


Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

	Course Title: WATER SUPPLY ENGINEERING		
	Credits (L:T:P) : 4:0:0	Total Contact Hours: 52	Course Code: 15CE32T
	Type of Course: Lectures, Self Study & Student activities	Credit :04	Core/ Elective: Core
CIE- 25 Marks		SEE- 100 Marks	

Prerequisites: Basic knowledge of environmental science and mathematics.

Course Objectives: It aims at enabling the student to understand the various components of environment in and around the earth crust and understand the effects of it over plants, animals, etc.

1. Understand the important concepts of good water supply system to a city/town or a village.
2. To understand the need of conservation of rain water and its applications.
3. To understand the sources, effects, prevention and control measures of water pollution and its legislative aspects.

On successful completion of this course, the student will be able to

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Relate the relations between the environment and ecology, estimating water requirement for public water supply scheme.	R/U/A	1,2,5,6,10	15
CO2	Ascertain the quality of water as per BIS and select the appropriate treatment method required for the water source.	R/U/A	1,2,3,6,10	14
CO3	Study and Establish the suitable distribution system for a locality and know the appurtenances used.	U/A	2,4,5,8	07
CO4	Identify and summarize the arrangement of water supply and fittings in a building.	U/A	2,4,6,8,9	06
C05	Determine the need of conservation of water and rural water supply.	U/A	1,2,4,5,6,7,10	05
C06	Identify the sources of water pollution and suitable control measures.	U/A	1,5,6,7,10	05
C06	Perform suggested activity	U/A	1 to 10	*
		Total sessions		52



Legend- R; Remember U: Understand Ap: Application Ay: Analysis C:Creation E: Evaluation

* Related to Student activity beyond classroom hours.

Programme outcome Attainment Matrix

Mapping of COs with POs	PROGRAMME OUTCOME									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
	Basic Knowledge	Discipline Knowledge	Experiments & practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Lifelong learning
WATER SUPPLY ENGINEERING	3	3	2	2	3	3	1	2	1	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If $\geq 40\%$ of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If $< 5\%$ of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

DETAILED COURSE CONTENT

UNIT	COURSE CONTENT	HOURS
1	<p>ENVIRONMENT AND ECOLOGY: Atmosphere, Lithosphere, Hydrosphere, Biosphere. Relation between Plant, Animals and Environment. Eco System, Man and Ecology.</p> <p>WATER REQUIREMENT: Necessity of water supply, Methods of population forecasting (Arithmetical, Geometrical and Incremental Increase method), Water Requirements for a) Domestic Purpose b) Industrial Use c) Fire Fighting d) Public Purpose e) Losses. Per Capita Demand and Factors affecting it. Total Quantity of Water Required for a Town.</p> <p>SOURCES OF WATER: Surface Sources - Lakes, Streams, Rivers. Impounded Reservoirs. Underground Sources - Infiltration Galleries, Infiltration Wells and Springs.</p> <p>INTAKE AND CONVEYANCE OF WATER: Types of intakes i) Reservoir intake ii) River intake iii) Canal intake, Conveyance of Water - Open Channels and Pipes. Pipe Materials - Cast Iron Pipes, Steel Pipes, Concrete Pipes, Pre-Stressed Concrete Pipes, Merits and Demerits. Pipe Joints - Spigot and Socket Joint, Flange Joint, Universal Pipe Joint, Expansion Joint, Flexible Joint, Various stages of pipe laying and its testing. Pipe corrosion and remedial measures</p>	15
2	<p>QUALITY OF WATER: Impurities of water - organic and inorganic classification and examination of water. Physical - temperature, colour, turbidity, taste and odour. Chemical - pH Value, Total Solids, Hardness, Chlorides, Iron and Manganese, Fluoride and Dissolved Oxygen. Bacteriological - E-coli, Most Probable Number (MPN), Quality Standards for Domestic purpose as per BIS.</p> <p>TREATMENT OF WATER: Flow diagram of different units of treatment, brief description of constructional details, working and operation of the</p>	14

UNIT	COURSE CONTENT	HOURS
	following units - plain sedimentation, sedimentation with coagulation, flocculation, filtration-Slow sand filters, Rapid sand filters and pressure filters (no design) Disinfection of water, Chlorination.	
3	DISTRIBUTION SYSTEM: General Requirements, Systems of Distribution - Gravity System, Combined System, Direct Pumping. Methods of Supply - Intermittent and Continuous. Maintenance of required pressure in Distribution Systems. Storage - Underground, Ground Level And Overhead Service Reservoirs – Sketch, Necessity and Accessories. Types of lay-out : dead end, grid iron, radial and ring systems, their merits and demerits and their suitability APPURTENANCES IN DISTRIBUTION SYSTEM: Use of Sluice Valves, Check Valves, Air Valves, Scour Valves, Zero Velocity Valves, Fire Hydrants, Water Meter.	7
4	WATER SUPPLY ARRANGEMENT IN BUILDINGS: General lay-out of water supply arrangement for single and multi- storied buildings as per B.I.S code of practice. Pipe Materials - Plastic Pipes, High Density Polythene Pipes, Densified cast iron pipes, Merits and Demerits. Connections from water main to buildings. Water supply fittings - their description and uses, water main, service pipes, supply pipe, distribution pipe, domestic storage tank, stop cock, ferrule, goose neck, water tap, Modern systems of Potable water purification-(RO, UV, Activated carbon), Hot water supply - electric and solar water heaters.	6
5	WATER CONSERVATION: Conservation of rain water, roof water harvesting, recharging of ground water. RURAL WATER SUPPLY: Rural water supply systems, Disinfection of well water.	5
6	WATER POLLUTION AND CONTROL: Sources of water pollution, types and its effects, Prevention and control measures of water pollution, Legislation with regards to water pollution control.	5

Course Delivery: The course will be delivered through lectures and Power point presentations/ Video

SUGGESTED LIST OF STUDENT ACTIVITIES

1. Collect the information about biotic and abiotic components of surrounding environment and frame relation among them.
2. Estimate the total quantity of water required for a town/locality/Institute.
3. Prepare map and written report for surface and underground sources of water in the neighbourhood.
4. Visit nearby Intake works of water of your place and collect details.
5. Charts are prepared for BIS and WHO quality standards for drinking water.
6. Visit nearby Certified Water testing laboratories and identify various tests conducted on water.
7. Visit Water Treatment Plant and collect details of unit operations and processes involved in it.
8. Study the distribution system of water supply of your locality.
9. To visit a newly constructed building for plumbing works.
10. Prepare a mini project report for roof top rain water harvesting for existing building



11. Study about Solar water heater and collect data
12. Prepare report/presentation on issues related to water pollution.

NOTE:

1. Students should select any one of the above or other topics relevant to the subject approved by the concerned faculty, individually or in a group of 3 to 5. Students should mandatorily submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics. Weightage for 5 marks Internal Assessment shall be as follows: (Unsatisfactory **1**, Developing **2**, Satisfactory **3**, **Good 4**, Exemplary **5**)

1. Reports should be made available along with bluebooks to IA verification officer

Example of model of rubrics / criteria for assessing student activity

Dimension	Students score				
	(Group of five students)				
	STUDENT 1	STUDENT 2	STUDENT 3	STUDENT 4	STUDENT 5
Rubric Scale	Unsatisfactory 1 , Developing 2 , Satisfactory 3 , Good 4 , Exemplary 5				
1.Literature	1				
2.Fulfill team's roles & duties	4				
3.Conclusion	3				
4.Conversions	5				
Total	13				
Average=(Total /4)	3.25				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity to attain last CO (course outcome) may be given to a group of FIVE students					

Note: Dimension should be chosen related to activity and evaluated by the course faculty

Dimension	Rubric Scale				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary
1.Literature	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles
3.Communication	Poor	Less Effective	Partially effective	Effective	Most Effective
4.Conversions	Frequent Error	More Error	Some Error	Occasional Error	No Error

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit	Major Topics	Hours Allotted	Questions to be set for SEE			Marks weightage	weightage (%)	A*	B*
			Cognitive Levels						
			R	U	Ap				
1	Environment and ecology, water requirement, sources of water, collection and conveyance of water,	15	16%	35%	47%	42	29	2	3
			7	15	20				
2	Quality & treatment of water	14	16%	35%	50%	39	27	2	3
			6	14	20				
3	Appurtenances and distribution system	7	0%	25%	75%	20	13	2	1
			0	5	15				
4	Water supply arrangement in buildings	6	0%	100%	0%	17	12	1	1
			0	17	0				
5	Water conservation, rural water supply	5	0%	50%	50%	14	10	1	1
			0	7	7				
6	Water pollution and control	5	0%	50%	50%	14	10	1	1
			0	7	7				
Total		52	5%	49%	45%	145	100	9	10
			13	64	68				

Legend: R; Remember, U: Understand A: Application Ay: Analysis C: Creation E: Evaluation
A*-SEE QUESTIONS TO BE SET FOR (05MARKS) in PART – A



B*- SEE QUESTIONS TO BE SET FOR (10MARKS) in PART – B

Questions for CIE and SEE will be designed to evaluate the various educational components such as:

Sl. No	Bloom's taxonomy	% in Weightage
1	Remembering and Understanding	55
2	Applying the knowledge acquired from the course	45
3	Analysis	0
4	Synthesis (Creating new knowledge)	0
5	Evaluation	0

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes	
Direct Assessment	CIE	IA	Students	Three IA tests (Average of three tests will be computed)	Test 1	20	Blue books	1,2,
					Test 2			3,4
					Test 3			5,6
				Student activities	05	Report	1,2,3,4,5,6,7	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6,7	
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1 & 2,3 Delivery of course	
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods	

*CIE – Continuous Internal Evaluation *SEE – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM		20			
	Year:					
Name of Course coordinator : CO's: _____			Units: __			
Question no	Question		MARKS	CL	CO	PO
1						
2						
3						
4						

Note: Internal choice may be given in each CO at the same cognitive level (CL).

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th weak of sem 10-11 Am	III SEM	WATER SUPPLY ENGINEERING	20			
	Year: 2015-16	Course code:15EN32T				
Name of Course coordinator CO1,CO2 Answer all questions						
Question			M	CL	CO	PO
1	List the methods of forecasting population.		3	R	1	1,2,5,6,10
2	Explain with sketch Infiltration Galleries and Infiltration Wells.		7	U	1	1,2,5,6,10
3	Explain with sketches the function, constructional details, working and operations of Aeration & Slow sand filter OR Clarifier & Rapid sand filter		10	A	2	1,2,6,10





TEXT BOOKS & REFERENCES

1. Water Supply & Sanitary Engineering- by Rangwala.
2. Water Supply Engineering Vol-I - by S.K.Garg.
3. Water Supply & Sanitary Engineering- by Birde.
4. Water Supply Engineering Vol-I - by Gurucharan Singh.
5. Environmental Engg.-Vol-I –by P.N. Modi.
6. Water Supply Engg.-Vol-I – by Fair & Geir.
7. Water Supply, Waste Disposal and Environmental Pollution Engineering-(Khanna publication) A.K.chatterjee .
8. Water Supply Engineering by Dr B.C.Punmia, Jain & Jain.

MODEL QUESTION PAPER (SEE)

Code: 15CE32T

Diploma in Civil Engineering

III Semester

Course title: WATER SUPPLY ENGINEERING

Time: 3 Hours]

[Max Marks: 100]

- Note:** i) Answer any SIX questions from PART - A. Each question carries 05 marks.
ii) Answer any SEVEN Questions from PART - B. Each question carries 10 marks.

PART – A

1. State the factors affecting Per Capita Demand.
2. Explain(i) Hydrosphere (ii) Biosphere
3. State any five BIS standards for drinking water.
4. Describe Break point chlorination
5. Distinguish intermittent system with continuous system of water supply?
6. Explain the functions of Sluice Valves with sketches
7. Distinguish between HDP pipe and CI pipe
8. Explain rural water supply systems.
9. List the Legislative acts to water pollution control

PART – B

1. a) List the sources for pipe corrosion
b) List the important points in any water supply
2. The following data have been observed from the census department

Sl No	Year	Population
1	1955	6000
2	1965	10000

3	1975	15000
4	1985	20500
5	1995	27000
6	2005	35500
7	2015	45000

- Estimate the population for the year 2025 and 2035 by Arithmetical Increase method.
3. Explain with sketch Infiltration Galleries.
 4. Summarise the merits and demerits of different systems of lay-out in a distribution system
 5. Explain with sketches the function, constructional details, working and operations of Rapid sand filter
 6. Explain Chemical tests conducted on water and their significances
 7. Explain with sketches the following systems of lay-outs in distribution system
 - i) Dead end;
 - ii) Grid iron;
 8. Sketch the constructional details and uses of following water supply fittings:
 - i) Ferrule;
 - ii) Goose neck
 9. Explain the methods of Recharging ground aquifer
 10. Explain the prevention and control of water pollution

MODEL QUESTION BANK

CO 1: Understand relations between the environment and ecology ,estimating water requirement for public water supply scheme.

REMEMBER LEVEL QUESTIONS

1. Define the terms Ecology and ecosystem?
2. Describe how the animals depend on plants?
3. Explain the relations between plant, animals and Environment.
4. List the important points in any water supply scheme.
5. List the methods of forecasting population.
6. State the factors affecting Per Capita Demand.
7. List the sources of water
8. State the different methods of conveyance of water.
9. List the sources for pipe corrosion

UNDERSTANDING LEVEL QUESTIONS

1. Explain Atmosphere, Lithosphere, Hydrosphere and Biosphere?
2. Explain briefly the importance of Ecosystem and ecology.
3. Explain the necessity of water supply.
4. Explain about Per Capita Demand
5. Explain the major sources of water supply scheme?
6. Explain different types of pipe materials used for conveyance of water.



7. Summarise the merits and demerits of (i) C.I pipes (ii) Concrete pipes (iii) Plastic pipes
8. Describe pipe corrosion and its effects?

APPLICATION LEVEL QUESTIONS

1. The following data have been observed from the census department

SI No	Year	Population
1	1955	6000
2	1965	10000
3	1975	15000
4	1985	20500
5	1995	27000
6	2005	35500
7	2015	45000

Estimate the population for the year 2025 and 2035 by Arithmetical Increase method.

2. Estimate the requirement of water for various uses in a) Domestic uses b) Industrial Use c) Fire Fighting d) Public uses e) Losses.
3. Estimate the total quantity of water required for a town
4. Explain with sketch Infiltration Galleries and Infiltration Wells.
5. Explain with neat sketches, reservoir intake, river intake and canal intake.
6. Explain with neat sketches, different types of pipe joints.
7. Explain the procedure of laying pipes.
8. Explain the method of testing of pipe lines.

CO 2: Ascertain the quality of water as per BIS and select the appropriate treatment method required for the water source.

REMEMBER LEVEL QUESTIONS

1. List the impurities present in water.
2. State any five BIS standards for drinking water.
3. List the different chemicals used in the treatment of water?

UNDERSTANDING LEVEL QUESTIONS

1. Explain Chlorination and its advantages.
2. Explain different forms of chlorination and explain any one.
3. Describe Break point chlorination

APPLICATION LEVEL QUESTIONS

1. Explain physical tests conducted on water and their significances
2. Explain Chemical tests conducted on water and their significances
3. Explain Bacteriological tests conducted on water.
4. Sketch the flow diagram for the water treatment works.

5. Explain with sketches the function, constructional details, working and operations of i) Aeration; ii) Flash Mixer; iii) Flocculator; iv) Clarifier v) Slow sand filter; vi) Rapid sand filter, vii) Pressure filters viii) chlorinating chamber
6. Explain with sketch the chemical feeding devices?
7. Explain the method of determining the dosage of coagulants?
8. Estimate the quantity of alum required by 15MLD of water at treatment plants. When 12 mg/L of alum is required.
9. Calculate the amount of bleaching powder to be required per day to treat 3.0 MLD of water for a town. The percentage of chlorine in bleaching powder is 30%. The chlorine required is 0.4 mg/l to maintain residual chlorine of 0.15 mg/l.

CO 3: Study and Establish the suitable distribution system for a locality and know the appurtenances used.

UNDERSTANDING LEVEL QUESTIONS

1. Distinguish intermittent system with continuous system of water supply?
2. Explain the necessity of service reservoirs.
3. Distinguish underground service reservoirs with overhead service reservoirs
4. Summarise the merits and demerits of different systems of lay-out in a distribution system

APPLICATION LEVEL QUESTIONS

1. Explain with sketches the different systems of distribution i) Gravity distribution; ii) Combined gravity and pumping system; iii) pumping system.
2. Sketch the following i) Rectangular overhead service reservoir; ii) Intz tank showing all the accessories
3. Explain with sketches the following systems of lay-outs in distribution system i) Dead end; ii) Grid iron; iii) Radial; iv) Ring.
4. Judge the suitability of the system of lay-out for a given locality.
5. Explain the functions of the following appurtenances with sketches i) Sluice Valves ii) Check valves or reflex valves; iii) Air valves iv) Drain valves or blow-offs; v) Fire hydrants; vi) water meters.

CO 4: Know the arrangement of water supply and fittings in a building.

UNDERSTANDING LEVEL QUESTIONS

1. Explain the modern systems for portable water treatment
2. Distinguish between HDP pipe and CI pipe.
3. Describe requirements of water supply arrangement for single storied buildings as per B.I.S code of practice

APPLICATION LEVEL QUESTIONS

1. Sketch a general lay-out to show suitable water supply buildings with mains.
2. Explain interior water supply arrangements for a single and multi-storied building as per I. S. Code



3. Sketch the constructional details and uses of following water supply fittings: i) Water main; ii) Service pipe; iii) supply pipe; iv) distribution pipe; v) domestic storage tank; vi) stop cock; vii) Air gap; viii) ferrule; ix) Goose neck; x) Water tap
4. Sketch the general lay-out for hot water supply for a domestic building using both electric water heaters and solar water heaters.

CO 5: Know the conservation of water and rural water supply.

UNDERSTANDING LEVEL QUESTIONS

1. Explain rural water supply systems.

APPLICATION LEVEL QUESTIONS

- 1 Explain the methods of harvesting of Rain water
- 2 Explain the methods of Recharging ground aquifer
- 3 Explain disinfection of well?

CO 6: Identify the sources of water pollution and suitable control measures..

UNDERSTANDING LEVEL QUESTIONS

- 1 Write Water pollution control acts

APPLICATION LEVEL QUESTIONS

- 1 Write the causes of water pollution, Sources - Point and Non-point sources, effects on plants and animals
- 2 Explain the prevention and control of water pollution

