INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENVIRONMENTAL ENGINEERING**				
Course Code	ACE015				
Programme	B.Tech				
Semester	VII	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	3
Chief Coordinator	Ms. KoppoliAnushaHadassa, Assistant Professor				
Course Faculty	Mr .R. Suresh, Assistant Professor, Ms. KoppoliAnushaHadassa, Assistant Professor				

I. COURSE OVERVIEW:

This course will cover the study of various waterborne diseases which are very harmful to human beings, population forecasting for designing distribution systems, Designing of water treatment plant and various considerations, to determine the optimum dosage of coagulant, working of filters and troubles in their operation, various disinfection methods, Design principles of distribution system and analysis by hardy cross & equivalent pipe method, methods of conveying sewage to the treatment plant, various valves which are used in distribution system and also the characteristics of sewage and its estimation, various appurtenances in sewers, sewage disposal and farming. This course also cover the study of construction of oxidation pond, sludge digestion tank, skimming tanks, grit chambers, sedimentation tanks and designing of septic tanks and soak pits.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE015	VII	Water Resources Engineering	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Environmental 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 module. 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 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ 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, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Guest Lectures
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.	1	Seminars
PO 6	**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	Assignments

Program Outcomes (POs)		Strength	Proficiency assessed by
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	Seminar

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..	1	Seminar
PSO 2	**Broadness and Diversity**: Graduates will have a broad understanding of economic, 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.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Outline the different sources of water and its per capita demand.
II	Describe the basic characteristics of water and study the procedure for determination
III	Design the water supply lines, water collection and different distribution networks.
IV	Construct and design waste water treatment units such as oxidation ponds, sludge digestion tanks, soak pits etc.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe population forecasts, design period, water demand, types of demand, factors affecting fluctuations, fire demand, storage capacity, water quality and testing. Drinking water standards	CLO 1	Understand the concept and importance of Protected water supply.
		CLO 2	Estimate the Population for the design period by using different forecasting methods.
		CLO 3	Calculate and Understand the water demand, types of demand, factors affecting fluctuations.
		CLO 4	Calculate the fire demand, storage capacity, water quality and its testing.
CO 2	Determine Layout and general outline of water treatment units, sedimentation, uniform settling velocity, principles, design factors, surface loading, jar test, optimum dosage of coagulant, coagulation, flocculation, clarifier design, coagulants, and feeding arrangements. filtration	CLO 5	Understand the concept of Drinking water standards. Comparison from quality and quantity and other considerations
		CLO 6	Understand theintakes, infiltration galleries, confined and unconfined aquifers.
		CLO 7	Understand the, distribution systems, requirements, methods and different layouts.
		CLO 8	Understand the Layout and general outline of water treatment system
		CLO 9	Explain sedimentation, uniform settling velocityprinciples, design factors, surface loading.
		CLO 10	Understand jar test, optimum dosage of coagulant, coagulation, flocculation, clarifier design, coagulants, and feeding arrangements.
CO 3	Understand Conservancy and water carriage systems, sewage and storm water estimation, type of concentration, storm water over flows combined flow characteristics ofsewage, cycles of decay, decomposition of sewage, and examination of sewage.	CLO 11	Evaluate Filtration theory, working of slow and rapid gravity filters ,multimedia filters, design of filters, troubles in operation comparison of filters,
		CLO 12	Understand disinfection, types of disinfection, theory of chlorination chlorine demand and other disinfection
		CLO 13	Different treatment methods. distribution systems, types of layouts of distribution systems, design of distribution systems
		CLO 14	AnalyzeHardy Cross and equivalent pipe methods
		CLO 15	Understand service reservoirs, joints, valves such as sluice valves, air valves, scour valves and check valves water meters, laying and testing of pipe lines, pump house
CO 4	Explore Lay out and general outline of various units in a waste water treatment plant, primary treatment design of screens, grit chambers, skimming principles and design of biologicaltreatment, trickling filters, standard and high rate.	CLO 16	Explain Conservancy and water carriage systems, sewage and storm water estimation.
		CLO 17	Understand type of concentration,storm water over flows combined flow.
		CLO 18	Understand characteristics of sewage, cycles of decay, decomposition of sewage, examination of sewage,.B.O.D. and C.O.D. equations.
		CLO 19	Analyze the design of sewers, shapes and materials, sewer appurtenances manhole, inverted siphon, catch basins, flushing tanks, ejectors, pumps and pump houses, house drainage
		CLO 20	Understand different components requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage, sewage farming, and dilution.

CO 5	Construction and design of oxidation ponds, sludge digestion tanks, factors effecting, design of digestion tank, sludge disposal by drying, septic tanks working principles and design-soak pits. Ultimate disposal of waste water, self-purification of rivers, sewage farming.	CLO 21	Understand and analyze Lay out and general outline of various units in a waste water treatment plant, primary treatment design of screens, grit chambers, skimming tanks-sedimentation tanks-principles
		CLO 22	Evaluate the design of biological treatment, trickling filters, standard and high rate.
		CLO 23	Construction and design of oxidation ponds, sludge digestion tanks, factors effecting, design of digestion tank, sludge disposal by drying
		CLO 24	Understand the septic tanks working principles and design-soak pits. Ultimate disposal of waste water, self-purification of rivers, sewage farming

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
ACE015.01	CLO 1	Understand the concept and importance of Protected water supply.	PO 1, PO 6, PO 7	2
ACE015.02	CLO 2	Estimate the Population for the design period by using different forecasting methods.	PO 1	2
ACE015.03	CLO 3	Calculate and Understand the water demand, types of demand, factors affecting fluctuations.	PO 1	3
ACE015.04	CLO 4	Calculate the fire demand, storage capacity, water quality and its testing.	PO 2	2
ACE015.05	CLO 5	Understand the concept of Drinking water standards. Comparison from quality and quantity and other considerations..	PO 1, PO 2	2
ACE015.06	CLO 6	Understand theintakes, infiltration galleries, confined and unconfined aquifers.	PO 2	2
ACE015.07	CLO 7	Understand the, distribution systems, requirements, methods and different layouts	PO 3	2
ACE015.08	CLO 8	Understand the Layout and general outline of water treatment system	PO 1, PO 3	3
ACE015.09	CLO 9	Explain sedimentation, uniform settling velocityprinciples, design factors, surface loading	PO 3, PO 6	2
ACE015.10	CLO 10	Understand jar test, optimum dosage of coagulant, coagulation, flocculation, clarifier design, coagulants, and feeding arrangements.	PO 3	2
ACE015.11	CLO 11	Evaluate Filtration theory, working of slow and rapid gravity filters, multimedia filters, design of filters, troubles in operation comparison of filters,.	PO 1	1
ACE015.12	CLO 12	Understand disinfection, types of disinfection, theory of chlorination chlorine demand and other disinfection.	PO 1	3
ACE015.13	CLO 13	Different treatment methods. distribution systems, types of layouts of distribution systems, design of distribution systems	PO 3, PO 6, PO 7	1
ACE015.14	CLO 14	AnalyzeHardy Cross and equivalent pipe methods	PO 2, PO 6	3
ACE015.15	CLO 15	Understand service reservoirs, joints, valves such as sluice valves, air valves, scour valves and check valves water meters, laying and testing of pipe lines, pump house.	PO 3, PO 7	1
ACE015.16	CLO 16	Explain Conservancy and water carriage systems, sewage and storm water estimation.	PO 3, PO 6	2
ACE015.17	CLO 17	Understand type of concentration,storm water over flows combined flow.	PO 3, PO 6	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE015.18	CLO 18	Understand characteristics of sewage, cycles of decay, decomposition of sewage, examination of sewage,.B.O.D. and C.O.D. equations	PO 2, PO 3	2
ACE015.19	CLO 19	Analyze the design of sewers, shapes and materials, sewer appurtenances manhole, inverted siphon, catch basins, flushing tanks, ejectors, pumps and pump houses, house drainage.	PO 2, PO 3	1
ACE015.20	CLO 20	Understand different components requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage, sewage farming, and dilution.	PO 2, PO 3 PO 7	2
ACE015.21	CLO 21	Understand and analyze Lay out and general outline of various units in a waste water treatment plant, primary treatment design of screens, grit chambers, skimming tanks-sedimentation tanks-principles.	PO 2, PO 3	2
ACE015.22	CLO 22	Evaluate the design of biological treatment, trickling filters, standard and high rate.	PO 3, PO 6 PO 7	2
ACE015.23	CLO 23	Understand the septic tanks working principles and design-soak pits. Ultimate disposal of waste water, self-purification of rivers, sewage farming	PO 6, PO 7	2
ACE015.24	CLO 24	Understand the septic tanks working principles and design-soak pits. Ultimate disposal of waste water, self-purification of rivers, sewage farming	PO 6, PO 7	1

3= High; 2 = Medium; 1 = Low

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

Course Outcomes (COs)	Program Outcomes (POs)						
	PO 1	PO 2	PO 3	PO 6	PO 7	PSO1	PSO2
CO 1	3			2	1	1	
CO 2	3	2	2			1	
CO 3	2	3	2		1	2	
CO 4	3	2	2	2		3	
CO 5	3	2		1		2	

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XII. 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	3					2	1						1		

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 2	2												2		
CLO 3	3												2		
CLO 4		2											2		
CLO 5	3	1													
CLO 6		2											2		
CLO 7			2												
CLO 8	3		3										2		
CLO 9			2										1		
CLO 10			2												
CLO 11	1												2		
CLO 12	3														
CLO 13			2			1	1						2		
CLO 14		3				3									
CLO 15			1				1						2		
CLO 16			1			3							2		
CLO 17			3			1							3		
CLO 18		3	2												
CLO 19	3	2											2		
CLO 20	2	1													
CLO 21	3	1											2		
CLO 22		2											3		
CLO 23		3				1							1		
CLO 24						1									

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XIII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1, PO2, PO3, PO 6, PO 7, PSO1	SEE Exams	PO1, PO2, PO3, PO 6, PO 7, PSO1	Assignments	PO 6	Seminars	PO 3, PO 7, PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES-INDIRECT

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

XV. SYLLABUS

UNIT-I	**WATER QUALITY, DEMAND AND SUPPLY**
Protected water supply, population forecasts, design period, water demand, types of demand, factors affecting fluctuations, fire demand, storage capacity, water quality and testing. Drinking water standards. Comparison from quality and quantity and other considerations, intakes, infiltration galleries, confined and unconfined aquifers, distribution systems, requirements, methods and layouts.	
UNIT-II	**WATER TREATMENT AND DISTRIBUTION**
Layout and general outline of water treatment units, sedimentation, uniform settling velocity, principles, design factors, surface loading, jar test, optimum dosage of coagulant, coagulation, flocculation, clarifier design, coagulants, and feeding arrangements. filtration, theory, working of slow and rapid gravity filters ,multimedia filters, design of filters, troubles in operation comparison of filters, disinfection, types of disinfection, theory of chlorination chlorine demand and other disinfection treatment methods. distribution systems, types of layouts of distribution systems, design of distribution systems, Hardy Cross and equivalent pipe methods, service reservoirs, joints, valves such as sluice valves, air valves, scour valves and check valves water meters, laying and testing of pipe lines, pump house.	
UNIT-III	**SEWAGE TREATMENT AND DISPOSAL**
Conservancy and water carriage systems, sewage and storm water estimation, type of concentration,storm water over flows combined flow, characteristics of sewage, cycles of decay, decomposition of sewage, examination of sewage, B.O.D. and C.O.D. equations. Design of sewers, shapes and materials, sewer appurtenances manhole, inverted siphon, catch basins, flushing tanks, ejectors, pumps and pump houses, house drainage, components requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage, sewage farming ,dilution	
UNIT-IV	**WASTEWATER TREATMENT**
Lay out and general outline of various units in a waste water treatment plant, primary treatment design of screens, grit chambers, skimming tanks-sedimentation tanks-principles and design of biological treatment, trickling filters, standard and high rate.	
UNIT-V	**DESIGN AND WORKING OF TREATMENT UNITS**
Construction and design of oxidation ponds, sludge digestion tanks, factors effecting, design of digestion tank, sludge disposal by drying, septic tanks working principles and design-soak pits. Ultimate disposal of waste water, self-purification of rivers, sewage farming.	

Text Books:
1. S.K. Garg, "Environmental Engineering", Vol. I: Water Supply Engineering, 20th Edition Khanna Publishers, 2011. 2. Birdie, G.S. and Birdie, "Water Supply and Sanitary Engineering", DhanpatRai& Sons, 1992. 3. Duggal, K.N. "Elements of Environmental Engineering", S.Chand& Co, 2002. 4. Punmia B.C, Ashok Jain &Arun Jain, "Water Supply Engineering", Laxmi Publications, Pvt. Ltd., New Delhi, 2004.
Reference Books:
1. Metcalf and Eddy, "Waste Water Engineering, Collection, Treatment and Disposal", Tata McGraw Hill, Inc., New York. 2. H.S. Peavy and D.R.Rowe, "Environmental Engineering", 2nd Edition, Mc.Graw Hill Publishing

XVI. 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 and importance of Protected water supply.	CLO 1	T2:24.6
3-4	Estimation of Population for the design period by using different forecasting methods.	CLO 1	T2:24.8 R1:4.2
5-6	Water demand, types of demand, factors affecting fluctuations	CLO 2	T2:24.7
7-8	Fire demand, storage capacity, water quality and its testing.	CLO 2	T7:12.14 R1: 7.1
9-10	Drinking water standards. Comparison from quality and quantity and other considerations.	CLO 3	T2:26.8
11-12	Intakes, infiltration galleries, confined and unconfined aquifers.	CLO 3	T2:26.10
13-14	Distribution systems, requirements, methods and different layouts	CLO 4	T2:26.14 R2:21.55
15-16	Layout and general outline of water treatment system.	CLO 4	T2:26.15 R2:21.58
17-19	Sedimentation, uniform settling velocity principles, design factors, surface loading	CLO 5	T2:26.16 R2:21.61
20-22	Jar test, optimum dosage of coagulant, coagulation, flocculation	CLO 5	T2:25.12 R2:21.24
23-25	Clarifier design, coagulants, feeding arrangements	CLO 6	T2:25.16 R2:21.29
26	Filtration theory, working of slow and rapid gravity filters, multimedia filters,	CLO 7	T2:25.14 R2:21.31
27-30	Design of filters, troubles in operation comparison of filters,	CLO 8	T2:25.14 R2:21.33
31-32	Disinfection, types of disinfection, theory of chlorination chlorine demand and other disinfection	CLO 9	R2:21.33
33-34	Different treatment methods. distribution systems, types of layouts of distribution systems	CLO 10	T2:27.2 R2:21.64
35-38	Design of distribution systems and their working	CLO 11	T2:27.2
39-40	Derivation and working principle of Hardy Cross and equivalent pipe methods.	CLO 12	T2:27.2 R2:21.67
41-42	Service reservoirs, joints, valves such as sluice valves, air valves, scour valves	CLO 14	T2:27.2
43-44	Check valves water meters, laying and testing of pipe lines, pump house.	CLO 14	T2:27.3 R2:21.71

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
45	Conservancy and water carriage systems, sewage and storm water estimation	CLO 15	T2:27.4 R2:21.68
46	Concentration, storm water over flows combined flow,	CLO 14	T2:27.7 R2:21.74
47	Characteristics of sewage, cycles of decay, decomposition of sewage, examination of sewage,. B.O.D. and C.O.D. equations	CLO 16	T2:27.12 R2:21.75
48	Different components requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage, sewage farming, and dilution.	CLO 17	T2:27.8 R2:21.72
49-51	Lay out and general outline of various units in a waste water treatment plant, primary treatment design of screens, grit chambers, skimming tanks-sedimentation tanks-principles	CLO 19	T2:27.8 R2:21.73
52	Design of biological treatment, trickling filters, standard and high rate.	CLO 21	T2:27.14 R2:21.78
53	Design of oxidation ponds, sludge digestion tanks, factors effecting, design of digestion tank, sludge disposal by drying	CLO 23	T2:27.19 R2:21.814
54	Septic tanks working principles and design-soak pits. Ultimate disposal of waste water, self-purification of rivers, sewage farming	CLO 23	T2:27.12 R2:21.82
55	Different components requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing, ultimate disposal of sewage, sewage farming, and dilution.	CLO 24	T2:27.18 R2:21.82

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

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	To improve standards and analyze the concepts in environmental engineering.	Seminars	PO 6	PSO 1
2	Understand the standards in water resource engineering.	Guest lecture	PO 6	PSO 1
3	Encourage students to solve real time applications and prepare towards examinations.	NPTEL	PO 2	PSO 1

Prepared by:
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