



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION**

<b>Program</b>	<b>Civil Engineering</b>	<b>Semester</b>	<b>V</b>
<b>Course Code</b>	<b>20CE54I</b>	<b>Type of Course</b>	<b>Carrier Pathway</b>
<b>Course Name</b>	<b>Built Environment</b>	<b>Contact Hours</b>	<b>36 hr/week</b>
<b>L: T:P</b>	<b>104: 52: 312</b>	<b>Credits</b>	<b>24</b>
<b>CIE Marks</b>	<b>240</b>	<b>SEE Marks</b>	<b>160</b>

**Introduction:** Welcome to the curriculum for Built Environment Specialization. This specialization course is taught in Bootcamp mode. Bootcamps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to build, operate, assess, monitor the human-made facilities/surroundings that provide the setting for public health.

Leading to the successful completion of this bootcamp, you shall be equipped to either do an internship at an organization working in Built Environment related industry or do a project related to Built Environment. After the completion of your Diploma, you shall be ready to take up roles like Junior Engineer, Facility Manager, Environmental Engineer, Water Analyst, Green Engineer.

This course will teach you Fundamentals of data collection, data analysis, forecasting, design, evaluation, estimating and costing, management and maintenance of different components of Water supply, Waste water and Solid waste Management System. Details of the curriculum is presented in the sections below.

### **Pre-requisite**

Before the start of this specialization course, you would have completed the following courses;

In the 1st year of study, you would have studied Engineering Mathematics, Communication Skills, Civil Engineering Graphics, Statistics & Analysis, Basic IT Skills, Basic Surveying, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Construction Materials, Environmental Sustainability.

In the 2nd year of study, you would have studied Engineering Mechanics and Strength of Materials, Modern Surveying, Construction Techniques, Building Drawing using CADD, Concrete

Technology, Building Estimating and valuation, Site Management, Design and detailing of RCC structures.

In this year of study, you shall be applying your previous years learning along with specialized field of study into projects and real-world applications.

### **Course Cohort Owner**

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialized field of study and the cohort of students who have chosen to study that specialized field of study.

### **Guidelines for Cohort Owner**

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.
3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.
4. The industry session shall be addressed (in contact mode/online / recorded video mode) by industry subject experts in the discipline only.
5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for any industrial visits.
7. Cohort owner shall maintain and document industrial assignments, weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom sessions can augment or use supplementally teaching and learning opportunities including good quality online courses available on platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM , etc.

**Course outcome: At the end of the semester students will be able to,**

<b>CO 1</b>	Interpret Built Environment and evaluate the need for efficient built environment to achieve Sustainable Development.
<b>CO 2</b>	Asses the quality of water, waste water, solid waste as per BIS, WHO and interpret their relation to public health.
<b>CO 3</b>	Analyze, design and optimize the components of Water Supply system, Waste water and Solid waste Management system.
<b>CO 4</b>	Work with appropriate tools, software's and technology for the design, operation, maintenance and management of built Environment.

Week	CO	PO	Day	1 <sup>st</sup> Session (9am to 1pm)	L	T	P	2 <sup>nd</sup> Session (1.30pm to 4.30pm)	L	T	P
1	1,3	1,2	1	<p><b>Built Environment:</b> Introduction, need, types, public health and sustainable built environment. Sustainable Development Goal's (SDG's).</p> <p>Audio - Video Presentation on Built Environment.</p> <p><b>Case Exercise:</b> 1. Conduct a Survey of nearby locality and prepare a report on: (A) Different types of Built Environment. (B) Prioritize types of built environment based on public health and justify your answer. (Note: Conclusion and recommendations are must)</p> <p>References: SDG's: THE 17 GOALS   Sustainable Development (un.org)</p>	1	1	2	<p><b>Water Supply system:</b> Need, Objectives, Scenario on Water Deficits in India. Water and SDG's. Water supply schemes, Roles and Responsibilities of Engineers, Job Opportunities. Water measurement units and conversion. Simple problems on conversion of water quantities.</p> <p><b>Case Exercise:</b> 2. Conduct a Survey of nearby locality and prepare a report on: (A) Existing water supply scheme and quantity of water supplying. (Note: Conclusions and recommendations are must)</p> <p>3. Outline the highlights of JalaAmruth Water Supply Scheme-Karnataka. References: 1. Central Public Health and Environmental Engineering organization: Manual on Water Supply and Treatment - 1999: Central Public Health &amp; Environmental Engineering Organization (CPHEEO), Govt of India</p>	1		2
	1,3	1,2	2	<p><b>Sources of Water:</b> World water distribution, Natural and artificial Sources of water and their availability, characteristics and Selection of sources, Uses of Water, Water supply key issues.</p> <p>THE RAINWATER (HARVESTING AND STORAGE) BILL, 2016</p> <p><b>Case Exercise:</b></p>	2		2	<p><b>Sizing the challenge:</b> Water demand.</p> <ul style="list-style-type: none"> <li>• Components.</li> <li>• Per capita water demand.</li> <li>• Factors affecting water demand.</li> <li>• Commercial and Industrial water demand.</li> <li>• Firefighting demand.</li> <li>• Fluctuations in water demand.</li> <li>• Types of variations.</li> </ul>	1		2



			<p>4. Conduct a Survey of nearby locality to identify sources of fresh water.</p> <p>5. Prepare a report on Rain water harvesting and Desalination.</p> <p>6. Estimate the quantity of rain water can be harvested from building roof top.</p> <p>(Note: Conclusions and recommendations are must)</p> <p>References:</p> <p>1. Desalination: IVRCL</p> <p>2. Rainwater Harvesting: RWH starting page.pmd (iricen.gov.in)</p>			<ul style="list-style-type: none"> <li>Peak demand for maximum demand Estimations.</li> </ul> <p>Peak factor, Design period and design population, population forecasting methods, Demand forecasting and Design Capacities. Accurate population forecasting.</p> <p><b>Case Exercise:</b></p> <p>7. Collect water demand and supply data of your district for a period of 10 years and analyze.</p> <p>8. Identify the factors affecting the variation between the actual population and forecasted population.</p> <p>(Note: Conclusions and recommendations are must)</p> <p>References:</p> <p>1. An Analysis of Demand and Supply of Water in India   Bhat   Journal of Environment and Earth Science (iiste.org)</p>		
2	2	3	<p>Practice problems on population forecasting and demand calculation, Design flow of water treatment plant.</p> <p><b>Case Exercise:</b></p> <p>9. Using population data of nearby locality find. (Specify the nature of locality)</p> <p>(A) Forecasted population.</p> <p>(B) Forecasted total demand.</p> <p>(C) Allocation of water for various demands as per codal provisions.</p> <p>(Note: Conclusions and recommendations are must)</p>	1	3	<p><b>Conveyance from the source:</b></p> <p>Collection of water from sources. Surface water Intake system, Types of intake structure, Intake Structures-Function, design considerations and location criteria. Subsurface water intake system. Well interferences, well losses and Efficiency.</p> <p><b>Case Exercise:</b></p> <p>10. Suggest a suitable intake structures for various types of surface water sources.</p>	2	1
3	1,3	4	<p><b>Water Conveyance:</b></p> <p><b>Pipes and conduits for water supply</b></p>	1	3	<p>Design of pipe lines, Losses in pipes and factors affecting losses. Laying, jointing and</p>		3

				Pipe materials and selection, Hydraulics of flow in pipes-Causes of pressure drop in pipe lines and remedial measures. Design of the economical diameter for the rising main. Darcy-Weisbach equation in design of pipe lines.			testing of pipes, appurtenances, Defects in pipes and remedial measures. Practice problems on losses in pipes.			
	1,3	1,3	5	Developmental assessment: (Suggested assessment-200 second presentations, as video. Lecturers evaluate on Communication, Comprehension, Commitment. Followed by Q & A session on each presentation) Submission of week-1 case exercises.			Assessment Review and corrective action			3
	1,3	1,3	6	Industry class: Per capita demand and factors affecting it. Estimation of total quantity of water required for a town.	2	3	Industry assignment			
2	1,3	2,3	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)	4		<b>Pumps:</b> Types and capacity of pumps, Energy efficient pumps, Selection of pumps, pumping stations, Booster pumping stations. Practice problems on pumps. <b>Case Exercise:</b> 11. Conduct a market survey and prepare a report on types of pipes, pipe fixtures and its applications and suitability. 12. Conduct a market survey and prepare a report on types of pumps available and its applications and suitability.	1		2
	1,2,4	4	2	<b>Water Storage:</b> Raw water storage, Treated water storage, Location, Geometrical design and Construction of storage Reservoirs. Practice problems on Reservoir capacity Estimation. <b>Case Exercise:</b>	1	3	<b>Water Sampling and Analysis:</b> Types, Sampling location, Sampling frequency, Sample collection, Automatic sampler, On spot analysis, Sample preservation, Analytical methods and Instrumental techniques, Data handling and reporting.	1		2

			13.Design the size of raw and treated water storage Reservoirs for the given data. (Note: Conclusions and recommendations are must)			Demonstrate Collection of Water Samples: Surface, Running and Ground water samples. (Collect sufficient amount of water for Physical, Chemical and biological examination.)			
1,2,4	3,4	3	Physical, Chemical and biological examination of water. Preparation of standard chemical solutions required for physical and chemical analysis in the laboratory.		4	Analyze the collected water sample for Physical and Chemical parameters. <b>Physical Parameters:</b> Color, Taste and Odor, pH, Turbidity, Total Dissolved solids. Compare the result with BIS and interpret the result. Reference: IS 10500 (2012): Drinking water (cgwb.gov.in) Virtual Lab: Virtual Labs (vlab.co.in)			3
1,2,4	3,4	4	<b>Chemical Parameters:</b> Total Hardness, Calcium hardness, Magnesium Hardness, Chlorides, Nitrates, Fluoride, Sulphates, Iron, Residual chlorine and chlorine demand, Calcium, Acidity, Alkalinity and other relevant chemical parameters. Compare the result with BIS and interpret the result. Reference: IS 10500 (2012): Drinking water (cgwb.gov.in) Virtual Lab: Virtual Labs (vlab.co.in)		4	Continuation of chemical analysis... Virtual Lab: Virtual Labs (vlab.co.in)  Compare the result with BIS and interpret the result.			3
1,2,4	3,4	5	Developmental assessment: (Suggested assessment-200 second presentations, as video. Lecturers evaluate on Communication, Comprehension, Commitment. Followed by Q & A session on each presentation)  Submission of week-2 case exercises.			Allocation of grades. Assessment Review and corrective action			3
1,2,4	3,4	6	Industry Class-Biological analysis of water. Reference: Virtual lab: Virtual Labs (vlab.co.in)		5	Weekly industry assignment.			

3	1,2	2,3	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)	4	<b>Water Treatment units:</b> <b>Screening and aeration:</b> Introduction, Selection, Application, Operation, design and Process control. Practice problems on screens and aeration. Demonstrate relevant videos. <b>Sedimentation:</b> Introduction, Selection, Application, Design of sedimentation tank, Operation and Process control. Practice Problems on Sedimentation. Demonstrate relevant videos.	2	1	
	1,2	2	2	<b>Coagulation and Flocculation:</b> Introduction, Selection, Application, Estimation of optimum dosage of coagulant, Operation and Process control. Practice Problems on Estimation of optimum dosage of coagulant. Demonstrate relevant videos. Case Exercise: Compulsory PPT/model preparation on a simple Coagulation methodology at the end of Week3	1	3	<b>Filtration process:</b> Introduction, Filtration theory, principle, Selection criteria. Construction, operation, Filter media, components and cleaning of <ul style="list-style-type: none"><li>• Slow sand filters.</li><li>• Rapid sand filter.</li><li>• Pressure filters.</li><li>• Ultra and micro filtration.</li></ul> Design of slow and rapid sand filters. Demonstrate relevant videos.	2	1
	1,2,3	2,4	3	<b>Disinfection.</b> <ul style="list-style-type: none"><li>• Chlorination</li><li>• Ozone and UV disinfection.</li><li>• Advanced and alternate treatment systems.</li><li>• Advanced oxidation processes and Membrane process.</li><li>• Water softeners.</li><li>• Sludge management.</li></ul> Practice problems on chlorine demand and sludge deposition. <b>Case Exercise:</b>	2	2	<b>Design of Water Distribution network:</b> <ul style="list-style-type: none"><li>• Systems of Water distribution networks.</li><li>• Methods of water supply.</li><li>• Analysis and design of Water Distribution Networks.</li><li>• Types of layouts and their suitability.</li></ul> Practice Problems on Pipe flow. <b>Case Exercise:</b>		3



				14. Suggest appropriate treatment for the water sample if needed. (Refer Data from Week 2, Day 4)			15. For a selected locality Suggest a suitable water supply system and design water distribution network.			
	1,3,4	5,7	4	<ul style="list-style-type: none"> <li>Water Losses in the Water Distribution System.</li> <li>Water balance for water loss Assessment and performance Indicators.</li> <li>Water loss Detection and control.</li> <li>Continuous (24/7) water supply systems.</li> </ul> Case study on 24/7 water supply system: Karnataka: Three Towns Pilot 24/7 Water Supply (worldbank.org) Practice problems on water audit and water loss Estimation.	2	2	Software for water distribution networks design and analysis (Hydraulic Simulation) <ul style="list-style-type: none"> <li>Necessity of Hydraulic Simulation</li> <li>Challenges of Hydraulic simulation</li> </ul> Demonstrate EPANET/ WaterGEMS/LOOP4/FLOW and other software's.			3
	1,3,4		5	CIE 1- Written and practice test Submission of week-3 case exercise reports.			Assessment Review and corrective action			3
	1,2,4	2	6	Industry class-Importance of water quality analysis and monitoring. Possible outbreaks of waterborne and induced diseases.		5	Industry weekly assignment			
4	4	4,7	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)		4	Get familiar with the commands and step by step procedure. (Assumed data) <ul style="list-style-type: none"> <li>Project Set up.</li> <li>Drawing the network.</li> <li>Setting the properties of the object in the model.</li> <li>Save the project.</li> </ul>			3
	4	4,7	2	<b>Smart water Supply and monitoring system:</b> Need, Concept, Objectives. <ul style="list-style-type: none"> <li>Introduction to Automation in Water supply systems and case study.</li> </ul>	2	2	<ul style="list-style-type: none"> <li>Modern smart water systems: IoT and Sensing devices.</li> <li>Smart water metering and monitoring systems.</li> </ul>	1		2

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						Audio Video presentation on <ul style="list-style-type: none"> <li>• Need of waste water management system.</li> <li>• Waste water treatment process.</li> </ul> Reference: CPHEEO Manual on Sewerage and Sewage Treatment Systems - 2013; Central Public Health & Environmental Engineering Organization (CPHEEO), Govt of India			
1,3	1,2	2	<b>Introduction:</b> Technical Terms used, Sources of waste water generation, Types of waste water.  <b>Case Exercise:</b> 17.(A) Visit nearby locality to identify the Sources of waste water generation. (B) List the types of waste water generated and their characteristics. (C) Prepare a report on Waste water management system. (Note: Conclusions and recommendations are must)	2	2	<b>Sewer appurtenances:</b> <ul style="list-style-type: none"> <li>• Types</li> <li>• Suitability</li> <li>• Location.</li> <li>• Materials.</li> <li>• Construction.</li> </ul> <b>Case Exercise:</b> 18. For a residential building Suggest suitable type of sewer appurtenances required and specify suitable location.	2	1	
1,3	3	3	<b>Design and construction of sewers:</b> Estimation of quantity of sewage, Population forecast, Design period, Per capita sewage generation, Appropriate peak factor. <b>Case Exercise:</b> 19. Estimate quantity of sewage generated for a selected locality.	2	2	<b>Hydraulics of sewers:</b> Depth of flow, Variability of flow, limiting velocity, Self-cleansing and Maximum velocities of sewer. Determination of velocity and discharge. Simple problems on design of sewers. <b>Case Exercise:</b> 20. Design a sewer for a selected nearest ongoing project.	2	1	
1,3	2	4	<b>Surface and storm water drainage:</b> Determination of Storm Water Flow, Run-Off Co-Efficient, Time of Concentration, Empirical Formulae for Run-Off.	1	3	<b>Collection, Conveyance, Treatment and Disposal of waste water.</b> <b>Sewerage system:</b> <ul style="list-style-type: none"> <li>• Types: Separate, Combined and Partially Separate Systems.</li> </ul>		3	

			Problems on Design of Storm Water Sewers Systems. <b>Case Exercise:</b> 21. Estimate quantity of storm water run-off flow for a selected locality and design storm water sewer.			<ul style="list-style-type: none"> <li>Working principle.</li> <li>Suitability</li> <li>Types of sewers.</li> </ul> Method of Conveyance: Gravity, Low Pressure and Vacuum. <b>Case Exercise:</b> 22. Suggest suitable type of sewerage system and sewers for a selected locality. Reference: (1007) Wastewater Collection   Method of conveyance - YouTube			
	1,3		CIE 2- Written and practice test Submission of week-5 case exercise reports.			Assessment Review and corrective action			3
	1,3	2	Industry class-Repairs and maintenance of sewerage systems.	3	2	Industry weekly assignment			
6	2,5	4	1 <b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)		4	<b>Waste water characteristics:</b> Physical, Chemical and Biological characteristics. Source specific wastewater characteristics. <ul style="list-style-type: none"> <li>Sampling technique.</li> <li>Sample preservation</li> <li>Analytical methods and Instrumental techniques</li> <li>Data handling and reporting.</li> </ul> Collect and Read IS code for waste water analysis. Demonstrate Collection of waste Water Samples.	2		1
	2,5	4	2 Preparation of standard chemical solutions required for physical and chemical analysis in the laboratory.	1	3	Analyze the collected wastewater sample for Physical and Chemical parameters. <b>Analysis of physical Parameters:</b> Color, Temperature and Odor, pH, Turbidity, Total solids, Suspended Solids, Dissolved Solids, volatile solids, fixed solids, Settleable Solids. Virtual Lab: Virtual Labs (vlab.co.in)	1		2



							Compare the result with BIS and interpret the result.			
	3	4	3	<b>Analysis of Chemical Parameters:</b> Chlorides, Nitrogen, phosphorus, Acidity, Alkalinity, Residual chlorine and chlorine demand, DO, COD, BOD and other relevant chemical parameters. Reference: Virtual Lab: Virtual Labs (vlab.co.in) Compare the result with BIS and interpret the result.	1	3	Continuation of Chemical Analysis of waste water. Practice problems on BOD and DO Reference: Virtual Lab: Virtual Labs (vlab.co.in)	1		2
	1,3	4	4	Continuation of Chemical Analysis of waste water. Virtual Lab: Virtual Labs (vlab.co.in)	1	3	<b>Wastewater treatment:</b> Objectives, Unit Operations and Processes, Selection of treatment processes, Onsite sanitation, grey water harvesting. Reference: LIQUID WASTE MANAGEMENT SYSTEMS IN RURAL TAMIL NADU (swachhbharatmission.gov.in)	2		1
	1,3		5	Developmental assessment: (Suggested assessment-200 second presentations, as video. Lecturers evaluate on Communication, Comprehension, Commitment. Followed by Q & A session on each presentation).  Submission of week-6 case exercise reports.			Assessment Review and corrective action			3
	1,3	2	6	Maintenance of sewers, safety precautions and Hazards. Wastewater pumping.	2	3	Industry weekly assignment			
7	1,3	2	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)	4		<b>Primary treatment of Sewage:</b> Principles, functions and design of sewage treatment units-screens, grit chamber, Skimming tank, Sedimentation tanks. Construction, Operation and Maintenance aspects.	2		1

8	3	2	2	<b>Secondary treatment of sewage:</b> Objectives, Selection of Treatment Methods, Principles, Functions. (i) Activated sludge process: Conventional, completely mixed, extended aeration. (ii) Aerobic attached growth system: Trickling filters, Rotating biological contactor, waste stabilization pond.	3	1	Anaerobic Treatment. Sludge treatment and disposal: Objectives, Sludge characterization, Thickening, Sludge digestion, Biogas recovery, Sludge Conditioning and Dewatering, Sludge drying beds, ultimate residue disposal.	2	1
	3		3	<b>Tertiary treatment:</b> Sand and activated carbon filter and chlorination. Explore reuse of tertiary treated waste water. <b>Case Exercise:</b> 23. Estimate quantity of fresh water consumption can be reduced by reusing treated waste water.	2	2	<b>Effluent Disposal:</b> Dilution, Self-purification of streams, factors affecting self-purification. Disposal in Sea water, Disposal on Lands. Recycle of wastewater. <b>Case exercise:</b> 24. Identify the disposal method/system of treated wastewater in your locality.	2	1
	3	5	4	<b>Rural Sanitation:</b> Low-cost treatment process, working principle and geometric design of septic tank for small communities in rural and urban areas, two pit latrines, eco-toilet and soak pits.	2	2	Continuation. Case exercise: Explore innovative methods of converting waste to beneficial.	1	2
	3		5	CIE 3 – Written and practice test Submission of week-7 case exercise reports.			Assessment Review and corrective action		3
	1,3	2	6	Operation and maintenance of wastewater treatment plant.	3	2	Industry weekly assignment		
	4	4,7	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)	4		Application of SCADA in waste water treatment and Demonstration.  Note: Orientation and preparation for <b>Project 1</b> works to be conducted for the next 4 days.	2	1
	4	3	2	<b>Project 1</b> <b>Water supply and waste water Management Project.</b> 1. Village traversing.					7
	3,4	3	3						7
	3,4	3	4						7

				<p>2.Examination of sources of water and water quality analysis.</p> <p>3.Examination of sources of waste water and waste water analysis.</p> <p>4.Calculation of quantity of water required based on existing and future projected population for a village.</p> <p>5. Estimation of waste water generated.</p> <p>6.Selection of sites for ground level reservoir, overhead tank and treatment plants.</p> <p>7.Block levelling for water treatment and waste treatment plant.</p> <p>8.Longitudinal section from source to the treatment plant and from treatment plant to the overhead tank (OHT) or reservoir.</p> <p>9.Longitudinal section along the left and right side of the roads in the entire village.</p> <p>10.Underground drainage system surveys for laying the sewers.</p> <p><b>Drawings to be prepared</b></p> <p>1.Preparation of village map</p> <p>1.Plan of water supply line, sewer lines in village map</p> <p>2.L/S of water supply and sewer lines</p> <p>3.Block levelling placing overhead tanks</p> <p>4.Block levelling Placing WTP</p> <p><b>Instructions:</b></p> <p>1. It is suggested to use total station for surveying works.</p> <p>2. The <b>Project-1</b> Report should be attached with field book, calculation sheets, all plans, drawings, estimates of earth work and structure in spread sheet should be submitted in the form of Hardcopy and softcopy.</p>						
	3,4		5	<p>Developmental assessment: (Suggested assessment-200 second presentations, as video. Lecturers evaluate on Communication, Comprehension, Commitment. Followed by Q &amp; A session on each presentation)</p> <p>Submission of week-8 case exercise reports.</p>			Assessment Review and corrective action			3
	1,3	2	6	Wastewater Treatment Plant Visit		5	Industry weekly assignment			
9	1	5	1	<p><b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)</p> <p><b>Review of Project-1 progress.</b></p>		4	<p><b>Solid Waste Management System:</b> Introduction, Need, Impact, early waste disposal. Solid waste Management Hierarchy. Video demonstration on 1.Impact of solid waste. 2.Solid waste management system.</p>	1		2

							Reference: Solid Waste Management Rules 2016 — Vikaspedia			
3	5	2	Sources, Classification, Characteristics and composition of solid waste. <b>Case Exercise:</b> 23. Identify types and sources of waste generation in your locality/Institution. (Note: Conclusions and recommendations are must) Reference: Swachh Bharat Mission - Gramin, Ministry of Drinking Water and Sanitation CPHEEO Manual on Municipal solid waste management: Part1(1).pdf (cpheeo.gov.in)	2	2	Factors affecting waste generation. Units of quantity measurement and method of Quantity estimation. (Note: Conclusions and recommendations are must) <b>Case Exercise:</b> 24. Estimate the quantity of solid waste generated at your institution based on their characteristics and composition separately.	1		2	
4	3	3	<ul style="list-style-type: none"><li>• Separation and reduction of solid waste at source.</li><li>• Storage: Selection and function of containers.</li><li>• Collection: Frequency of collection, Factors affecting collection, Segregated collection, collection methods.</li></ul> <b>Case Exercise:</b> 25. Prepare presentation on the method of solid waste storage facility provided at your institution and present it. Suggest suitable storage facility if not available. (Note: Conclusions and recommendations are must)	2	2	<ul style="list-style-type: none"><li>• Collection routes.</li><li>• Tools and equipment's.</li><li>• Designing collection system:<ol style="list-style-type: none"><li>1. Determining type and number of vehicles</li><li>2. Determining vehicles time on the route</li><li>3. Routing</li></ol></li></ul> <b>Case Exercise:</b> 26. Suggest suitable vehicle to transport solid waste from source to transfer station for the estimated quantity of a selected locality. (Note: Conclusions and recommendations are must)	2		1	
3,4	2	4	Transfer and Transport: Need for transfer operation, Transportation vehicle with their capacity working. <b>Case Exercise:</b>	1	3	Solid waste generation rate. Material mass balance. Transfer stations: Meaning, Function, necessity, location, types.  Separation of	2		1	



			27. Collect the relevant technical and commercial information about tools used for collection of solid waste.			Case study: 1487853226A Case Study on Municipal Solid Waste Management in Solapur.pdf (assam.gov.in)		
	3,4		CIE 4 – Written and practice test Submission of week-9 case exercise reports.			Assessment Review and corrective action		3
	4	3	6 Design of a new waste Collection system and collection route optimization.	1	4	Industry weekly assignment		
10	3	2	1 <b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)  <b>Review of Project-1 progress.</b>		4	<b>Processing of municipal solid waste:</b> Purpose, Methods and waste minimization, recovery, recycle and reuse (3R) of materials from solid waste, volume and size reduction, biological processing. <b>Case Exercise:</b> 28. Prepare a report on the common types of materials recovered from MSW.	1	2
	3	2	2 <b>Treatment methodologies:</b> Various Methods of waste treatment. Biological Treatment (waste to wealth): Aerobic and anaerobic process, principle methods of aerobic composting. Factors affecting. Demonstrate Techniques of Composting: Windrow composting, aerated static pile composting, Horizontal reactor, Mechanical/in vessel system, agitated bin system, backyard composting.  <b>Case Exercise:</b> 29. Analyze and select suitable composting technique for treating solid waste generated at your institution (Project-2).	1	3	<b>Case Exercise:</b> 30. Visit to nearby composting unit and prepare a report on. <ul style="list-style-type: none"> <li>• Estimation of degradable solid waste.</li> <li>• Design of composting pit</li> <li>• Processing of degradable solid waste.</li> <li>• Operation and maintenance of the unit.</li> </ul>		3
	3,4	3	3 <b>Project-2 At the end of 13<sup>th</sup> week there shall be a waste to wealth/waste to energy system executed.</b>					7
	3,4	3	4 1. Estimation of solid waste quantity. 2. Design of the system. 3. Preparation of project-2 schedule (Project duration is two weeks)					7

			4.Preparation of drawings in CADD, BOM, BOQ and Cost estimation. 5.Use reclaimed material for construction. 6.Initiation project.						
	3,4		5	Developmental assessment: (Suggested assessment-200 second presentations, as video. Lecturers evaluate on Communication, Comprehension, Commitment. Followed by Q & A session on each presentation) Submission of week-10 case exercise reports.				Assessment Review and corrective action	3
	4	4	6	Measures to minimize production of waste at source. Importance of 3R concept in achieving sustainability.		5		Industry weekly assignment	
11	3	3	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics) <b>Review progress of Project-1 and Project-2</b>	4			Thermal Treatment (waste to energy) : Need and comparison with other methods. 1. Incineration: About process, types of incinerators, Design Consideration, products of incinerator process with their use. <b>Case Exercise:</b> 31. Prepare a PPT and Present the working principle and process of Bio methanation and refuse derived fuel (RDF).	1 2
	3	3	2	2.Pyrolysis: About process, products of pyrolysis process, advantages and disadvantages. <b>Case Exercise:</b> 32.Analyze the impact of thermal treatment on environment  Ultimate disposal: Land filling: Concept, necessity, Problems associated, Siting considerations, stages of landfill, Landfill types.	1	3		Land filling method and operation: Area method, Trench method and ramp method. Composition, characteristics, generation, movement and control of landfill gas. Composition, formation, movement and control of leachate in landfills. Layout and preliminary design of landfills, landfill closure and final cover	2 1
	3	2	3	<b>Biomedical waste management:</b> Introduction, sources and generation, classification, Issues, Management technologies.	1	3		<b>Industrial waste management:</b> Introduction, varieties of industrial waste,	1 2

				Collect and read: Bio medical waste management rules 2016.				issues, control measures for industrial waste, Recycling of industrial waste.			
	3	2	4	<b>E-Waste Management:</b> Introduction, Verities of E-waste, Dangers of E-waste, Recycling of E-waste, Disposal of E-waste. Collect and read: E-waste management rules 2016.	1		3	<b>Construction and demolition waste:</b> Introduction, origin, major components, issues, Onsite management, Processing and recovery, markets for C & D waste, landfill disposal. Collect and read: construction and demolition waste management rules 2016.	1		2
	3	2	5	CIE 5- Written and practice test				Assessment Review and corrective action			3
			6	Present scenario, Legal aspects, Rules, regulations and guidelines for various waste management.	2		3	Industry weekly assignment			
12	1,3	2	1	<b>PEER REVIEW:</b> Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics) <b>Review of Project-1 and Project-2 progress.</b>		4		Agricultural waste: Introduction, source, Effects, management, creating wealth from agricultural waste, disposal, Reference for creating wealth from agricultural waste: Creating-Wealth-From-Agricultural-Waste.pdf (icar.org.in)	1		2
	1,3	2,7	2	Health aspects during handling and processing. Health problems during times of segregation, recovery, recycling and reuse of solid waste. Public involvement and community participation: Strategy to community participation.	1		3	System of waste management to be adopted, measures to be taken to bring about a change in public behavior, enforcement Reference CPHEEO chapter: Chapter XVIII - Community Participation.PDF (cpheeo.gov.in)			3
	1,3	2	3	Site visit to waste segregation and processing unit/Incineration plant/pyrolysis/ Landfill area to visualize the waste processing and disposal technique			4	Site visit to waste segregation and processing unit/Incineration plant/pyrolysis/ Landfill area to visualize the waste processing and disposal technique			3
	1,3	5	4	Conduct a public awareness program on Water, waste water and Solid waste management svstem.			4	Conduct a public awareness program on Water, waste water and Solid waste management system.			3

	1,3		5	Developmental assessment: (Suggested assessment-200 second presentations, as video. Lecturers evaluate on Communication, Comprehension, Commitment. Followed by Q & A session on each presentation)				Assessment Review and corrective action			
	1,3	5	6	Waste to energy: Power generation, energy recovery, blending with construction materials, governmental, non-governmental activities and roles under solid waste management.			5	Industry weekly assignment			
13				<b>Internship</b> a) Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship. b) Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies. c) Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence - including the areas of learning you expect to learn during internship.				<b>Project</b> a) Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project - either as provided by faculty or as identified by the student. Document the impact the project will have from a technical, social and business perspective. b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified. c) Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome.			



**References:**

1. Fair, G.M., Geyer J.C and Okun, (1969) "Water and Wastewater Engineering" Vol II, John Wiley Publications.
2. Weber W.J., (1975) "Physico - Chemical Processes for Water Quality Control".
3. AWWA, (1971), "Water Quality and Treatment" McGraw Hill.
4. CPHEEO Manual, (1991), "Water Supply and Treatment", GOIPublications, New Delhi.
5. Tchobanoglous G., Theissen H., and Eliassen R.(1991), "Solid Waste Engineering Principles and Management Issues", McGraw Hill, New York.
6. Peavy, Rowe and Tchobanoglous (1985), "Environmental Engineering", McGraw Hill Co. 4th Edition
7. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
8. Integrated Solid Waste Management - Engineering Principles and Management Issues, Tchobanoglous/Theisen/Vigil, McGraw Hill (1993)
9. Mantell C.L., (1975), "Solid Waste Management", John Wiley.
10. Wastewater Engineering (2013) by Metcalf and Eddy; Publisher - McGraw-Hill
11. Environmental Engineering (2015) by Peavy, Rowe and Tchobanoglous; Publisher - McGraw-Hill
12. Water Quality Engineering: Physical / Chemical Treatment Processes (2013) by Lawler and Benjamin; Publisher - John Wiley & Sons
13. Industrial Wastewater Treatment, Recycling and Reuse (2014) by Bhandari and Ranade; Publisher - Elsevier
14. Unit Operations and Processes in Environmental Engineering (1996) by Reynolds and Richards Publisher - CL Engineering
15. Manual on Sewerage and Sewage Treatment (2013), Publisher - CPHEEO (MoUD) Additional reference material will be provided by the course instructor
16. Peavy, Rowe and Tchobanoglous (1985), "Environmental Engineering", McGraw Hill Co. 4th Edition

17. Waste Treatment and Disposal 2nd edition Paul T Williams, Wiley, 2005

18. Mantell C.L., (1975), "Solid Waste Management", John Wiley

19. Visit websites of:

- Rural Drinking water and Sanitation Department: Drinking Water – RDWSD Karnataka (swachhamevayate.org)
- Karnataka Urban Water Supply and Drainage Board: ಕರ್ನಾಟಕ ನಗರೀಯ ನೀರಾವರಿ ಮತ್ತು ಪಾಲಿಗ್ರಾಫಿಕ್ ಬೋರ್ಡ್ (kuwsdb.org)
- Bangalore Water Supply and Sewerage Board: Home - Bangalore Water Supply and Sewerage Board (karnataka.gov.in)

#### CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
<b>TOTAL CIE MARKS (A)</b>			<b>240</b>
<b>SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks</b>		<b>3</b>	<b>60</b>
<b>SEE 2 – Practical</b>		<b>3</b>	<b>100</b>
<b>TOTAL SEE MARKS (B)</b>			<b>160</b>
<b>TOTAL MARKS (A+B)</b>			<b>400</b>

\* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods.

#### Assessment framework for CIE (1 to 5)

**Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam - 4 hours**

#### CIE 1- Model Question Paper

Programme		Civil Engineering	Semester	V		
Course		Built Environment	Max Marks	30		
Course Code		20CE541	Duration	4 hours		
Name of the course coordinator						
Note: Answer one full question from each section.						
Qn.No	Question		CL L3/L4	CO	PO	Marks
Section-1 (Theory) – 10 marks						
1.a)	For a village of 1000 population and for per capita demand of 135 liters estimate total fresh water demand and express the demand in gallons.		L3	3	1,2	05
b)	If a small village uses ground water for drinking purpose and it looks clear and smells fine then the water is absolutely safe for drinking? Justify your answer.		L4	1	1,2	05
2.a)	The present population of a community is 28000 with an average water consumption of 4200 m3/d. The existing water treatment plant has a design capacity of 6000 m3/d. It is expected that the population will increase to 44000 during the next 20 years. The number of years from now when the plant will reach its design capacity, assuming an arithmetic rate of population growth, will be.		L3	3	1,2	05
b)	For a town situated in plain region and withdrawing water from a nearby river, what is the most appropriate and cost-effective water distribution system? Justify your answer.		L4	3	2,4	05
Section-2 (Practical) - 20 marks						

3)	<p>Estimate water demand for your Institution. Assume relevant data required.</p> <ul style="list-style-type: none"><li>• Identify suitable source of water.</li><li>• Estimate firefighting demand.</li><li>• Estimate average daily demand.</li><li>• Peak demand.</li><li>• Design period.</li></ul> <p>Design suitable storage reservoir.</p>																														
4)	<p>Estimate quantity of rainwater can be harvested from your institution.</p> <p>Use the data given below:</p> <p>Runoff co-efficient(K) for impervious surface=0.8</p> <p>Runoff co-efficient(K) for pervious surface=0.2</p> <p>Annual rainfall data</p> <table><tr><th>Months</th><th>Average Annual Rainfall (mm)</th></tr><tr><td>Jan</td><td>2.3</td></tr><tr><td>Feb</td><td>6.4</td></tr><tr><td>Mar</td><td>16.0</td></tr><tr><td>Apr</td><td>44.5</td></tr><tr><td>May</td><td>96.0</td></tr><tr><td>Jun</td><td>85.7</td></tr><tr><td>Jul</td><td>100.3</td></tr><tr><td>Aug</td><td>117.8</td></tr><tr><td>Sep</td><td>194.6</td></tr><tr><td>Oct</td><td>154.5</td></tr><tr><td>Nov</td><td>43.9</td></tr><tr><td>Dec</td><td>15.8</td></tr></table> <p>1.Roof top of your institution building. (Minimum area to consider 500 m<sup>2</sup>)</p> <p>2.Surface run off of your institution premises.</p>	Months	Average Annual Rainfall (mm)	Jan	2.3	Feb	6.4	Mar	16.0	Apr	44.5	May	96.0	Jun	85.7	Jul	100.3	Aug	117.8	Sep	194.6	Oct	154.5	Nov	43.9	Dec	15.8				
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Jul	100.3																														
Aug	117.8																														
Sep	194.6																														
Oct	154.5																														
Nov	43.9																														
Dec	15.8																														

**Note : Theory questions shall be aligned to practical questions**



## Assessment framework for SEE 1 (Theory) – 100

<b>Programme : Civil Engineering</b> <b>Course : Built Environment</b> <b>Course Code : 20CE54I</b>			<b>Semester : V</b> <b>Max Marks : 100</b> <b>Duration : 3 Hrs</b>								
<b>Instruction to the Candidate:</b> Answer one full question from each section.											
<b>Q.No</b>	<b>Question</b>	<b>CL</b>	<b>CO</b>	<b>Marks</b>							
<b>Section-1</b>											
1.a)	I. Why is monitoring the water quality of your water and testing it regularly is very important? (05) II. What elements might distort a water sample's actual quality? (03) III. Why is it important to make sure all equipment used is clean before sampling? (02)	L3	1	10							
b)	Suggest a suitable technique for separation of papers, glass, metals and inert materials from municipal solid waste.	L4		10							
2.a)	The use of a diverse range of water sources improves the security of water supply for the future. The use of alternative water sources needs to be safe, meet regulatory and environmental standards, and reflect community expectations. What are the alternate sources of water and what percentage of water can be processed and supplied.	L3		10							
b)	Highlight how any city can achieve sustainability with efficient water supply, waste water management and solid waste management system.	L4		10							
<b>Section-2</b>											
3.a)	Match the pair of correlated water quality parameters given in the columns below and state their correlation. <table border="1"><tr><td>A- Turbidity</td><td>1- Fecal Coliform</td></tr><tr><td>B- Conductivity</td><td>2- Suspended Solids</td></tr><tr><td>C- Most Probable Number</td><td>3- Dissolved solids</td></tr></table>	A- Turbidity	1- Fecal Coliform	B- Conductivity	2- Suspended Solids	C- Most Probable Number	3- Dissolved solids	L4	2	10	
A- Turbidity	1- Fecal Coliform										
B- Conductivity	2- Suspended Solids										
C- Most Probable Number	3- Dissolved solids										

b)	I. A wastewater sample of 2 ml is made upto 300 ml in a BOD bottle with distilled water. The initial DO of the sample is 8 mg/L and after 5 days it is 2mg/L. What is its BOD (mg/L)? (05)  II. The domestic sewage of a town was tested for total solids and the following results were obtained: Weight of sample of sewage = 1000 gms Weight of the solid after evaporation of liquid=0.952 gms. Weight of dry residue after ignition= 0.516 gms. What is the value of volatile solids? (05)	L3		10												
4.a)	Chlorine usage in the treatment of 25,000 m3/day of water has been 9 kg/day. The residual chlorine after 10 minutes contact is 0.2 mg/l. The chlorine demand of water would be?	L4		10												
b)	Propose a waste water recycling and municipal solid waste 3R strategy for residential area.	L3		10												
Section- 3																
5.a)	Water supply system is to be designed for a town for a design period of 30 years from now.  The average municipal demand is predicted to be 200 lpcd throughout the design period. The Population record for the town is as under. <table border="1"><tr><td>Year</td><td>1971</td><td>1981</td><td>1991</td><td>2001</td><td>2011</td></tr><tr><td>Population (in thousands)</td><td>52</td><td>66</td><td>83</td><td>105</td><td>136</td></tr></table> Calculate the following:  i. Forecasted population at the end of design period (use arithmetic increase method, geometric increase method and incremental increase method, and compare the forecasted values)  ii. Fire demand for the town using Kuichling's Formula.	Year	1971	1981	1991	2001	2011	Population (in thousands)	52	66	83	105	136	L3	3	10
Year	1971	1981	1991	2001	2011											
Population (in thousands)	52	66	83	105	136											
b)	A town with a population of 3 lakh produces solid waste at a rate of 2.5 kg/capita/day. If the waste is compacted to a density of 1500 kg/m³, how much volume of landfill site is needed in a year ? Assuming that the ratio of solid waste to cover is 4:1, what volume of cover soil is needed in a year? What type of soil would you recommend as a cover?	L4		10												
6.a)	Determine the approximate quantity of wastewater generated from a city with total daily consumption of 165 lpcd, if the conversion rate of water to wastewater is 85% and the total population of the city is 165000.	L3		10												

b)	What is the length of work day in a trip for haul container system? Number of trips per day = 3 Time to drive between dispatch station to the first container location = 0.13 hours Time required to drive between the last container location to the dispatch station = 0.18 hours Pick up time = 0.75 h/trip At Site time = 0.123 h/trip Haul time = 0.554 h/trip Off-route factor= 0.15	L4		10
<b>Section-4</b>				
7.a)	There are many hydraulic modeling software's are available to support water distribution system operations. Which hydraulic modeling software do you recommend for a growing city, justify your answer.	L4	4	10
b)	Why Continuous real-time monitoring of equipment status is a critical part of water treatment and waste water treatment process. Does the use of SCADA provide a noticeable cost savings (e.g., reduction in staff time to necessary to maintain operations, reduction in material/ energy consumption, etc.) in annual operating expenses?	L4		10
8.a)	No other natural resource is as significant to life and business as water. Not only is water essential for human life, but it also plays a central role in many industrial operations. Conserving it is crucial. Consequently, the benefits of automated water treatment are becoming increasingly appealing. List the benefits of automation in water treatment industry.	L4		10
b)	Over 75% of the waste we generate is recyclable but we, in India, recycle just 30%. It is time for the nation to wake up and start taking waste management seriously because if this issue is ignored any further then by 2030 we will need a landfill as big as Bengaluru to dump all the waste. According to the Central Pollution Control Board, less than 15% of the municipal solid waste generated is processed or treated. What are the best ways to convert waste to wealth?	L4		10
<b>Section-5</b>				
9.a)	A raw water reservoir is to be provided aiming 6 months buffer for water supply to a town with 1 lakh population having a water demand of 150 lpcd. Consider 15% storage of the reservoir as dead storage. The average seasonal discharge in the source river is 12m <sup>3</sup> /s in summer (Mar-Jun), 25m <sup>3</sup> /s in monsoon (Jul-Oct) and 15m <sup>3</sup> /s in winter (Nov-Fed). Environmental provisions recommend that maximum 20% of the water could be withdrawn,	L4	5	10

	subject to leaving minimum 10m <sup>3</sup> /s flow in the downstream. Determine the size and shape of the reservoir you would recommend.			
b)	How does incineration help in the management of solid waste? Describe the incineration technologies and air emissions and its control in detail.	L3		10
10.a)	A city has its catchment area of 7500 hectares. If the population density of the city is 200 persons per hectare and the water is supplied at the rate of 175 liters per capita per day, what would be the design flow for a combined sewer? Take intensity of rainfall equal to 30 mm/hour, average runoff coefficient equal to 0.50 and only 75% of water supplied contributes to the sewage. Also, peak discharge factor should be taken as 3.0	L4		10
b)	Design a rectangular sedimentation tank to supply water for a population of 50,000 with an assured average supply of 135 lpcd. Detention time of the tank is 4 hours. Assume data needed suitably.	L3		10

## Scheme of Evaluation (1) for SEE 2

Sl. No	Description	Marks: 100
<b>Problem statement</b>	For a given population data with relevant conditions. Design a water supply system/ Waste water management facility / Solid waste management facility.	
1	Analysis of population trend and population forecast. <b>(For design of a water supply system)</b>	10
2	Forecasted demand.	05
3	Design capacities of fresh and treated water reservoir.	10
4	Decide suitable Intake structure	05
5	Selection of pump and Design of suitable pipe line.	10
6	Analyze the given water quality parameters and suggest suitable treatment method.	10
7	Design of various water treatment units.	40
8	Design of suitable water supply layout and distribution network.	10

<b>Total</b>	<b>100</b>
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**Scheme of Evaluation (2) for SEE 2**

Sl. No	Description	Marks: 100
<b>Problem statement</b>	For a given population data with relevant conditions. Design a water supply system/ Waste water management System / Solid waste management system.	
1	Analysis of population trend and population forecast. <b>(For design of waste water management system)</b>	05
2	Per capita sewage generation and Estimation of sewage quantity.	10
3	Design of sewers and Selection of suitable sewer material for given conditions.	10
4	Design of storm water sewer systems for given data.	10
5	Selection of suitable sewerage system and appurtenances for given conditions.	10
6	Analyze the given waste water parameters and suggest suitable treatment.	10
7	Design of waste water treatment units.	40
8	Decide suitable effluent disposal method.	05
<b>Total</b>		<b>100</b>



## Scheme of Evaluation (3) for SEE 2

Sl. No	Description	Marks: 100
<b>Problem statement</b>	For a given population data with relevant conditions (like composition of solid waste). Design a water supply system/ Waste water management facility / Solid waste management System.	
1	Analysis of population trend and population forecast. <b>(For design of solid waste management System)</b>	05
2	Per capita solid waste generation and Estimation of solid waste quantity.	10
3	Design of solid waste collection system (determining number of vehicles, Determining vehicles time on the route, Routing)	20
4	Decide suitable waste processing method.	10
5	Design suitable biological treatment method for given conditions.	15
6	Design of thermal treatment unit for given conditions.	15
7	Design of Landfill for given conditions.	25
<b>Total</b>		<b>100</b>