainfall over a basin, processing of rainfall data, adjustment of record, rainfall double mass curve runoff, factors affecting runoff, runoff over a catchment, empirical and rational formulae. Abstraction from rainfall, evaporation, factors affecting evaporation, measurement of evaporation, evapo-transpiration, penman and Blaney & Criddle methods, infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.	
UNIT-II	**DISTRIBUTION OF RUNOFF**
Hydrograph analysis flood hydrograph, effective rainfall, base flow separation, direct runoff hydrograph, unit hydrograph, definition, and limitations applications of unit hydrograph, derivation of unit hydrograph from direct runoff hydrograph and vice versa, hydrograph, synthetic unit hydrograph.	
UNIT-III	**GROUND WATER OCCURRENCE**
Ground water Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient. Darcy,,s law, radial flow to wells in confined and unconfined aquifers. Types of wells, well construction, well development.	
UNIT-IV	**NECESSITY AND IMPORTANCE OF IRRIGATION**
Work necessity and importance of irrigation, advantages and ill effects of irrigation, types of irrigation, and methods of application of irrigation water, India agricultural soils, methods of improving soil fertility, crop rotation, and preparation of land for irrigation, standards of quality for irrigation water, soil, water, plant relationship, vertical distribution of soil moisture, soil moisture constants, soil moisture tension, consumptive use, duty and delta, factors affecting duty, design discharge for a water course. Depth and frequency of irrigation, irrigation efficiencies, water logging.	
UNIT-V	**CLASSIFICATION OF CANALS**
Mechanical classification of canals, design of irrigation canals by Kennedy,,s and Lacey,,s theories, balancing depth of cutting, IS standards for a canal design canal lining. Design discharge over a catchment, computation of design discharge, rational formula, SCS curve number method, flood frequency analysis of stream flow.	
Text Books:	
1. Jayarami Reddy, "Engineering hydrology", Laxmi publications Pvt. New Delhi,2005. 2. Punmia & Lal, "Irrigation and Water Power Engineering", Laxmi publications Pvt. Ltd, New Delhi, 1992. 3. V.P.Singh, "Elementary hydrology", PHI publications, 1992. 4. Dr.G.Venkata Ramana, "Water Resources Engineering-I", Academic Publishing Company. 5. D.K.Majundar, "Irrigation Water Management", Prentice Hall of India, 2002.	
Reference Books:	
1. Elementary hydrology by V.P.Singh, PHI publications 2. Irrigation and water Resources & Water power by P.N.Modi,Standard Book House 3. Irrigation and water Management by Dr.Majumdar,Printice Hall of India 4. Irrigation and Hydraulic Structures by S.K. Garg 5. Applied hydrology by Ven Te Chow, David R.Mays Tata Mc Graw Hill. 6. Introduction to hydrology by Warren Viessvann,Jr ,Garyl.Lewis,PHI.	

XV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Introduction to engineering hydrology and its applications, Hydrologic cycle.	CLO 1	T2:24.6-8 R2: 2.4
3-4	Types and forms of Derive the kinds and forms of precipitation.	CLO 1	T1:12.14
5-6	Rainfall measurement, types of rain gauges, Computation of average rainfall over a basin	CLO 2	T4:3.10 R2: 2.8
7-8	Processing of rainfall data. Abstraction from rainfall. Adjustment of record	CLO 2	T4:3.11,1 2
9-10	Rainfall double mass curve	CLO 4	T1:16.2
11-12	Runoff – factors affecting runoff.	CLO 3	T16:5
13-14	Runoff over catchment empirical formulae.	CLO 3	T16:6.2
15-16	Rational formulae.	CLO 4	T2:26.9
17-18	Evaporation – factors affecting evaporation	CLO 3	T2:26.11
19-20	Measurement of evaporation and evapotranspiration.- penman method	CLO 5	T1:6:7 R2:3.1
21-22	Evapotranspiration.- criddle method	CLO 5	T2:26
23-24	Infiltration – factors affecting infiltration, measurement of infiltration, infiltration indices.	CLO 6	T2:20.4 R2: 4.1
25-26	Distribution of runoff- Hydrograph analysis flood hydrograph.	CLO 7	T2:23.4
27	Effective rainfall base Flow separation direct method	CLO 8	T2:20.9 T2:20.10
28-30	Derivation of Unit Hydrograph, S hydrograph, Synethic unit hydrograph	CLO 12	T2:21.1 - 21.2
31	Derivation of Unit Hydrograph, S hydrograph, Synethic unit hydrograph.	CLO 11	T2:21.1 - 21.2
32-33	Ground water - Occurrence, types of aquifers.	CLO 13	T2:23-24
34-35	Aquifer parameters, porosity, specific yield, permeability, Transmissivity and storage coefficient, types of wells.	CLO 14	T2:21.5 - 26
36-37	Darcy‟s law, radial flow to wells in confined and unconfined aquifers	CLO 15	T4:7.1 - 7.3
38	Types of wells, well construction and development	CLO 15	T3:27.2
39-40	Necessity and Importance of Irrigation, advantages and ill effects of Irrigation.	CLO 16	T3:27.9 R2: 5.4
41-42	Types of Irrigation, methods of application of Irrigation water	CLO 16	T3:27.9
43-44	Indian agricultural soils, methods of improving soil fertility	CLO 17	T3:27.10
45-46	Soil-water plant relationship	CLO 17	T3:27.11
47-48	Vertical distribution of soil moisture, Soil moisture constants.	CLO 17	T3:27.12
49-50	Soil moisture tension, consumptive use	CLO 18	T4:10.7
51-52	Duty and delta, Factors affecting duty.	CLO 19	T4:10.8 T4:10.9
53-54	Factors affecting duty, Irrigation efficiencies. Water logging	CLO 19	T4:10.10
55-57	Classification of canals, Design of irrigation by Kennedy‟s and lacey‟s theories	CLO 18	T5:13.8 R2:7.1
57-59	Balancing depth of cutting ,IS Standard for canal design canal lining	CLO 20	T5:13.9 R2:7.3
60	Design discharge over a catchment, Computation of design discharge - rational formula.	CLO 21	T4:9.8 T4:9.9
61-63	SCS Curve number method, flood frequency analysis – introductory part only	CLO 21	T4:9.10 R2:8.2
64	Stream gauging measurement and estimation of stream flow	CLO 22	T3:27.12

XVI. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With PO's	Relevance With PSO's
1	Concepts for Planning Water Resources Development	Seminars/Guest Lectures/NPTEL	PO 3 PO 4	PSO 1
2	National Policy For Water Resources Development	Seminars/Guest Lectures/NPTEL	PO 1	PSO 1
3	India's Irrigation Needs and Strategies for Development	Seminars/NPTEL	PO 4	PSO 1

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